# Tui Remedial Works: Baseline Monitoring

Prepared for
Environment Waikato

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**PATTLE DELAMORE PARTNERS LTD**
Level 4, 235 Broadway, Newmarket
Auckland, PO Box 9528
Newmarket, Auckland, New Zealand

Tel +9 **523 3931** Fax +9 **529 0633**
Web Site **http://www.pdp.co.nz**
Auckland Wellington **Christchurch**

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# Quality Control Sheet

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Prepared by

SIGNATURE

Remalia Sharplin

Andrew Rumsby

Directed, reviewed and approved by

SIGNATURE

Keith Delamore

**Limitations:**

The report has been prepared for Environment Waikato according to their instructions, for the particular objectives described in the report. The information contained in the report should not be used by anyone else or for any other purposes.

## Executive Summary

Environment Waikato (EW) has commissioned Pattle Delamore Partners Ltd (PDP) to undertake baseline monitoring of the Tui and Tunakohoia Streams in the vicinity of the Tui mine, Te Aroha, prior to proposed remediation of the mine site. The programme encompasses a variety of water quality parameters and provides information about the ecological health of the streams. The work included:

- Ecological monitoring at locations SW7, SW8 and SW13 in the Tui and Tunakohoia streams.
- Flow monitoring and water quality sampling at 9 sampling locations in the Tui and Tunakohoia Streams and from the Tui adit and tailings dam discharges.

  Water quality analysis was undertaken for a variety of physicochemical parameters (dissolved oxygen (DO), electrical conductivity (EC), pH, temperature and turbidity) as well as laboratory analysis of the water samples for EC, pH, total suspended solids and dissolved and total metal concentrations (Hill Laboratories Drinking Water suite).

  At particular locations, the following additional parameters were also analysed:

  - Cation and anion profiles and total dissolved silica at SW3, SW5, SW100 and SW101,
  - Total cyanide at SW11, SW13 and SW15,

As part of the monitoring programme, EW required that 3 rounds of sampling were undertaken at evenly spaced intervals under a variety of different flow conditions to establish the nature and variability of the existing water quality of the water resources prior to proposed rehabilitation of the mine site. Water samples were collected in:

- September – taken under low flow conditions: 17 days after significant rainfall event (>4 mm/day);
- October – taken under moderate flow conditions: 2 days after significant rainfall event;
- November – taken under low flow conditions: 8 days after significant rainfall event.

The water sampling programme found that:

- The highest concentrations of metals were generally found in the discharges from the Tui tailings dam into the Tui Stream (SW11).

However, the highest concentrations of zinc were found in the discharge from adit 5 of the Tui Mine (SW5).

- The discharges from the tailings dam and the Tui mine adits are elevated in dissolved arsenic, cadmium, copper, lead and zinc. However, concentrations of mercury at all monitoring sites were below analytical detection limit (<0.00008 g/m$^3$).
- With the exception of the discharges from the tailings dam (SW11 and SW15) the pH of the water was found to be generally between 6.5 and 7.5 pH units (circum-neutral pH) at all monitoring sites.
- The concentration of contaminants of concern decreased during high flow events; however, the total mass flux of contaminants increased during high flow events. This indicates that during storm events stormwater does dilute the discharge; however, it also washes out more contaminants as well.
- The concentration of contaminants being discharged from adit 4 (SW3) appears to have decreased slightly over time. This may be due to a recent (since 2002) partial collapse within adit 4, which may be diverting some contaminated water from the adit 4 discharge. Although the change in concentrations may be statistically significant it is not substantial in terms of absolute concentrations at the site.
- The concentration of contaminants of concern at the tailings dam discharge to the Tui Stream (SW11) appears to be elevated compared to historical monitoring undertaken in 1998-2001. However, it should be noted that in 2006 partial remediation of the tailings dam occurred which may have decreased the volume of water (and hence, increased the concentration of contaminants) being discharged from this location.

Ecological sampling undertaken as part of this project found healthy aquatic macro-invertebrates communities at the control sites along the Tui Stream (SW12) and the Tunakohoia Stream south branch (SW8). However, healthy macro-invertebrate communities were not observed downstream of the tailings and mine discharges in the Tui Stream (SW13) and the Tunakohoia Stream north branch (SW7). Physical habitats at the ecological monitoring sites show that the physical habitats of all the sites were all similar and there was no significant variation in the physico-chemical parameters (dissolved oxygen, pH and temperature) between the control sites and the sites downstream of the discharges from the mine tailings dam and mine adits. Based upon the findings of the ecological report it appears that the freshwater ecology at the monitoring localities that receive mine discharges (SW13 and SW7) is impacted by past and/or present activities at the Tui Mine.

A quality assurance programme was implemented as part of the water quality monitoring programme checks to ensure the data meets EW data quality objectives. The quality assurance programme found that:

- The analysis of cyanide between Hills and SGS varied significantly between the two laboratories. Further investigation undertaken by PDP indicated that Hill Laboratories reported results for cyanide were accurate.
- The pH values reported for field and laboratory pH at SW15 (which monitors discharge from the tailings dam into the Tunakohoia stream) were not in good agreement (the difference between the two measurements was more than 1 pH unit). Based upon historical data and field quality assurance procedures it is believed that the field pH is more representative of the site pH.
- Occasionally, dissolved metal concentrations marginally exceeded total recoverable metal concentrations at some of the monitoring sites for some highly soluble metals. However, the difference between the dissolved metal concentrations and total metal concentrations are within standard analytical variability. Therefore, the slightly elevated metal concentrations are not thought to be due to either field or laboratory contamination issues and do not have an adverse impact on the quality of the data used in the baseline assessment.
- Laboratory spot contamination of low levels (1-2 ppb) of lead, lithium and zinc was found in some of the samples submitted as part of the third sampling round (November 2009). Samples containing low concentrations (less than 20 ppb) of these elements were re-analysed and found to be free of contamination.

No other quality assurance/quality control issues were found.

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## Appendices

# 1.0 Introduction

Environment Waikato (EW) commissioned Pattle Delamore Partners Limited (PDP) to undertake baseline monitoring of the Tui and Tunakohoia Streams in the vicinity of the Tui mine (Figure 1) prior to proposed remediation of the mine site. The programme encompasses a variety of water quality parameters and provides information on the ecological health of the streams. The work included:

- Ecological monitoring at locations SW7, SW8 and SW13 in the Tui and Tunakohoia streams.
- Flow monitoring and water quality sampling at 9 sampling locations in the Tui and Tunakohoia Streams and from the Tui adit and tailings dam discharges.

  Water quality analysis was undertaken for a variety of physicochemical parameters (Dissolved oxygen (DO), electrical conductivity (EC), pH, temperature and turbidity) as well as laboratory analysis of the water samples for EC, pH, total suspended solids (TSS) and dissolved and total metal concentrations (Hill Laboratories Drinking Water suite).

  At particular locations, the following additional parameters were also analysed -

  - Cation and anion profiles and total dissolved silica at SW3, SW5, SW100 and SW101,
  - Total cyanide at SW11, SW13 and SW15,

As part of the monitoring programme, EW required that three rounds of sampling were undertaken within similar time intervals under a variety of different flow conditions to assist to establish the nature and variability of the existing water quality of the water resources prior to proposed rehabilitation of the mine site. The monitoring programme was undertaken as follows:

- First monitoring round: 17 and 18 September 2009 under low flow conditions;
- Second monitoring round: 8 and 9 September 2009 under high flow conditions;
- Third monitoring round: 17 November 2009 under low flow conditions.

A quality assurance and quality control (QA/QC) programme was implemented as part of the water quality monitoring programme checks to ensure the data meets EW data quality objectives.

### 1.1 Structure of this Report

The structure of the report is as follows:

- Section 1 provides an introduction to the project and the overall aim of the project.
- Section 2 outlines the sampling and quality assurance/quality control methodologies used in this study as well as the data quality objectives
- Section 3 provides a brief summary of the results of this study including a summary of the water quality monitoring, flow monitoring and the ecological sampling and quality assurance program undertaken as part of this project.
- Section 4 provides a more detailed discussion of the results, including: a review of the monitoring data from current data at the various sampling sites, an assessment of the data quality of the two historical data sets reviewed as part of this project and an assessment of contaminant mass loads.
- Section 5 provides a summary of the nature and variability of the existing water quality of the water resources prior to proposed rehabilitation of the mine site.

## 2.0 Methodology

### 2.1 Field Sampling Locations

Field sampling locations were selected by EW based on accessibility, the locations of monitoring sites from previous studies, and the water discharges from the mine adits and tailings dams. The investigation comprised nine water quality monitoring sites and four ecological monitoring sites. These are summarised in Table 1.

**Table 1: Tui Baseline Monitoring Sites and Parameters**

| Site Label | Monitored For | Site Description | Laboratory Parameters |
|---|---|---|---|
| SW3 | Water Quality | Adit 4 outlet (discharges to Tunakohoia Stream, north branch). | pH, EC, TSS;<br>Drinking water metal suite[1];<br>Ion Profile;<br>Total dissolved silica |
| SW5 | Water Quality | Adit 5 outlet (discharges to Tunakohoia Stream, north branch) | pH, EC, TSS;<br>Drinking water metal suite[1];<br>Ion Profile;<br>Total dissolved silica |
| SW7 | Water Quality & Ecology | Tunakohoia Stream north branch, upstream of south branch confluence and downstream of tailings dam. | pH, EC, TSS;<br>Drinking water metal suite[1] |

***Notes:*** *1. Total and dissolved metals. Refer to laboratory reports in Appendix A for Hill Laboratories' Drinking Water Suite.*

| Table 1 (continued): Tui Baseline Monitoring Sites and Parameters | | | |
|---|---|---|---|
| **Site Label** | **Monitored For** | **Site Description** | **Laboratory Parameters** |
| SW8 | Water Quality & Ecology | Tunakohoia Stream south branch, upstream of north branch confluence, town water supply inlet. | pH, EC, TSS; Drinking water metal suite[1] |
| SW11 | Water Quality | Tailings dam tributary, downstream of tailings dam and sediment trap (discharges to Tui Stream). | pH, EC, TSS; Drinking water metal suite[1]; Total Cyanide |
| SW12 | Ecology | Tui Stream, upstream of tailings discharge. | pH, EC, TSS; Drinking water metal suite[1] |
| SW13 | Water Quality & Ecology | Tui Stream, downstream of tailings discharge upstream of ford and culverts. | pH, EC, TSS; Drinking water metal suite[1]; Total Cyanide |
| SW15 | Water Quality | Tailings dam tributary, diverted through culvert beneath Tui Rd (discharges to Tunakohoia Stream, north branch). | pH, EC, TSS; Drinking water metal suite[1]; Total Cyanide |
| SW100 | Water Quality | Tunakohoia Stream north branch, upstream of Mountain Access Road, downstream of SW3 and SW5 discharges. | pH, EC, TSS; Drinking water metal suite[1]; Ion Profile; Total dissolved silica |
| SW101 | Water Quality | Ruakaka Adits Tributary, downstream of the Ruakaka Adits and upstream of Mountain Access Road culverts (discharges to Tunakohoia Stream, north branch). | pH, EC, TSS; Drinking water metal suite[1]; Ion Profile; Total dissolved silica |
| ***Notes:*** *1. Total and dissolved metals. Refer to laboratory reports in Appendix A-C for Hill Laboratories' Drinking Water Suite.* | | | |

Site parameters were determined by EW. Ion profiles were selected at two stream sites and at two acid drainage sites. Total cyanide was sampled in the tailings discharges and in downstream receiving waters, as cyanide may have been used in ore processing.

## 2.2 Chemical Field Sampling Procedures

### 2.2.1 Order of sampling

Samples were collected in a specific order to minimise the potential for cross contamination of samples from earlier sampling events. Downstream, potentially less contaminated samples were collected before upstream potentially more heavily contaminated samples were collected. The order of sampling during the first and third round was SW8, SW7, SW13, SW101, SW100, SW15, SW5, SW 3 and finally SW11. During the second monitoring round, SW15 and SW11 were sampled before SW3 and SW5. This was due to the weather impeding sampling times, and issues surrounding weir removal at SW5.

At each monitoring site, water samples were collected before any field measurements, flow monitoring and ecological sampling had been undertaken to prevent disturbance of the water quality. Flow monitoring and ecological sampling were conducted after the physiochemical measurements had been completed.

### 2.2.2 Water Grab Samples collection procedures

Water samples were collected upstream of the person collecting the sample before any other measurements were obtained at monitoring sites, to avoid disturbance of sediments which could potentially contaminate the samples. The water grab samples were collected mid-stream in the main flow and care was taken not to disturb any sediment at the bottom of the stream. This was particularly important around discharges from the tailings dam (SW11) and the mine adits (SW3 and SW5) as sediments in these areas contain high concentrations of iron oxide floc. If disturbed, the floc may enter the sample container and would elevate total metal concentrations and suspended solids in the sample. If any floc did enter the sample container, the sample was discarded downstream of the sampling site. A new sample was then collected upstream of the area which had been disturbed.

Samples were collected and stored in the appropriate sample bottles which had been supplied and certified clean by the analysing laboratory. Each sample bottle was uniquely identified in accordance with PDP chain of custody and sampling labelling procedure.

After collection, the water samples were sent under standard PDP chain of custody documentation to the appropriate laboratories as soon as possible. This was to ensure the laboratories received the samples within the required hold times and to ensure sample integrity was maintained.

### 2.2.3 Field measurements

To measure field parameters, a multi-parameter Troll 9500 datalogger (physicochemical parameters: dissolved oxygen, electrical conductivity, pH, redox potential, temperature and turbidity) and a YSI optical dissolved oxygen (ODO) meter were used. During the third monitoring round a multi-parameter Horiba U-52 meter was used to measure physicochemical parameters.

Prior to each sampling round, the field instruments were calibrated against NIST traceable standards as per the manufacturer's instructions. This was in accordance with good lab practices (GLP) as detailed in USEPA and APHA/ AWWA/ WEF "Standard Methods for the Examination of Water and Waste Water" (21$^{st}$ edition). Between monitoring locations, the sensor of the meter was rinsed with Type 1 water (deionised water) and the field meter was checked against a manufacturer's quick-calibration solution (electrical conductivity, pH, redox and turbidity) and/or air saturation readings (dissolved oxygen).

## 2.3 Flow monitoring procedures

Flow monitoring was required to establish an estimate of mass contaminant loads from the mine adits, tailings dam, Tui Stream and Tunakohoia Stream. A number of different monitoring techniques were used to measure flow, due to site limitations.

Where possible, flow was gauged using a SonTek FlowTracker Handheld-ADV® (Acoustic Doppler Velocimeter). The FlowTracker requires water to be at least 0.05 m deep in order to gauge cross sectional area and flow. Where this was not possible, other flow techniques used were: V-notch weir installation; volumetric flow into a bucket of known volume; and calculation of flow using depth and gradient of a culvert.

The flow monitoring methodology for each site is summarised in Table 2.

**Table 2: Flow monitoring methodology**

| Flow Monitoring Location | PDP Method of Flow Monitoring |
|---|---|
| SW3 | V-notch weir |
| SW5 | Flow gauging [1] |
| SW7 | Flow gauging |
| SW8 | Flow gauging |
| SW11 | Flow gauging;<br>V-notch weir |
| SW13 | Flow gauging; |
| SW100 | Flow gauging |
| SW101 | Culvert gradient and depth calculations; |
| SW15 | Volumetric |

***Notes:*** *1. A V-notch weir was initially installed at SW5. However, this was ineffective so flow gauging methods were employed.*

## 2.4 Ecological Sampling procedures

Ecological monitoring was undertaken within the Tunakohoia and Tui Streams at sample locations SW7, SW8, SW12 and SW 13 (see Figure 1). Sites SW8 and SW12 were the control sites for this investigation as they do not receive mine discharges. Field work was undertaken at SW7, SW8 and SW13 on 7 September 2009 and at SW12 on 9 September 2009. Site SW12 was sampled two days later as it was not originally included in the ecological sampling programme. These sites were sampled during receding stream flow conditions, after 5 days of no rainfall, and after 17 days of no significant rainfall (less than 4mm).

Macro-invertebrate sampling (kick net sampling) was conducted in accordance with established guidelines. At least four replicates were collected at each site

to allow for the detection of statistically significant differences in macro-invertebrates. The macro-invertebrate samples were preserved in the field for later processing and analysis.

Water quality data (temperature, conductivity, dissolved oxygen and pH) were measured at each ecological monitoring site using calibrated field meters.

A more detailed methodology of the ecological monitoring procedures is provided in the ecological monitoring report attached in Appendix D.

### 2.5 Data Quality Objectives (DQOs)

The aim of this project was to determine baseline water quality concentrations at the various sampling locations within the Tui and Tunakohoia Streams and in the vicinity of the Tui mine adits and tailing discharges.

A data quality assessment of the data obtained in this study as well as any historical data used in determining baseline concentrations of the contaminants of concern was undertaken to determine if the data was suitable to be used as a baseline water quality dataset. The data quality assessment consists of two parts, data verification and data validation.

In the data verification step the data sets were evaluated for:

- Completeness (i.e. is the data collected for the correct analytes);
- Appropriate analytical methods (i.e. US EPA 200.2) and analytical detection limits;
- Sample location consistency (Have the samples been collected at the same locations as the current sampling programme);
- A QA/QC sampling (i.e. does the field quality control samples meet or exceed the recommended number of QC samples outlined in Table 4 of Contaminated Land Management Guideline No. 5 (MfE, 2004).

In the data validation step the data sets were:

- Checked for obvious anomalies (extreme highs or extreme lows);
- Checked that the correct units had been used;
- Checked that the accuracy and precision of data met the project data quality criteria (See Table 3).

| Table 3: Data Quality Criteria (based upon APHA and CLMG#5 recommendations) | | |
|---|---|---|
| **Parameter** | **Data Quality Objective** | **Proposed Action** |
| **Laboratory QA/QC report** | | |
| ⁘ Blank | <detection Limit | Re-analyse samples |
| ⁘ Duplicates | ±20% | Re-analyse samples |
| ⁘ Certified Reference Material | within Certified Range | Re-analyse samples |
| **Physiochemical Results** | | |
| **Anion/Cation Balance** | | |
| ⁘ 0 - 3.0 meq/L | ±0.2 meq/L | Check with Lab., identify if missing parameter or lab error. |
| ⁘ 3.0 - 10.0 meq/L | ± 2% | Check with Lab., identify if missing parameter or lab error. |
| ⁘ 10.0 - 80.0 meq/L | ± 5% | Check with Lab., identify if missing parameter or lab error. |
| Calculated Total Dissolved Solids versus measured EC | 0.55 to 0.7 | Check with Lab., identify if missing parameter or lab error. |
| Field pH versus Lab pH | ±0.5 pH units | Check with lab if precipitation of iron has occurred. |
| Field Conductivity versus Lab Conductivity | ± 20% | Check calibration of instruments and if precipitation of iron has occurred. |
| Calculated Total Dissolved Solids versus measured EC | 0.55 to 0.7 | Check with Lab., identify if missing parameter or lab error. |
| **Split/duplicate analysis** | | |
| ⁘ Results more than 10 x Detection Limit (DL) | ±30% | Check with lab and re-analysed if necessary. |
| ⁘ Results more than 5x DL but less than 10 x DL | ±50% | Check with lab and re-analysed if necessary. |
| ⁘ Results less than 5 x detection limit | ±100% | Check with lab and re-analysed if necessary. |
| **General Results Check** | | |
| Check if dissolved metal concentrations are equal or less than Total metal Concentrations. | | Check with lab and re-analysed if necessary. |
| Results more than 2 order of magnitude different than 95% UCL of historical data set. | | Check with lab and re-analysed if necessary. |

## 2.6 Quality Assurance/Quality Control

Assuring data quality is an important part of this project, due to the requirement for high quality data to be used to undertake a robust assessment of the ecological and water quality conditions before and after remediation has been undertaken. The QA/QC programme consisted of four sections:

1. Field quality control samples (filter blank and blind replicate samples);
2. Laboratory analysis quality control checks (Laboratory QA/QC reports);
3. Inter-laboratory Comparison;
4. Checking Correctness of Results.

### 2.6.1 Field Quality Assurance/Quality Control

As part of the field QA/QC sampling programme PDP collected:

- One blind replicate sample during each monitoring round and analysed for all parameters in this investigation;
- One filter (rinsate) blank during each monitoring round and analysed for dissolved metals (drinking water suite).

The aim of the blind replicate samples was to assess the precision of laboratory analyses. As each sampling site at Tui Mine presents its own analytical challenges for metal assays, the blind metal replicate samples were collected from different sampling locations for each monitoring round. The blind replicates were collected as follows:

- First monitoring round: blind replicate samples were collected at SW11, SW13 and SW100. These were analysed for total cyanide at SW11; total and dissolved metals at SW13; and pH, EC, TSS, Cation/Anion profile (including dissolved silica) at SW100.
- Second monitoring round: blind replicate samples were collected at SW11 and SW5. These were analysed for total cyanide at SW11; pH, EC, TSS, Cation/Anion profile (including dissolved silica) and total and dissolved metals at SW5.
- Third monitoring round: blind replicate samples were collected at SW11 and SW101. These were analysed for total cyanide and total and dissolved metals at SW11; pH, EC, TSS, Cation/Anion profile (including dissolved silica) at SW101.

Cyanide duplicate samples were obtained from the discharge of the tailings dam into the Tui Stream (SW11), because this was the only site to have detectable concentrations of cyanide.

Filter blanks were analysed to identify contamination which may have occurred in either sample collection and/or laboratory analysis. One filter blank was collected during each monitoring round. During the first round the blank was

filtered at SW11; during the second round the blank was filtered at SW5; and for the third round was filtered at SW13. These locations were selected due to various conditions across the site such as high metal concentrations (SW5), vicinity to waste rock (SW11), and sampling sites outside the mine area (SW13).

A trip blank was added to the second monitoring round programme in response to results of the first monitoring round. The trip blank (SW250, 9 October 2009) was a sample bottle filled with Type 1 (deionised) water by the laboratory. The bottle was placed amongst the other sample bottles, but remained unopened. This was to ensure laboratory practices were not responsible for contamination, as opposed to a filter blank which is analysed to determine contamination from sample collection and analysis.

In addition to collecting filter blanks and blind replicate samples, all water quality meters were calibrated against NITS traceable standards in the field as outlined in Section 2.2.3.

### 2.6.2 Laboratory Quality Assurance/Quality Control

The analytical laboratories utilised during this study were IANZ accredited. They were selected on the basis of their experience and ability to carry out the selected analyses to the required standards and detection limits.

Hill Laboratories was selected as the primary analytical laboratory because of their:

- Ability to analyse all parameters to very low analytical limits;
- Proximity to site, which allowed samples to be directly delivered to the laboratory;
- Fast turn around times;
- Experience in analysing water samples from the site;
- Low costs.

As part of the quality assurance programme, PDP obtained Hill Laboratories QA/QC reports for each monitoring round to ensure the laboratory analyses complied with the DQO for laboratory QA/QC set out in CLMG#5 (MfE, 2004)(see Table 3).

### 2.6.3 Inter-laboratory comparison

To verify the accuracy of analytical results from Hill Laboratories, a split sample was obtained during each sampling round and sent to Watercare Laboratory Services. Watercare Laboratory Services was selected to analyse the split sample because of their:

- Ability to analyse all parameters to very low analytical limits;
- Proximity to site, which allowed samples to be directly delivered to the laboratory;

- Fast turn around times.

As each sampling site at Tui Mine presents its own analytical challenges for metal assays, the split samples were collected from different sampling locations for each monitoring round. The split samples were collected as follows:

- First monitoring round: split samples were collected at SW11, SW13 and SW100. These were analysed for total cyanide at SW11; total and dissolved metals at SW13; and pH, EC, TSS, Cation/Anion profile (including dissolved silica) at SW100.
- Second monitoring round: split samples were collected at SW11 and SW5. These were analysed for total cyanide at SW11; pH, EC, TSS, Cation/Anion profile (including dissolved silica) and total and dissolved metals at SW5.
- Third monitoring round: split samples were collected from SW101. These were analysed for pH, EC, TSS, Cation/Anion profile (including dissolved silica), and total and dissolved metals.

A split water sample was obtained from SW11 during the first monitoring round and sent to SGS laboratories in Waihi to verify the accuracy of the Hill Laboratories cyanide analysis. SGS Laboratories was selected to undertake the analysis of the split cyanide sample because of their:

- Ability to analyse cyanide to very low analytical detection limits (similar to Hill Laboratories);
- Experience in analysing water samples from the site.

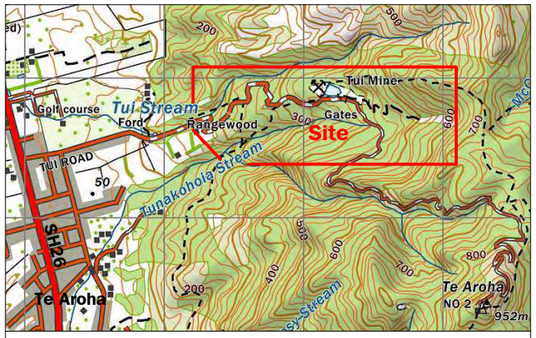
After consulting with expertise at Hill Laboratories, blind replicate samples were collected in place of split samples because the volatilisation of cyanide and oxidation of iron could present problems if typical split sample procedures were followed.

### 2.6.4 Correctness of Analysis

In addition to the QA/QC check undertaken in Sections 3.4.1 and 3.4.2, PDP undertook additional steps to verify the correctness of analyses outlined in Section 2.6.

Additional reports were requested from the laboratory to show the analytical variability for all analytes. These reports were used to assess the analytical variation of the results and were used primarily to assess if the variation would impact the DQOs.

RockWare® software AqQA was used to assess internal consistencies for the cation and anion profiles. This is because waters containing elevated constituents can be more difficult to balance in cation and anion tests.




SITE LOCATION

TUI STREAM

SW12

SW11

Tailings Dam
Tui Mine

Former Process Area

SW15

Waste Rock Piles

SW3

SW5

SW13

TUI ROAD

NORTH BRANCH OF THE TUNAKOHOIA STREAM

SW100

Waste Rock Piles

SW101

SW7

Town Supply Inlet

SW8

SOUTH BRANCH OF THE TUNAKOHOIA STREAM

KEY

- SW7 Water quality monitoring site
- SW7 Ecological monitoring site
- Old mine road
- Road
- Stream

0 100 200m

APPROX. SCALE 1:5000 (A3)

Source: Aerial imagery derived from Google Earth Pro (may not be spatially accurate).
Cadastral Map derived from LINZ data.

Figure 1 : TUI MINE BASELINE MONITORING LOCATIONS MAP



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# 3.0 Results

## 3.1 Ecological Report

An ecological survey was undertaken on the 7 and 9 September 2009 after 5 days of dry weather. Detailed results of the survey are presented in Section 3.0 of the attached report (Appendix D).

## 3.2 Water Quality Results

### 3.2.1 Field Measurements

Field measurement results for the three monitoring rounds are presented in Table 4. A copy of the field data is provided in Appendix E.

### 3.2.2 Laboratory Water Quality Results

Results of the laboratory analyses for the three monitoring rounds are presented in Table 4. A copy of the laboratory reports is provided in Appendix A (round 1), Appendix B (round 2) and Appendix C (round 3).

### 3.2.3 Flow monitoring results

Results of flow measurements for the three monitoring rounds are presented in Table 4. A copy of the FlowTracker reports and calculations is provided in Appendix F. Flow data was collected using a range of different techniques (See Table 2) including v-notch weirs, flow gauging instruments, gradient and depth calculations as well as a bucket and stopwatch. There is a significant degree of uncertainty associated with the flow measurements undertaken using gradient and depth calculations (SW101) and the bucket and stopwatch (SW15). Therefore, the flow rates obtained at these monitoring sites should be considered to be rough estimates only.

Figure 2 presents a summary of the flow data gathered during this project and the limited historical data (see Section 4.4) for the monitoring sites. The flow ranges (25 to 75 percentiles) presented in Figure 2 are comprised of only a very limited number of data points (minimum of three data points (at SW8, SW15 and SW101) to a maximum of eight data points (SW5 and SW13)).

The discharges from the mine adits (SW3 and SW5) as well as the tailings dam into the Tui stream (SW11) showed the least variation in the flow ranges at the various monitoring sites, while the measured flows in the downstream monitoring sites on the Tunakohoia and Tui Streams (SW7, SW8 and SW13) showed the greatest flow ranges.

Several QA/QC warnings were noted in the Flowtrackers reports (See Appendix F). These QA/QC warnings pertain to measurements undertaken in areas of stagnant water, with little or no flow and, therefore, the QC issues raised in the reports do not have a significant impact on the reported flows measured at these sites.

**Table 4: Water Quality and Flow Monitoring Results**

| **Sample Location** | | Level 4 Adit | | | Level 5 Adit | | | Tunakohoia N Branch, Downstream | | | Tunakohoia S Branch, Downstream | | | Tailings Drainage, Tui Tributary | | | Tui, Downstream | | | Tailings Drainage, Tkha trib | | | Tunakohoia N Branch, Upstream | | | Ruakaka Tributary | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample No.** | | **SW3** | **SW3** | **SW3** | **SW5** | **SW5** | **SW5** | **SW7** | **SW7** | **SW7** | **SW8** | **SW8** | **SW8** | **SW11** | **SW11** | **SW11** | **SW13** | **SW13** | **SW13** | **SW15** | **SW15** | **SW15** | **SW100** | **SW100** | **SW100** | **SW101** | **SW101** | **SW101** |
| **Sampling date** | | 17/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 9/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 | 18/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 | 17/09/09 | 8/10/09 | 17/11/09 |
| **Laboratory Number** | | 728224.1 | 734195.1 | 744474.1 | 728224.3 | 734195.2 | 744474.2 | 728224.5 | 734195.3 | 744474.15 | 728224.7 | 734195.4 | 744474.16 | 728224.9 | 734195.5 | 744474.9 | 728224.11 | 734195.11 | 744474.6 | 728224.13 | 734195.7 | 744474.11 | 728224.16 | 734195.9 | 744474.3 | 728224.17 | 734195.1 | 744474.4 |
| **Flow Rate** | $m^3/s$ | 0.0002 | 0.0021 | 0.0004 | 0.0057 | 0.0102 | 0.0081 | 0.0179 | 0.1089 | 0.0198 | 0.025 | 0.1237 | 0.0382 | 0.0012 | 0.0020 | 0.0011 | 0.018 | 0.089 | 0.0229 | 0.0021 | 0.0103 | 0.0017 | 0.0057 | 0.0251 | 0.0134 | 0.001 | 0.025 | 0.001 |
| | $m^3/min$ | 0.01 | 0.13 | 0.02 | 0.34 | 0.61 | 0.49 | 1.07 | 6.53 | 1.19 | 1.50 | 7.42 | 2.29 | 0.07 | 0.12 | 0.07 | 1.07 | 5.32 | 1.37 | 0.13 | 0.62 | 0.10 | 0.34 | 1.51 | 0.80 | 0.04 | 1.51 | 0.08 |
| **Flow Regime** | | low | high | low | low | high | low | low | high | low | low | high | low | low | high | low | low | high | low | low | high | low | low | high | low | low | high | low |
| **Field:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temperature | °C | 10.36 | 10.17 | 10.97 | 14.35 | 12.92 | 13.98 | 11.89 | 10.27 | 11.36 | 11.28 | 8.62 | 11.42 | 12.37 | 11.7 | 13.95 | 12.15 | 10.53 | 11.76 | 12.52 | 12.39 | 12.87 | 14.1 | 10.66 | 12.37 | 11.57 | 9.55 | 10.73 |
| pH | pH Units | 7.84 | 6.76 | 7.42 | 7.63 | 6.31 | 7.29 | 6.97 | 6.57 | 6.39 | 7.3 | 7.93 | 6.06 | 3.29 | 3.04 | 3.36 | 6.99 | 7.05 | 6.99 | 5.67 | 5.19 | 5.86 | 7.58 | 6.73 | 6.97 | 7.23 | 6.57 | 6.57 |
| Conductivity | mS/m | 9.209 | 6.508 | 10.8 | 56.29 | 46.55 | 61.4 | 30.07 | 15.68 | 34.6 | 8.4 | 6.0 | 9 | 52.9 | 61.83 | 69.3 | 13.4 | 8.96 | 15.3 | 7.91 | 18.1 | 21 | 44.9 | 19.92 | 47 | 10.5 | 7.05 | 11.3 |
| ORP | mV | 176 | 301 | 258 | 194 | 225 | 297 | 233 | 589 | 330 | 242 | 796 | 350 | 496 | 516 | 477 | 206 | 548 | 312 | 190 | 217 | 270 | 189 | 342 | 317 | 207 | 379 | 306 |
| Dissolved Oxygen | $g/m^3$ | 9.99 | 10.15 | 9.1 | 9.66 | 9.47 | 9.91 | 10.77 | 11.08 | 10.45 | 10.7 | 11.42 | 12.41 | 10.31 | 9.33 | 10.84 | 10.28 | 10.96 | 10.98 | 9.93 | 9.42 | 11.31 | 9.91 | 10.39 | 10.82 | 10.49 | 10.64 | 11.29 |
| Turbidity | NTU | <5 | <5 | 0.9 | <5 | <5 | 19 | <5 | <5 | 5.4 | <5 | <5 | 1.6 | <5 | <5 | 5 | <5 | <5 | 3.7 | <5 | <5 | 0.3 | <5 | <5 | 12.8 | <5 | <5 | 0.5 |
| **Laboratory:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH | pH Units | 6.7 | 7.8 | 6.7 | 7.2 | 7.1 | 7.3 | 7.3 | 7.4 | 7.0 | 7.7 | 7.7 | 7.3 | 3.2 | 3.2 | 3.3 | 6.6 | 6.5 | 6.8 | 6.3 | 6.0 | 6.2 | 7.2 | 6.9 | 7.6 | 7.2 | 7.0 | 7.5 |
| Conductivity | mS/m | 11.7 | 8.6 | 11.2 | 65.7 | 54.6 | 62.8 | 36.7 | 20.8 | 35.8 | 10.4 | 8.3 | 9.2 | 72.2 | 82.1 | 71.9 | 16.1 | 12.2 | 15.8 | 22.1 | 23.4 | 22.1 | 52.6 | 27.9 | 48.4 | 12.7 | 9.6 | 30 |
| Total Suspended Solids | $g/m^3$ | < 3.0 | < 3.0 | < 3.0 | 14 | 14 | 14 | < 3.0 | < 3.0 | < 3.0 | < 3.0 | < 3.0 | < 3.0 | 24 | 11 | 25 | < 3.0 | 5.2 | < 3.0 | < 3.0 | 3 | < 3.0 | 10 | 3.2 | 7.7 | < 3.0 | < 3.0 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ as $SiO_2$ | 13 | 12 | 13 | 17 | 17 | 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 16 | 14 | 15 | 14 | 12 | 12 |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - | 0.0022 | 0.0025 | 0.0026 | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0010 | - | - | - | - | - | - |
| **Cation/Anion Profile:** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cations | meq | 1.1 | 0.78 | 1.2 | 7.4 | 5.6 #1 | 7.5 #1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5.8 | 2.9 #1 | 5.6 #1 | 1.2 | 0.88 #1 | 1.2 #1 |
| Anions | meq | 1.1 | 0.77 | 1 | 6.5 | 4.9 #1 | 6.8 #1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4.9 | 2.4 #1 | 4.5 #1 | 1.0 | 0.71 #1 | 0.98 #1 |
| pH | pH Units | 6.7 | 7.8 | 6.7 | 7.2 | 7.1 | 7.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.2 | 6.9 | 7.6 | 7.2 | 7.0 | 7.5 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 17 | 11 | 16 | 68 | 43 | 64 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 49 | 20 | 44 | 10 | 10 | 9.8 |
| Bicarbonate | $g/m^3$ at 25°C | 21 | 14 | 19 | 83 | 52 | 78 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 59 | 24 | 54 | 12 | 12 | 12 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 36 | 23 | 33 | 290 | 220 | 300 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 220 | 96 | 200 | 33 | 19 | 30 |
| Conductivity (ms/m) | mS/m | 11.7 | 8.6 | 11.2 | 65.7 | 54.6 | 62.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 52.6 | 27.9 | 48.4 | 12.7 | 9.6 | 11.6 |
| Dissolved Calcium | $g/m^3$ | 10 | 6.7 | 9.9 | 88 | 64 | 91 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 64 | 27 | 59 | 8.7 | 4.8 | 7.6 |
| Dissolved Magnesium | $g/m^3$ | 2.4 | 1.5 | 2.1 #2 | 18 | 14 | 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 13 | 7.0 | 12 | 2.7 | 1.7 | 2.7 #2 |
| Dissolved Potassium | $g/m^3$ | 0.51 | 0.41 | 0.47 #2 | 1.3 | 0.93 | 1.3 #2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.1 | 0.67 | 0.99 #2 | 0.73 | 0.54 | 0.72 #2 |
| Dissolved Sodium | $g/m^3$ | 7.9 | 6.8 | 7.3 | 15 | 12 | 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 13 | 9.5 | 12 | 8.5 | 7.1 | 8.5 |
| Chloride | $g/m^3$ | 10 | 10 | 9.9 | 10 | 11 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 11 | 11 | 10 | 12 | 12 | 12 |
| Nitrite-N | $g/m^3$ | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | < 0.0020 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.004 | < 0.0020 | 0.0052 | < 0.0020 | < 0.0020 | < 0.0020 |
| Nitrate-N | $g/m^3$ | 0.14 | 0.17 | 0.16 | 0.024 | 0.062 | 0.033 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.049 | 0.13 | 0.061 | 0.16 | 0.25 | 0.14 |
| Nitrate-N+ Nitrite-N | $g/m^3$ | 0.14 | 0.17 | 0.16 | 0.025 | 0.063 | 0.033 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.053 | 0.13 | 0.066 | 0.16 | 0.25 | 0.14 |
| Sulphate | $g/m^3$ | 20 | 12 | 28 | 270 | 210 | 280 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 220 | 110 | 210 | 30 | 16 | 32 |
| ***Metals - Dissolved*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminium | $g/m^3$ | *< 0.0032* | *0.016* | *< 0.0032* | *0.0046* | *0.0083* | *0.0044* | *0.16* | *0.084* | *0.055* | *0.016* | *0.051* | *0.030* | *10* | *14* | *10* | *0.067* | *0.051* | *0.099* | *0.030* | *0.17* | *0.019* | *< 0.0032* | *0.014* | *< 0.0032* | *0.0053* | *0.012* | *0.0065* |
| Antimony | $g/m^3$ | *< 0.00021* | *< 0.00021* | *< 0.00021* | *0.00063* | *0.00037* | *0.00061* | *0.00022* | *< 0.00021* | *0.00074* | *< 0.00021* | *< 0.00021* | *0.00027* | *0.00044* | *0.00072* | *0.00039* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *0.00068* | *< 0.00021* | *0.00049* | *0.00046* | *< 0.00021* | *0.00037* |
| Arsenic | $g/m^3$ | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0021* | *< 0.0053* | *0.0014* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *0.018* | *0.026* | *0.012* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *0.0039* | *0.021* | *0.0022* | *< 0.0011* | *< 0.0021* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* |
| Barium | $g/m^3$ | *0.0068* | *0.0044* | *0.0063* | *0.024* | *0.022* | *0.026* | *0.024* | *0.021* | *0.025* | *0.0061* | *0.0054* | *0.0058* | *0.030* | *0.031* | *0.033* | *0.0092* | *0.0075* | *0.0095* | *0.020* | *0.028* | *0.024* | *0.025* | *0.019* | *0.026* | *0.018* | *0.015* | *0.017* |
| Beryllium | $g/m^3$ | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *0.00062* | *0.0008* | *0.00067* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* |
| Boron | $g/m^3$ | *0.012* | *0.011* | *0.012* | *0.024* | *0.019* | *0.027* | *0.015* | *0.013* | *0.015* | *0.0094* | *0.0095* | *0.010* | *0.012* | *0.012* | *0.013* | *0.012* | *0.012* | *0.013* | *0.013* | *0.012* | *0.015* | *0.018* | *0.014* | *0.024* | *0.012* | *0.012* | *0.013* |
| Cadmium | $g/m^3$ | *0.0036* | *0.0016* | *0.0038* | *0.13* | *0.19* | *0.12* | *0.046* | *0.028* | *0.049* | *< 0.000053* | *< 0.000053* | *< 0.000053* | *0.11* | *0.14* | *0.12* | *0.0045* | *0.0037* | *0.0054* | *0.0094* | *0.018* | *0.012* | *0.098* | *0.077* | *0.088* | *0.015* | *0.014* | *0.016* |
| Calcium | $g/m^3$ | *9.8* | *6.7* | *9.9* | *86* | *58* | *84* | *36* | *18* | *36* | *6.6* | *5.1* | *6.4* | *26* | *24* | *25* | *11* | *7.8* | *12* | *17* | *19* | *20* | *62* | *26* | *61* | *8.0* | *5.6* | *7.6* |
| Chromium | $g/m^3$ | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *0.0028* | *0.0037* | *0.003* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* |
| Copper | $g/m^3$ | *0.0019* | *0.00096* | *0.0013* | *0.0085* | *0.043* | *0.0093* | *0.021* | *0.020* | *0.0099* | *< 0.00053* | *< 0.00053* | *0.00063* | *0.96* | *1.7* | *0.97* | *0.0081* | *0.0075* | *0.011* | *0.038* | *0.17* | *0.029* | *0.0076* | *0.033* | *0.0085* | *0.0046* | *0.0073* | *0.0057* |
| Iron | $g/m^3$ | *< 0.021* | *< 0.021* | *< 0.021* | *< 0.021* | *< 0.021* | *< 0.021* | *0.16* | *0.037* | *< 0.021* | *< 0.021* | *0.026* | *0.029* | *20* | *26* | *17* | *< 0.021* | *0.022* | *0.024* | *0.22* | *1.1* | *0.12* | *< 0.021* | *0.033* | *< 0.021* | *< 0.021* | *< 0.021* | *< 0.021* |
| Lead | $g/m^3$ | *0.00058* | *0.00049* | *0.00093* | *0.00025* | *0.00077* | *0.00026* | *0.014* | *0.012* | *0.0036* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *0.71* | *0.89* | *0.87* | *0.0038* | *0.0023* | *0.0061* | *0.065* | *0.24* | *0.089* | *0.0042* | *0.005* | *0.0028* | *0.20* | *0.16* | *0.21* |
| Lithium | $g/m^3$ | *0.0020* | *0.0017* | *0.0019* | *0.020* | *0.015* | *0.021* | *0.0095* | *0.0047* | *0.0092* | *0.00051* | *0.0007* | *0.00050* | *0.017* | *0.022* | *0.021* | *0.0031* | *0.0026* | *0.0033* | *0.0057* | *0.0059* | *0.0059* | *0.014* | *0.0074* | *0.015* | *0.0022* | *0.0015* | *0.0022* |
| Magnesium | $g/m^3$ | *2.3* | *1.7* | *2.2* | *18* | *13* | *18* | *11* | *5.5* | *10* | *2.6* | *2.0* | *2.3* | *13* | *15* | *14* | *4.7* | *3.4* | *4.7* | *6.6* | *7.1* | *7.1* | *13* | *6.5* | *14* | *3.0* | *2.1* | *2.7* |
| Manganese | $g/m^3$ | *0.0024* | *< 0.00053* | *0.00086* | *1.9* | *1.5* | *1.7* | *0.55* | *0.23* | *0.55* | *< 0.00053* | *0.0014* | *0.0011* | *5.4* | *6.9* | *5.9* | *0.21* | *0.16* | *0.25* | *0.020* | *0.099* | *0.032* | *1.1* | *0.49* | *1.1* | *0.0018* | *0.0030* | *0.0014* |
| Mercury | $g/m^3$ | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* | *< 0.000080* |
| Molybdenum | $g/m^3$ | *< 0.00021* | *< 0.00021* | *< 0.00021* | *0.00058* | *0.00027* | *0.00043* | *< 0.00021* | *0.0045* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *< 0.00021* | *0.00098* | *< 0.00021* | *0.00033* | *< 0.00021* | *0.00032* | *< 0.00021* | *< 0.00021* | *< 0.00021* |
| Nickel | $g/m^3$ | *< 0.00053* | *< 0.00053* | *< 0.00053* | *0.025* | *0.021* | *0.023* | *0.011* | *0.0046* | *0.0094* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *0.054* | *0.066* | *0.053* | *0.0041* | *0.0026* | *0.0040* | *0.0022* | *0.0032* | *0.0024* | *0.020* | *0.0091* | *0.017* | *0.0014* | *0.0011* | *0.0012* |
| P2 Potassium | $g/m^3$ | *0.46* | *0.41* | *0.43* | *1.1* | *0.85* | *1.2* | *0.99* | *1.6* | *0.94* | *0.51* | *0.45* | *0.46* | *1.4* | *1.5* | *1.5* | *0.78* | *0.70* | *0.75* | *0.98* | *1.1* | *1.0* | *0.92* | *0.62* | *0.97* | *0.68* | *0.61* | *0.67* |
| Silver | $g/m^3$ | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0021* | *< 0.0053* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *0.0022* | *< 0.0053* | *< 0.0021* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0021* | *< 0.0021* | *< 0.0011* | *< 0.0011* | *< 0.0011* | *< 0.0011* |
| Selenium | $g/m^3$ | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* | *< 0.00011* |
| Sodium | $g/m^3$ | *7.2* | *6.6* | *7.3* | *13* | *11* | *15* | *11* | *9.5* | *12* | *7.9* | *7.0* | *7.8* | *9.3* | *9.4* | *11* | *9.5* | *8.2* | *10* | *10* | *9.9* | *11* | *12* | *8.4* | *13* | *8.0* | *7.6* | *8.4* |
| Tin | $g/m^3$ | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *<0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* | *< 0.00053* |
| Uranium | $g/m^3$ | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *0.00018* | *0.00023* | *0.00023* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* | *< 0.000021* |
| Zinc | $g/m^3$ | *0.41* | *0.18* | *0.43* | *20* | *27* | *19* | *6.6* | *3.9* | *6.8* | *0.0017* | *0.0015* | *< 0.0011* | *19* | *25* | *20* | *0.78* | *0.62* | *0.92* | *1.6* | *2.8* | *1.8* | *13* | *11* | *13* | *1.7* | *1.6* | *1.8* |
| **Metal - Total** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminium | $g/m^3$ | 0.0072 | 0.0046 | < 0.0032 | 0.26 | 0.44 | 0.26 | 0.38 | 0.29 | 0.34 | 0.03 | 0.074 | 0.048 | 10 | 14 | 12 | 0.49 | 0.39 | 0.46 | 0.032 | 0.23 | 0.019 | 0.15 | 0.14 | 0.12 | 0.013 | 0.018 | 0.0080 |
| Antimony | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 | 0.0010 | 0.00073 | 0.0010 | 0.00027 | 0.00027 | 0.0013 | < 0.00021 | < 0.00021 | 0.00066 | 0.00055 | 0.00077 | 0.00041 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | 0.00044 | < 0.00021 | 0.00096 | 0.0005 | 0.00076 | 0.00051 | 0.00036 | 0.00047 |
| Arsenic | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 | 0.0052 | 0.0038 | 0.0048 | < 0.0011 | 0.0041 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | 0.023 | 0.028 | 0.014 | < 0.0011 | < 0.0011 | < 0.0011 | 0.0046 | 0.024 | 0.0030 | 0.0028 | < 0.0021 | 0.0020 | < 0.0011 | < 0.0011 | < 0.0011 |
| Barium | $g/m^3$ | 0.0071 | 0.0047 | 0.0067 | 0.024 | 0.023 | 0.027 | 0.024 | 0.023 | 0.025 | 0.0063 | 0.0063 | 0.0061 | 0.031 | 0.03 | 0.031 | 0.0098 | 0.0081 | 0.0097 | 0.021 | 0.028 | 0.021 | 0.026 | 0.021 | 0.027 | 0.019 | 0.015 | 0.018 |
| Beryllium | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | 0.00058 | 0.00072 | 0.00070 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron | $g/m^3$ | 0.011 | 0.0099 | 0.011 | 0.023 | 0.022 | 0.026 | 0.016 | 0.014 | 0.017 | 0.0099 | 0.011 | 0.0087 | 0.011 | 0.011 | 0.014 | 0.011 | 0.011 | 0.013 | 0.013 | 0.014 | 0.016 | 0.021 | 0.015 | 0.019 | 0.012 | 0.013 | 0.012 |
| Cadmium | $g/m^3$ | 0.0038 | 0.0015 | 0.004 | 0.15 | 0.21 | 0.14 | 0.048 | 0.029 | 0.049 | < 0.000053 | < 0.000053 | < 0.000053 | 0.11 | 0.14 | 0.11 | 0.0048 | 0.0038 | 0.0054 | 0.0093 | 0.018 | 0.010 | 0.11 | 0.083 | 0.099 | 0.016 | 0.014 | 0.017 |
| Calcium | $g/m^3$ | 9.7 | 6.6 | 9.7 | 86 | 63 | 89 | 37 | 19 | 36 | 6.9 | 5.5 | 6.0 | 26 | 23 | 26 | 11 | 7.8 | 12 | 16 | 20 | 19 | 65 | 27 | 60 | 8.2 | 5.5 | 7.3 |
| Chromium | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | 0.00058 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | 0.0027 | 0.0037 | 0.0030 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | 0.00075 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper | $g/m^3$ | 0.0029 | 0.0012 | 0.016 | 0.2 | 0.49 | 0.21 | 0.041 | 0.065 | 0.042 | < 0.00053 | 0.0006 | 0.00076 | 1.0 | 1.6 | 0.99 | 0.027 | 0.026 | 0.027 | 0.039 | 0.17 | 0.028 | 0.12 | 0.17 | 0.1 | 0.0051 | 0.0073 | 0.0057 |
| Iron | $g/m^3$ | < 0.021 | < 0.021 | < 0.021 | 4.7 | 4.4 | 4.2 | 0.41 | 0.41 | 0.55 | 0.025 | 0.036 | 0.052 | 22 | 26 | 19 | 0.21 | 0.26 | 0.15 | 0.23 | 1.1 | 0.12 | 2.4 | 1.2 | 2.1 | < 0.021 | < 0.021 | < 0.021 |
| Lead | $g/m^3$ | 0.0013 | 0.0008 | 0.0011 | 0.072 | 0.15 | 0.077 | 0.033 | 0.1 | 0.036 | < 0.00011 | 0.00036 | 0.00041 | 0.77 | 0.91 | 0.87 | 0.026 | 0.022 | 0.025 | 0.067 | 0.24 | 0.079 | 0.054 | 0.075 | 0.053 | 0.23 | 0.17 | 0.23 |
| Lithium | $g/m^3$ | 0.0021 | 0.0016 | 0.0019 | 0.019 | 0.015 | 0.020 | 0.0097 | 0.005 | 0.0098 | 0.00059 | 0.00079 | 0.00059 | 0.016 | 0.021 | 0.021 | 0.0032 | 0.0024 | 0.0034 | 0.0057 | 0.0059 | 0.0062 | 0.016 | 0.0069 | 0.014 | 0.0023 | 0.0015 | 0.0021 |
| Magnesium | $g/m^3$ | 2.3 | 1.5 | 2 #2 | 18 | 14 | 19 | 11 | 5.6 | 11 | 2.7 | 2.1 | 2.0 | 13 | 15 | 15 | 4.7 | 3.2 | 4.7 | 6.7 | 7.1 | 7.2 | 15 | 6.9 | 12 | 3.1 | 2.2 | 2.5 #2 |
| Manganese | $g/m^3$ | 0.0024 | 0.0007 | 0.000077 | 1.8 | 1.6 | 1.7 | 0.57 | 0.24 | 0.63 | 0.0014 | 0.0028 | 0.0019 | 5.5 | 6.7 | 6.1 | 0.22 | 0.16 | 0.25 | 0.02 | 0.094 | 0.033 | 1.2 | 0.52 | 1.0 | 0.0021 | 0.0035 | 0.0013 |
| Mercury | $g/m^3$ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 | 0.00059 | 0.00036 | 0.00046 | < 0.00021 | 0.005 | 0.00023 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | 0.001 | < 0.00021 | 0.00033 | < 0.00021 | 0.00031 | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 | 0.025 | 0.021 | 0.023 | 0.011 | 0.005 | 0.010 | < 0.00053 | < 0.00053 | < 0.00053 | 0.054 | 0.065 | 0.054 | 0.0042 | 0.0029 | 0.004 | 0.0022 | 0.0033 | 0.0022 | 0.019 | 0.0091 | 0.016 | 0.0015 | 0.0012 | 0.0011 |
| Potassium | $g/m^3$ | 0.47 | 0.41 | 0.44 #2 | 1.1 | 0.94 | 1.1 #2 | 1.0 | 1.8 | 1.0 | 0.53 | 0.49 | 0.45 | 1.4 | 1.4 | 1.5 | 0.81 | 0.72 | 0.78 | 0.97 | 1.1 | 1.0 | 1.0 | 0.67 | 0.95 #2 | 0.7 | 0.6 | 0.68 #2 |
| Silver | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0021 | 0.0029 | < 0.0021 | < 0.0011 | < 0.0011 | 0.0012 | < 0.0011 | < 0.0011 | < 0.0011 | 0.0022 | < 0.0053 | 0.0024 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | 0.0011 | < 0.0011 | < 0.0011 | < 0.0021 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium | $g/m^3$ | < 0.00011 | < 0.00011 | 0.0047 | < 0.00011 | < 0.00011 | 0.0003 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium | $g/m^3$ | 7.2 | 6.3 | 7.5 | 13 | 11 | 14 | 11 | 9.6 | 12 | 8.1 | 7.3 | 7.2 | 9.0 | 8.9 | 11 | 9.5 | 8.4 | 10 | 11 | 11 | 12 | 12 | 8.7 | 13 | 8.2 | 7.7 | 8.6 |
| Tin | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | 0.00057 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium | $g/m^3$ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | 0.0002 | 0.00024 | 0.00022 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc | $g/m^3$ | 0.39 | 0.18 | 0.42 | 22 | 30 | 22 | 7.0 | 4.1 | 7.2 | 0.0013 | < 0.0011 | 0.0024 | 19 | 25 | 20 | 0.85 | 0.67 | 0.98 | 1.6 | 2.8 | 1.7 | 15 | 12 | 14 | 1.7 | 1.6 | 1.7 |

Notes:

#1 Cation and Anion balance were not in good agreement, but within the analytical variation of these methods.
#2 The dissolved fraction is greater than the total fraction, but within analytical variation of the method

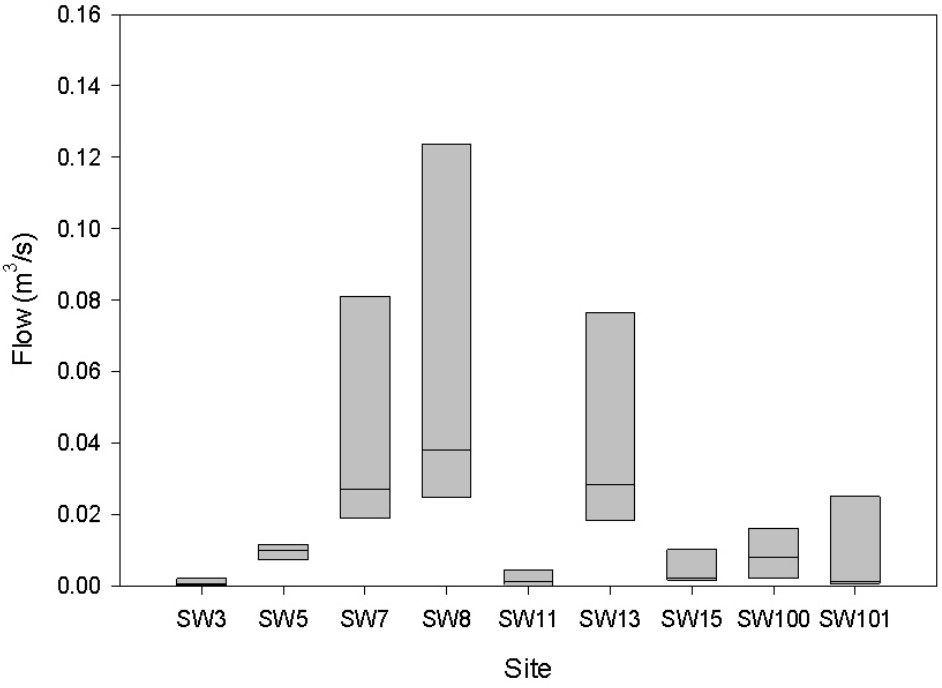


**Figure 2: Variations in flow at the various monitoring sites including historical data (box show medium, 25 and 75 percentile)**

### 3.3 Quality Assurance Programme

A QA/QC programme was implemented to ensure that field and laboratory data collected during baseline water quality monitoring provided reliable information for the characterisation of site conditions. The QA/QC program was designed to provide an overview of data collected during each round of the monitoring programme. The quality assurance programme consisted of four components which are outlined in the following sections (Field checks, laboratory checks, Inter-laboratory comparison, and correctness of analysis).

#### 3.3.1 Field QA/QC Checks

Comparisons between sample analyses were made based on DQOs discussed in Section 2.5 and summarised in Table 3. All replicate samples conformed to the DQOs outlined in this report (See Appendix G, Table G-10 for QA/QC sample results and calculated relative percentage difference between duplicate and split samples).

The filter blanks for this monitoring programme had all parameter concentrations below the analytical detection limits for all sampling rounds.

The flow across the v-notch weirs was independently checked using the flow tracker at sampling site SW11 and the two flow monitoring techniques were found to be in good agreement with each other (±5%).

### 3.3.2 Laboratory QA/QC Checks

A quality control report was provided by Hill Laboratories (the primary analytical laboratory). The report shows the laboratory QA/QC meets CLMG#5 (MfE, 2004) requirements and the project DQOs as outlined in Section 2.5 and Table 3 for most monitoring rounds. During the third monitoring round, elevated concentrations of lead and zinc (approximately 2 ppb and 1.2 ppb respectively) were detected in the filter blank (SW23B). A re-analysis of this sample found that the elevated concentrations of lead and zinc were due to a spot contamination issue within the laboratory.

A visual examination of the results for the other samples collected in this analytical run reveal that lithium, lead and zinc were elevated in sample SW8B compared to SW8 and the laboratory was asked to re-run the analysis of this sample. The re-analysis of sample SW8B revealed that spot contamination within the laboratory had elevated the reported concentrations of lithium, lead and zinc within this sample.

The source of the spot contamination within the laboratory has not been identified. It is possible that other samples within this analytical run may also be affected. However, the concentration of these elements normally encountered at all the other monitoring sites are much higher (several hundred of ppb) than the magnitude of the spot contamination detected within SW8B and SW23B (approximately 1 to 2 ppb). It is believed that any spot contamination that may have occurred during the analysis of these samples is likely to be less than the expected standard analytical error.

Therefore, it is believed that any spot contamination is unlikely to have a significant effect (i.e. vary the results by more than 10%) on the reported results for these samples.

Copies of the laboratory QA/QC reports are provided in Appendix A (Round 1), B Round 2) and C (Round 3). The laboratory QA/QC samples meet the project data quality objectives (DQOs).

### 3.3.3 Inter-laboratory Comparison

Comparisons between inter-laboratory sample analyses were made based on DQOs discussed in Section 2.5 and summarised in Table 3. All replicate samples (excluding cyanide) conformed to the DQOs outlined in this report.

The split cyanide sample results for the first monitoring round between Hill Laboratories and SGS did not agree with the project DQOs (See Table 5). Additional analysis was undertaken to determine if known cyanide analytical interferences affected the analysis, and to validate that Hill Laboratories cyanide analyses are accurate. This study indicates that Hill Laboratories cyanide

analyses are accurate and there are no known chemical interferences. A copy of the cyanide investigation study is provided in Appendix H.

**Table 5: Cyanide Analysis Results Obtained during baseline monitoring**

| Sample Location | | SW11 | | |
|---|---|---|---|---|
| Sample Name: | units | SW11 | SW11b | SW11a |
| | | | Duplicate | Split Sample |
| Laboratory | | Hills | Hills | SGS |
| Sampling date | | 17-Sep-09 | 17-Sep-09 | 17-Sep-09 |
| Lab Number: | | 728224.9 | 728224.22 | |
| Total Cyanide | $g/m^3$ | 0.0022 ± 0.0011 | 0.0022 ± 0.0011 | 0.019 |

### 3.3.4 Correctness of Analysis

The laboratory pH and the field pH for SW15 (6.7 compared with 5.4 respectively) are considerably different (more than 1 pH unit). The field measurement of pH is considered to be representative of conditions found at the site because pH of a water sample can change with time after sampling and immediately after measurement was taken, the accuracy of the pH meter was verified using a NITS traceable buffer solution. In addition, previous pH readings at the site have been generally between 5 and 6 pH units.

At several monitoring locations the total metal fraction was less than the dissolved metal fraction. However, the analytical uncertainty of the measurements for the dissolved and total metal fractions was larger than the differences between the reported laboratory for the dissolved and total metal fractions. The results therefore indicate that all of the metals detected in the samples were associated with the dissolved phase and the results between the two analyses are in good agreement within the range of analytical uncertainties.

In several cases the anion and cation balances reported by Hill Laboratories did not meet the data quality objectivities. In all cases, Hill Laboratory anion profiles (in meq) were higher than their respective cation profiles.

To verify, Hill Laboratories anion/cation balances a water quality control program (AqQA) was used to assess the ion profiles. Several additional cations, not used in Hill Laboratory calculations, (aluminium, zinc, iron, manganese and silica) were added to the calculations to see if anion/cation profiles would balance. As a result, most of the ion profiles balanced. Those that did not balance were very close to the project's data quality objectives (DQOs). The analytical variability for each parameter was also assessed for these results. It is concluded that the discrepancies in balancing the anion/cation profiles appear to be due to analytical variability and rounding of results rather than due to missing analytes.

# 4.0 Discussion

## 4.1 Summary of Baseline Monitoring Data

The Tui Mine Baseline Monitoring Programme consisted of three monitoring rounds and sampling during two different flow regimes. The first and third rounds were monitored under low flow conditions, whereas round two was monitored under high flow conditions.

Flow during the second round varied between sites from 2 to 35 times greater than the lowest flows measured. There was a notable difference in water quality between these two flow conditions. Results of the high flow monitoring round in October 2009 showed that EC, ion and metal concentrations were generally lower. The October sampling took place during, and after, a week of significant rain fall (167 mm) which effectively diluted the site waters.

Figure 1 shows the sampling locations and Table 1 provides a description of the sampling locations and analysis undertaken at the sampling sites.

The mine and tailings discharges vary significantly between sites, but generally contain high concentrations of total and dissolved metals. Elevated dissolved metals across the site include arsenic, cadmium, copper, iron, lead, nickel and zinc.

The elevations of metals per site are described as follows:

- Slightly elevated: 1 – 4.99 times the control site values;
- Moderately elevated: 5 – 9.99 times the control site values;
- Significantly elevated: 10 times or greater than the control site values.

### 4.1.1 Tunakohoia Stream Catchment

<u>SW8 - Town Water Supply Inlet, South Branch of the Tunakohoia stream</u>

- The control site at the town supply (SW8) showed approximately neutral stream conditions. The pH at this site ranged between 6 and 7.7 pH, and EC was less than 10 mS/m.
- Metal concentrations at SW8 were generally lower than all other sites.

<u>SW101 - Ruakaka Adits Tributary, North Branch</u>

- The Ruakaka Adits tributary (which receives discharges from the Ruakaka adits) had neutral pH and neutral, but slightly elevated EC measurements (<13 mS/m).
- With respect to the control site (SW8), SW101 had:
  - Slightly elevated nickel;
  - Moderately elevated copper;
  - Significantly elevated cadmium, lead and zinc.

SW3 - Adit 4 Outlet, North Branch

- The Adit 4 discharge (SW3) had approximately neutral pH and EC conditions and the lowest metal concentrations of the mine and tailings discharges.
- With respect to the control site (SW8), SW3 had:
  - Slightly elevated dissolved copper and dissolved lead;
  - Moderately to significantly elevated cadmium and total iron;
  - Significantly elevated total copper, total lead and zinc.

SW5-Adit 5 Outlet, North Branch

- Adit 5 had the highest EC measurements and metal concentrations in the Tunakohoia catchment, but had an approximately neutral pH.
- With respect to the control site (SW8), SW5 had:
  - Slightly elevated arsenic;
  - Slightly to significantly elevated dissolved iron and dissolved lead;
  - Significantly elevated cadmium, copper, total iron, total lead, nickel and zinc.
- The Adit 5 discharge (SW5) shows elevated metals and sulphate.

SW100 - Mountain Access Road, North Branch

- The Tunakohoia Stream at this site had neutral pH and slightly elevated EC.
- With respect to the control site (SW8), SW100 had:
  - Moderately to significantly elevated dissolved lead;
  - Significantly elevated cadmium, copper, iron, total lead, nickel and zinc.
- This site receives discharge from Adit 4 (SW3) and Adit 5 (SW5). The receiving waters at this point generally showed elevated metal concentrations that were lower than the Adit 5 discharge metals, but higher than the Adit 4 discharge metals.

SW15 - Tailings Dam Tributary, North Branch

- The tailings tributary (SW15) had the lowest pH in the catchment and slightly elevated EC.
- With respect to the control site (SW8), SW15 had:
  - Slightly to moderately elevated dissolved nickel;
  - Slightly to significantly elevated arsenic;
  - Moderately to significantly elevated total iron;

- Significantly elevated cadmium, copper, dissolved iron, lead, and zinc.

- The historical data set for this site is limited and there was not enough data to assess total nickel concentrations.

SW7 - Tunakohoia North Branch, Upstream of the South Branch Confluence

- The Tunakohoia Stream at this site had neutral pH and had slightly too significantly elevated EC.
- With respect to the control site (SW8), SW7 had:
  - Moderately to significantly elevated total iron;
  - Significantly elevated cadmium, copper, lead, nickel and zinc.
  - This site receives discharge from the tailings tributary (SW15), Adit 4 (SW3) and Adit 5 (SW5).

### 4.1.2 Tui Stream Catchment

SW11 - Tailings Dam Tributary

- The tailings drainage (SW11) had the lowest pH, highest EC and highest metal concentrations of all the sites in this investigation.
- With respect to the control site (SW8), SW11 had:
  - Significantly elevated arsenic, cadmium, copper, iron, lead, nickel and zinc.
- The metals measured at this monitoring location are predominantly present in dissolved form.

SW13 - Tui Stream

- The receiving Tui Stream (SW13) has a relatively neutral EC and pH, although the EC is slightly elevated compared to the control site (SW8).
- With respect to the control site (SW8), SW13 had:
  - Slightly elevated arsenic and dissolved iron;
  - Slightly to significantly elevated total iron and dissolved lead;
  - Moderately elevated dissolved copper and nickel;
  - Moderately to significantly elevated cadmium;
  - Significantly elevated total copper, total lead and zinc.
- This site receives discharge from the tailings tributary (SW11). The receiving waters at this point showed elevated metal concentrations, but which were lower than the metal concentrations found at SW11.

### 4.2 Ecological Monitoring Report

Sites along the Tui Stream (SW13) and Tunakohoia Stream north branch (SW7) are located downstream of Tui mine discharges. These sites were investigated and compared with their respective control sites upstream of the Tui tailings discharge (SW12) and the Tunakohoia Stream south branch (SW8).

All four monitoring sites were physically similar, hard-bottomed habitats. Healthy aquatic macro-invertebrates were observed at the control sites along the Tui Stream (SW12) and the Tunakohoia Stream south branch (SW8). However, healthy macro-invertebrate communities were not observed downstream of the tailings and mine discharges in the Tui Stream (SW13) and the Tunakohoia Stream north branch (SW7).

Detailed findings and conclusions of the survey are presented in Sections 3.0 and 4.0 of the attached report (Appendix D).

### 4.3 Mass Loads of Contaminants

The results of this study show that contaminant mass fluxes varied between dry and wet weather conditions. While concentrations of key contaminants of concern generally decrease during wet weather events due to dilution, the mass flux generally increased as contaminants are washed out of the tailings dam and mine adits due to increased flows. The exception to this trend was the Tui tailings tributary (SW11).

There was insufficient amount of data to draw any firm conclusions about the changes in the contaminant mass fluxes at Tunakohoia tailings tributary (SW15). However, the mass fluxes of contaminants at this site did increase significantly in the round 2 (high flow monitoring round).

Historical mass flux results also showed that the Tui tailings discharge (SW11) had similar mass flux to the current study results. Gully control works were undertaken in April 2006 to reduce the volume of tailings discharge to the Tui Stream. It appears the works have successfully reduced the volume of water being discharged; however, the concentrations of key contaminants have increased as a result. Overall, it appears the gully control works have not reduced the net mass flux of contaminants entering the Tui Stream.

Results of the mass flux calculations for the three monitoring rounds and available historical data are presented in Appendix I.

Historical mass flux results show that Adit 4 (SW3) had slightly higher mass flux than the current study results, although contaminant concentrations remain similar since the historical monitoring. This is due to lower flows observed in this study, possibly caused by a partial blockage in adit 4.

### 4.4 Review of Historical Data

Two historical data sets (URS, 1998-2001 and Remalia Sharplin (RS) MSc Thesis, 2008) were reviewed and used to supplement the data collected in this study to ascertain the baseline concentration of contaminants of concern.

These two data sets were selected for review because both of these two data sets have been collected recently (since 1998) and from the same monitoring locations as this study. Historical data together with the monitoring data from this study for each monitoring are shown in Tables G-1 to G-9 in Appendix G.

### 4.4.1 Review of URS data set

URS undertook up to six water quality monitoring rounds around the former Tui Mine site and tailing dam between 25 May 1998 and 15 December 2001. The URS monitoring programme including a number of monitoring sites which are not part of the current monitoring programme. Samples were collected at irregular sampling intervals with two sampling rounds being undertaken in March and May 1998 and up to 4 sampling rounds at some sites being collected between December 2000 and February 2001. All samples were analysed for anion/cation balance and for dissolved and total metals (As, Cd, Cu, Ni, Pb and Zn only) at Hill laboratories using comparable analytical methods that were used in this study. No QA/QC samples results were reported in the URS report (Tui Mine Remedial Options Investigations, May 2002); however, the examination of the laboratory reports indicated that some blank samples were submitted with some sample batches (on the 4/12/01 and on 14/12/01). Minor concentrations of some dissolved metals (Pb and Zn) were noted in the blank samples, however, the concentrations of the metals in the blanks were very low (low ppb) and unlikely to have a significant impact on the analytical results.

The URS report did not include analytical results for SW101 and only one set of data for SW15 (obtained on 15/12/2000).

In the reported analytical results the concentrations of dissolved metal were occasionally higher than the concentration of total recoverable metals. Although at times the concentration of dissolved metals could be as much as 10% higher than the total metal concentrations (i.e. A697 at SW11 on 22/2/01) and is greater than what can be expected for the experimental variation of the analytical method, the analytical results are within the expected range of results from the site. Therefore, the results have been included in the baseline dataset.

A comparison of URS data with the data obtained by Remalia Sharplin and the results of this study reveals that concentrations of some metals at the adit 4 discharge monitoring location (SW3) (cadmium (dissolved and total), copper (dissolved and total), iron (total), lead (dissolved and total and zinc (dissolved and total)) are elevated compared to the other data sets used in this study and those found by Remalia Sharplin. Conversations with URS staff (Anthony Kirk, pers. com.) revealed that there has been a cave-in within adit 4 which might have diverted the flow of some of the contaminated water away from the adit 4 portal (SW3 sampling location) and this may explain why the URS results are slightly elevated compared to the results in this study.

The analytical results obtained by URS at SW11 (Tailing discharge into the Tui Stream) were approximately one order of magnitude lower than those obtained by this study. The differences in the concentration between URS dataset and

the current dataset for metals may be related to the partial remediation of the tailings dam that occurred in April, 2006 (Sharplin, 2008). Care will need to be taken when using the historical dataset to compare with post remediation monitoring results.

Reviewing the data from SW8 (Te Aroha drinking water supply on Tunakohoia stream) it appears that the metal results (dissolved copper, nickel and zinc) for SW8 on 6 December 2000 are elevated compared to results obtained by any of the other sampling rounds (including RS and the current study). Although these results may be an outlier, currently there is no reason to exclude them from the dataset.

Overall, despite some QA/QC discrepancies, the data is suitable for inclusion into the baseline dataset for the sites. However, care will need to be taken when using the historical data for adit 4 (SW3) and Tui tailings discharge (SW11). If statistical analysis is used to compare the concentration of the contaminants of concern before and after remediation of the site has been completed then it may be prudent to run the statistical tests with and within the data from these sites to see if it could potentially influence the outcome of the tests (i.e. results in a Type I or Type II error).

### 4.4.2 Review of Remalia Sharplin data set

As part of her Thesis for Master of Science (Geology), Remalia Sharplin (RS) undertook up to four water quality monitoring rounds around the former Tui Mine site and tailing dam between 30 February 2007 and November 2007. Monitoring was undertaken at all of the same monitoring sites as the current study with the exception of SW11 (Tailing discharge into the Tui Stream), SW15 (Tailing dam discharge into Tunakohoia stream) and SW101 (Ruakaka Adits Tributary). All samples were analysed for dissolved oxygen, electrical conductivity, dissolved and acid soluble metals (As, Cd, Cu, Mn, Ni, Pb and Zn only), pH and sulphate. The data set was suitable for inclusion as part of the baseline because the data:

- Covers the same sampling sites and under a variety of flow conditions (high and low);
- Includes flow monitoring results for all sampling sites;
- Uses similar field QA/QC processes as undertaken in this study.

Although different analytical instrumentation and technique were used by RS, replicate analysis undertaken by Hills Laboratory, using the same methods used in this study, indicates that the results are comparable and can be used as part of the baseline dataset. The detection limits reported by RS are different to those reported by Hills laboratories, but they are roughly similar. The method detection limits (MDLs) reported by RS for arsenic, iron and manganese were slightly lower than Hills (0.4 ppb (As), 2.7 ppb (Fe) and 0.4 ppb (Mn) compared to Hills MDLs of 1.1 ppb (As), 21 ppb (Fe) and 0.53 ppb (Mn). Cadmium, copper, lead and zinc method detection limits are slightly higher for the

analytical methods that RS used compared to the Hills methodology (0.2 ppb (Cd), 0.8 ppb (Cu), 0.8 ppb (Pb) and 2.0 ppb (Zn) compared to Hills MDL of 0.053 ppb (Cd), 0.53 ppb (Cu), 0.1 ppb (Pb) and 1.1 ppb (Zn).

Comparison of RS data with the current study found that most of the data was comparable to the current study, with the exception that water quality data from SW11 was generally higher than the current study. This is because the sample was collected upstream of the sampling location for the current study. The two sampling sites do not appear to be comparable; therefore, the data has not been used in this study for assessing the baseline water quality of the site before remediation in undertaken. However, the data has still been included in Table G-5 in Appendix G.

Overall the data is suitable for inclusion into the baseline dataset for sites SW3, SW5, SW7 SW13 and SW100.

## 5.0 Baseline Concentrations of Key Parameters

The aim of this study is to provide Environment Waikato with the baseline concentrations of various parameters at nine water quality monitoring sites within the Tui and the Tunakohoia catchments. Table 6 provides a statistical summary of the baseline concentrations (including historical results) of key parameters. A full summary of all parameters is provided in Appendix H, together with a description of the data handling techniques used in assessing the data.

With the exception of the discharges from the tailings dams (SW11 and SW15), most of the monitoring sites have circum-neutral pH. All sites expect for south branch of the Tunakohoia stream (SW8) are elevated in cadmium, copper, lead and zinc. Of all the metals, zinc is the mostly highly elevated at all monitoring sites which received discharges from either the Tui mine adits or tailings dam. The monitoring sites further downstream of the mine adits and tailing dam discharges show a trend of decreasing metal concentrations with increasing distance away from the discharge point.

**Table 6: Statistical Summary of Baseline Concentrations of Various Contaminants**

| | | Units | SW3 | SW5 | SW7 | SW8 | SW11 | SW13 | SW15 | SW100 | SW101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | minimum | pH units | 6.6 | 6.5 | 6.0 | 6.8 | 3.2 | 6.5 | 5.2 | 6.4 | 7 |
| | mean | pH units | 7.0 | 7.1 | 6.8 | 7.2 | 3.5 | 6.7 | 5.6 | 7.0 | 7.2 |
| | median | pH units | 6.70 | 7.2 | 6.9 | 7.2 | 3.5 | 6.7 | 5.7 | 7.0 | 7.2 |
| | maximum | pH units | 7.8 | 7.3 | 7.4 | 7.7 | 3.9 | 7.1 | 5.9 | 7.6 | 7.5 |
| Alkalinity | minimum | (mg/L as $CaCO_3$) | 11 | 11 | - | - | - | - | - | 20 | 9.8 |
| | mean | (mg/L as $CaCO_3$) | 15 | 60 | - | - | - | - | - | 41 | 9.9 |
| | median | (mg/L as $CaCO_3$) | 15 | 64 | - | - | - | - | - | 52 | 10 |
| | maximum | (mg/L as $CaCO_3$) | 23 | 83 | - | - | - | - | - | 62 | 10 |
| Bicarbonate | minimum | (mg/L at 25°C) | 12 | 52 | - | - | - | - | - | 24 | 12 |
| | mean | (mg/L at 25°C) | 19 | 73 | - | - | - | - | - | 47 | 12 |
| | median | (mg/L at 25°C) | 19 | 79 | - | - | - | - | - | 52 | 12 |
| | maximum | (mg/L at 25°C) | 26 | 83 | - | - | - | - | - | 62 | 12 |
| Total Hardness | minimum | (mg/L as $CaCO_3$) | 23 | 220 | - | - | - | - | - | 24 | 19 |
| | mean | (mg/L as $CaCO_3$) | 31 | 270 | - | - | - | - | - | 47 | 27 |
| | median | (mg/L as $CaCO_3$) | 33 | 290 | - | - | - | - | - | 52 | 30 |
| | maximum | (mg/L as $CaCO_3$) | 36 | 300 | - | - | - | - | - | 59 | 33 |
| Electrical Conductivity | minimum | mS/m | 8.6 | 45.5 | 15.68 | 8.3 | 36.6 | 8.96 | 2.1 | 27.9 | 9.6 |
| | mean | mS/m | 11 | 58 | 73.7 | 9.7 | 129 | 14.3 | 9.4 | 42.7 | 11.3 |
| | median | mS/m | 11 | 56 | 37.8 | 9.7 | 58 | 14.6 | 7.9 | 41.1 | 11.6 |
| | maximum | mS/m | 14 | 69 | 276 | 10.9 | 562 | 19.4 | 18.1 | 62.2 | 12.7 |
| Calcium | minimum | $g/m^3$ | 5.71 | 61.5 | - | - | - | - | - | 27.0 | 4.8 |
| | mean | $g/m^3$ | 8.7 | 80.6 | - | - | - | - | - | 50.7 | 7.033 |
| | median | $g/m^3$ | 8.7 | 81.8 | - | - | - | - | - | 60.0 | 7.6 |
| | maximum | $g/m^3$ | 11.9 | 91 | - | - | - | - | - | 65 | 8.7 |
| Magnesium | minimum | $g/m^3$ | 1.42 | 11.9 | - | - | - | - | - | 6.5 | 2.1 |
| | mean | $g/m^3$ | 1.88 | 15.3 | - | - | - | - | - | 11.2 | 2.6 |
| | median | $g/m^3$ | 1.9 | 15.5 | - | - | - | - | - | 13 | 2.7 |
| | maximum | $g/m^3$ | 2.3 | 18 | - | - | - | - | - | 14 | 3 |
| Sulphate | minimum | $g/m^3$ | 12 | 210 | - | - | - | - | - | 110 | 16 |
| | mean | $g/m^3$ | 19.3 | 267 | - | - | - | - | - | 184 | 26 |
| | median | $g/m^3$ | 17.6 | 276 | - | - | - | - | - | 183 | 30 |
| | maximum | $g/m^3$ | 28 | 292 | - | - | - | - | - | 252 | 32 |

**Table 6 (continued): Statistical Summary of Baseline Concentrations of Various Contaminants**

| | | Units | SW3 | SW5 | SW7 | SW8 | SW11 | SW13 | SW15 | SW100 | SW101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| dissolved Arsenic | minimum | $g/m^3$ | <0.0011 | 0.0008 | 0.000676 | <0.0011 | <0.0011 | <0.0011 | 0.0022 | <0.0011 | <0.0011 |
| | mean | $g/m^3$ | - | 0.00127 | - | - | 0.0103 | - | 0.00903 | - | - |
| | median | $g/m^3$ | <0.0011 | 0.001 | <0.0011 | <0.0011 | 0.00868 | <0.0011 | 0.0039 | <0.0011 | <0.0011 |
| | maximum | $g/m^3$ | <0.0011 | 0.00265 | - | <0.0011 | 0.026 | 0.013 | 0.021 | 0.0005 | <0.0011 |
| Arsenic | minimum | $g/m^3$ | <0.0011 | 0.003 | <0.0011 | <0.0011 | 0.002 | 0.0006 | 0.003 | <0.0021 | <0.0011 |
| | mean | $g/m^3$ | - | 0.0046 | - | - | 0.0148 | 0.00526 | 0.0105 | 0.0026 | - |
| | median | $g/m^3$ | <0.0011 | 0.0049 | <0.0011 | <0.0011 | 0.0141 | 0.002 | 0.0039 | 0.0021 | <0.0011 |
| | maximum | $g/m^3$ | <0.0011 | 0.006 | 0.00464 | <0.0011 | 0.033 | 0.0132 | 0.024 | 0.006 | <0.0011 |
| dissolved Cadmium | minimum | $g/m^3$ | 0.0016 | 0.033 | 0.027 | <0.00053 | 0.0179 | 0.001 | 0.0179 | 0.059 | 0.014 |
| | mean | $g/m^3$ | 0.00403 | 0.126 | 0.0452 | - | 0.0652 | 0.00415 | 0.0131 | 0.0885 | 0.015 |
| | median | $g/m^3$ | 0.0036 | 0.12 | 0.0461 | <0.00053 | 0.056 | 0.00432 | 0.012 | 0.088 | 0.015 |
| | maximum | $g/m^3$ | 0.0103 | 0.19 | 0.0639 | <0.00053 | 0.14 | 0.0059 | 0.018 | 0.122 | 0.016 |
| Cadmium | minimum | $g/m^3$ | 0.0015 | 0.108 | 0.027 | <0.00053 | 0.0175 | 0.002 | 0.0093 | 0.059 | 0.014 |
| | mean | $g/m^3$ | 0.0043 | 0.142 | 0.0437 | - | 0.0679 | 0.00415 | 0.0124 | 0.0947 | 0.0157 |
| | median | $g/m^3$ | 0.004 | 0.14 | 0.0461 | <0.00053 | 0.0668 | 0.00432 | 0.01 | 0.099 | 0.016 |
| | maximum | $g/m^3$ | 0.0106 | 0.21 | 0.0614 | <0.00053 | 0.14 | 0.0059 | 0.018 | 0.121 | 0.017 |
| dissolved Copper | minimum | $g/m^3$ | 0.00089 | 0.005 | 0.0015 | <0.00053 | 0.12 | 0.001 | 0.029 | 0.00199 | 0.0046 |
| | mean | $g/m^3$ | 0.003 | 0.0139 | 0.0109 | 0.000738 | 0.524 | 0.0057 | 0.079 | 0.0118 | 0.00587 |
| | median | $g/m^3$ | 0.002 | 0.0093 | 0.00975 | 0.000715 | 0.373 | 0.0067 | 0.038 | 0.009 | 0.0057 |
| | maximum | $g/m^3$ | 0.0059 | 0.043 | 0.021 | 0.0011 | 1.7 | 0.00845 | 0.17 | 0.033 | 0.0073 |
| Copper | minimum | $g/m^3$ | <0.021 | 0.099 | 0.0176 | <0.00053 | 0.134 | 0.006 | 0.028 | 0.006 | 0.0051 |
| | mean | $g/m^3$ | 0.011 | 0.237 | 0.04 | 0.000743 | 0.653 | 0.0263 | 0.079 | 0.12 | 0.00603 |
| | median | $g/m^3$ | 0.0115 | 0.2 | 0.041 | 0.00065 | 0.432 | 0.0187 | 0.039 | 0.12 | 0.0057 |
| | maximum | $g/m^3$ | 0.038 | 0.49 | 0.0651 | 0.0012 | 1.6 | 0.0987 | 0.17 | 0.198 | 0.0073 |
| dissolved Iron | minimum | $g/m^3$ | <0.021 | 0.0032 | <0.021 | <0.00005 | 1 | 0.009 | 0.12 | 0.00617 | <0.21 |
| | mean | $g/m^3$ | 0.0107 | 0.0502 | - | 0.015 | 11.408 | - | 0.48 | 0.259 | - |
| | median | $g/m^3$ | <0.021 | 0.01 | <0.021 | 0.02 | 2.743 | <0.021 | 0.22 | 0.0215 | <0.021 |
| | maximum | $g/m^3$ | 0.016 | 0.457 | 0.16 | 0.029 | 30.6 | 0.06 | 1.1 | 0.987 | <0.021 |
| Iron | minimum | $g/m^3$ | <0.021 | 2.46 | 0.11 | <0.00005 | 1.67 | 0.01 | 0.12 | 1.04 | <0.21 |
| | mean | $g/m^3$ | 0.29 | 3.719 | 0.416 | 0.0432 | 15.131 | 0.535 | 0.483 | 1.982 | |
| | median | $g/m^3$ | 0.07 | 3.7 | 0.41 | 0.044 | 11.365 | 0.164 | 0.23 | 1.7 | <0.021 |
| | maximum | $g/m^3$ | 1.27 | 4.85 | 0.841 | 0.06 | 35.3 | 3.686 | 1.1 | 3.73 | <0.021 |

**Table 6 (continued): Statistical Summary of Baseline Concentrations of Various Contaminants**

| | | Units | SW3 | SW5 | SW7 | SW8 | SW11 | SW13 | SW15 | SW100 | SW101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| dissolved Lead | minimum | g/m$^3$ | <0.0005 | <0.0005 | 0.00249 | <0.0001 | <0.05 | 0.00093 | 0.065 | 0.001 | 0.16 |
| | mean | g/m$^3$ | 0.0008 | 0.000871 | 0.00708 | 0.000326 | 0.383 | 0.0022 | 0.131 | 0.00498 | 0.19 |
| | median | g/m$^3$ | 0.0008 | 0.00077 | 0.0057 | <0.0001 | 0.328 | 0.0023 | 0.089 | 0.005 | 0.2 |
| | maximum | g/m$^3$ | 0.0013 | 0.0028 | 0.014 | 0.0011 | 0.89 | 0.0038 | 0.24 | 0.01 | 0.21 |
| Lead | minimum | g/m$^3$ | 0.0008 | 0.03 | 0.01 | <0.0001 | 0.018 | 0.0011 | 0.067 | 0.012 | 0.17 |
| | mean | g/m$^3$ | 0.0117 | 0.076 | 0.0403 | 0.000612 | 0.481 | 0.0365 | 0.129 | 0.0722 | 0.21 |
| | median | g/m$^3$ | 0.0037 | 0.077 | 0.033 | 0.00033 | 0.328 | 0.019 | 0.079 | 0.062 | 0.23 |
| | maximum | g/m$^3$ | 0.0697 | 0.15 | 0.1 | 0.0021 | 0.91 | 0.217 | 0.24 | 0.174 | 0.23 |
| dissolved Nickel | minimum | g/m$^3$ | <0.00053 | 0.0186 | 0.005 | <0.00053 | 0.0176 | 0.000265 | 0.0022 | 0.0091 | 0.0011 |
| | mean | g/m$^3$ | - | 0.0221 | 0.0089 | - | 0.0468 | 0.00337 | 0.0026 | 0.0154 | 0.00123 |
| | median | g/m$^3$ | <0.00053 | 0.0223 | 0.0094 | <0.00053 | 0.0478 | 0.004 | 0.0024 | 0.017 | 0.0012 |
| | maximum | g/m$^3$ | <0.00053 | 0.025 | 0.0123 | <0.00053 | 0.066 | 0.0045 | 0.0032 | 0.019 | 0.0014 |
| Nickel | minimum | g/m$^3$ | <0.00053 | 0.0195 | 0.005 | <0.00053 | 0.0178 | 0.000265 | - | 0.0091 | 0.0011 |
| | mean | g/m$^3$ | - | 0.0222 | 0.00944 | - | 0.0468 | <0.0011 | - | 0.0147 | 0.00127 |
| | median | g/m$^3$ | <0.00053 | 0.0217 | 0.01 | <0.00053 | 0.0473 | 0.0039 | - | 0.016 | 0.0012 |
| | maximum | g/m$^3$ | <0.00053 | 0.025 | 0.0126 | 0.0009 | 0.065 | 0.0047 | - | 0.019 | 0.0015 |
| dissolved Zinc | minimum | g/m$^3$ | 0.18 | 14.6 | 3.9 | 0.0015 | 2.64 | 0.43 | 1.6 | 9.35 | 1.6 |
| | mean | g/m$^3$ | 0.5 | 19.373 | 6.079 | 0.008 | 12.323 | 0.774 | 2.067 | 12.073 | 1.7 |
| | median | g/m$^3$ | 0.41 | 16.175 | 6.377 | 0.0055 | 14.1 | 0.76 | 1.8 | 10.7 | 1.7 |
| | maximum | g/m$^3$ | 1.08 | 27 | 7.79 | 0.017 | 25 | 1.34 | 2.8 | 15.2 | 1.8 |
| Zinc | minimum | g/m$^3$ | 0.18 | 16.8 | 4.1 | 0.001 | 2.2 | 0.42 | 1.6 | 9.97 | 1.6 |
| | mean | g/m$^3$ | 0.5 | 21.607 | 6.304 | 0.00328 | 13.171 | 0.769 | 2.033 | 13.546 | 1.67 |
| | median | g/m$^3$ | 0.39 | 20 | 6.314 | 0.0022 | 14.1 | 0.812 | 1.7 | 11.625 | 1.7 |
| | maximum | g/m$^3$ | 1.2 | 30 | 8.04 | 0.01 | 25 | 1.18 | 2.8 | 16.9 | 1.7 |

## 6.0 References

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Smith, C. D. (1995) Hydraulic Structures. University of Saskatchewan.

URS (2002) Tui Mine Remedial Options Investigations. Prepared for Environment Waikato 21 May 2002. URS New Zealand Limited.

# Appendix A

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 728224 | SPv2 |
| **Contact:** | A Rumsby | **Date Registered:** | 18-Sep-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 19-Oct-2009 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | AO 2277600 | |
| | | **Submitted By:** | R Sharplin | |

## Amended Report

This report replaces an earlier report issued on the 29 Sep 2009 at 1:37 pm

Following a number of queries by the client, the cyanide results for 728224.9 and 22, the sodium results for samples 728224.19 and 20, the tin results for 728224.9 and 10, and the zinc results for 728224.7 and 8 were re-analysed and found to confirm those originally reported (within the analytical variation). However the re-extracted results have been used for QA/QC purposes.

**Sample Type: Aqueous**

| Sample Name: | | SW3 17-Sep-2009 | SW3B 17-Sep-2009 | SW5 17-Sep-2009 | SW5B 17-Sep-2009 | SW7 17-Sep-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 728224.1 | 728224.2 | 728224.3 | 728224.4 | 728224.5 |
| Individual Tests | | | | | | |
| pH | pH Units | - | - | - | - | 7.3 |
| Electrical Conductivity (EC) | mS/m | - | - | - | - | 36.7 |
| Total Suspended Solids | g/m³ | < 3.0 | - | 14 | - | < 3.0 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 13 | - | 17 | - | - |
| Silicon | g/m³ | 6.1 | - | 7.8 | - | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.0072 | < 0.0032 | 0.26 | 0.0046 | 0.38 |
| Total Antimony | g/m³ | < 0.00021 | < 0.00021 | 0.0010 | 0.00063 | 0.00027 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | 0.0052 | < 0.0021 | < 0.0011 |
| Total Barium | g/m³ | 0.0071 | 0.0068 | 0.024 | 0.024 | 0.024 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.011 | 0.012 | 0.023 | 0.024 | 0.016 |
| Total Cadmium | g/m³ | 0.0038 | 0.0036 | 0.15 | 0.13 | 0.048 |
| Total Calcium | g/m³ | 9.7 | 9.8 | 85 | 86 | 37 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.0029 | 0.0019 | 0.20 | 0.0085 | 0.041 |
| Total Iron | g/m³ | < 0.021 | < 0.021 | 4.7 | < 0.021 | 0.41 |
| Total Lead | g/m³ | 0.0013 | 0.00058 | 0.072 | 0.00025 | 0.033 |
| Total Lithium | g/m³ | 0.0021 | 0.0020 | 0.019 | 0.020 | 0.0097 |
| Total Magnesium | g/m³ | 2.3 | 2.3 | 18 | 18 | 11 |
| Total Manganese | g/m³ | 0.0024 | 0.0024 | 1.8 | 1.9 | 0.57 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | 0.00059 | 0.00058 | < 0.00021 |
| Total Nickel | g/m³ | < 0.00053 | < 0.00053 | 0.025 | 0.025 | 0.011 |
| Total Potassium | g/m³ | 0.47 | 0.46 | 1.1 | 1.1 | 1.0 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0021 | < 0.0021 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 7.2 | 7.2 | 13 | 13 | 11 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 0.39 | 0.41 | 22 | 20 | 7.0 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW3<br>17-Sep-2009 | SW3B<br>17-Sep-2009 | SW5<br>17-Sep-2009 | SW5B<br>17-Sep-2009 | SW7<br>17-Sep-2009 |
| **Lab Number:** | | 728224.1 | 728224.2 | 728224.3 | 728224.4 | 728224.5 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | 1.1 | - | 7.4 | - | - |
| Sum of Cations | meq/L | 1.1 | - | 6.5 | - | - |
| pH | pH Units | 6.7 | - | 7.2 | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 17 | - | 68 | - | - |
| Bicarbonate | g/m³ at 25°C | 21 | - | 83 | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 36 | - | 290 | - | - |
| Electrical Conductivity (EC) | mS/m | 11.7 | - | 65.7 | - | - |
| Dissolved Calcium | g/m³ | 10 | - | 88 | - | - |
| Dissolved Magnesium | g/m³ | 2.4 | - | 18 | - | - |
| Dissolved Potassium | g/m³ | 0.51 | - | 1.3 | - | - |
| Dissolved Sodium | g/m³ | 7.9 | - | 15 | - | - |
| Chloride | g/m³ | 10 | - | 10 | - | - |
| Nitrite-N | g/m³ | < 0.0020 | - | < 0.0020 | - | - |
| Nitrate-N | g/m³ | 0.14 | - | 0.024 | - | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.14 | - | 0.025 | - | - |
| Sulphate | g/m³ | 20 | - | 270 | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW7B<br>17-Sep-2009 | SW8<br>17-Sep-2009 | SW8B<br>17-Sep-2009 | SW11<br>17-Sep-2009 | SW11B<br>17-Sep-2009 |
| **Lab Number:** | | 728224.6 | 728224.7 | 728224.8 | 728224.9 | 728224.10 |
| Individual Tests | | | | | | |
| pH | pH Units | - | 7.7 | - | 3.2 | - |
| Electrical Conductivity (EC) | mS/m | - | 10.4 | - | 72.2 | - |
| Total Suspended Solids | g/m³ | - | < 3.0 | - | 24 | - |
| Total Cyanide | g/m³ | - | - | - | 0.0022 | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.16 | 0.030 | 0.016 | 10 | 10 |
| Total Antimony | g/m³ | 0.00022 | < 0.00021 | < 0.00021 | 0.00055 | 0.00044 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | 0.023 | 0.018 |
| Total Barium | g/m³ | 0.024 | 0.0063 | 0.0061 | 0.031 | 0.030 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | 0.00058 | 0.00062 |
| Total Boron | g/m³ | 0.015 | 0.0099 | 0.0094 | 0.011 | 0.012 |
| Total Cadmium | g/m³ | 0.046 | < 0.000053 | < 0.000053 | 0.11 | 0.11 |
| Total Calcium | g/m³ | 36 | 6.9 | 6.6 | 25 | 26 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | 0.0027 | 0.0028 |
| Total Copper | g/m³ | 0.021 | < 0.00053 | < 0.00053 | 1.0 | 0.96 |
| Total Iron | g/m³ | 0.16 | 0.025 | < 0.021 | 22 | 20 |
| Total Lead | g/m³ | 0.014 | < 0.00011 | < 0.00011 | 0.77 | 0.71 |
| Total Lithium | g/m³ | 0.0095 | 0.00059 | 0.00051 | 0.016 | 0.017 |
| Total Magnesium | g/m³ | 11 | 2.7 | 2.6 | 13 | 13 |
| Total Manganese | g/m³ | 0.55 | 0.0014 | < 0.00053 | 5.5 | 5.4 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | 0.011 | < 0.00053 | < 0.00053 | 0.054 | 0.054 |
| Total Potassium | g/m³ | 0.99 | 0.53 | 0.51 | 1.4 | 1.4 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | 0.0022 | 0.0022 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 11 | 8.1 | 7.9 | 9.0 | 9.3 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | 0.00020 | 0.00018 |
| Total Zinc | g/m³ | 6.6 | 0.0013 | 0.0017 | 19 | 19 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW13<br>17-Sep-2009 | SW13B<br>17-Sep-2009 | SW15<br>18-Sep-2009 | SW15B<br>18-Sep-2009 | SW100<br>17-Sep-2009 |
| **Lab Number:** | | 728224.11 | 728224.12 | 728224.13 | 728224.14 | 728224.15 |
| Individual Tests | | | | | | |
| pH | pH Units | 6.6 | - | 6.3 | - | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW13<br>17-Sep-2009 | SW13B<br>17-Sep-2009 | SW15<br>18-Sep-2009 | SW15B<br>18-Sep-2009 | SW100<br>17-Sep-2009 |
| **Lab Number:** | | 728224.11 | 728224.12 | 728224.13 | 728224.14 | 728224.15 |
| Individual Tests | | | | | | |
| Electrical Conductivity (EC) | mS/m | 16.1 | - | 22.1 | - | - |
| Total Suspended Solids | g/m³ | < 3.0 | - | < 3.0 | - | 10 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | - | - | - | - | 16 |
| Total Cyanide | g/m³ | < 0.0010 | - | < 0.0010 | - | - |
| Silicon | g/m³ | - | - | - | - | 7.3 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.49 | 0.067 | 0.032 | 0.030 | 0.15 |
| Total Antimony | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | 0.00096 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | 0.0046 | 0.0039 | 0.0028 |
| Total Barium | g/m³ | 0.0098 | 0.0092 | 0.021 | 0.020 | 0.026 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.011 | 0.012 | 0.013 | 0.013 | 0.021 |
| Total Cadmium | g/m³ | 0.0048 | 0.0045 | 0.0093 | 0.0094 | 0.11 |
| Total Calcium | g/m³ | 11 | 11 | 17 | 17 | 65 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.027 | 0.0081 | 0.039 | 0.038 | 0.12 |
| Total Iron | g/m³ | 0.21 | < 0.021 | 0.23 | 0.22 | 2.4 |
| Total Lead | g/m³ | 0.026 | 0.0038 | 0.067 | 0.065 | 0.054 |
| Total Lithium | g/m³ | 0.0032 | 0.0031 | 0.0057 | 0.0057 | 0.016 |
| Total Magnesium | g/m³ | 4.7 | 4.7 | 6.7 | 6.6 | 15 |
| Total Manganese | g/m³ | 0.22 | 0.21 | 0.020 | 0.020 | 1.2 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | 0.00033 |
| Total Nickel | g/m³ | 0.0042 | 0.0041 | 0.0022 | 0.0022 | 0.019 |
| Total Potassium | g/m³ | 0.81 | 0.78 | 0.97 | 0.98 | 1.0 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 9.5 | 9.5 | 11 | 10 | 12 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 0.85 | 0.78 | 1.6 | 1.6 | 15 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | - | - | - | - | 5.8 |
| Sum of Cations | meq/L | - | - | - | - | 4.9 |
| pH | pH Units | - | - | - | - | 7.2 |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | - | - | 49 |
| Bicarbonate | g/m³ at 25°C | - | - | - | - | 59 |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | - | - | 220 |
| Electrical Conductivity (EC) | mS/m | - | - | - | - | 52.6 |
| Dissolved Calcium | g/m³ | - | - | - | - | 64 |
| Dissolved Magnesium | g/m³ | - | - | - | - | 13 |
| Dissolved Potassium | g/m³ | - | - | - | - | 1.1 |
| Dissolved Sodium | g/m³ | - | - | - | - | 13 |
| Chloride | g/m³ | - | - | - | - | 11 |
| Nitrite-N | g/m³ | - | - | - | - | 0.0040 |
| Nitrate-N | g/m³ | - | - | - | - | 0.049 |
| Nitrate-N + Nitrite-N | g/m³ | - | - | - | - | 0.053 |
| Sulphate | g/m³ | - | - | - | - | 220 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW100B<br>17-Sep-2009 | SW101<br>17-Sep-2009 | SW101B<br>17-Sep-2009 | SW23<br>17-Sep-2009 | SW23B<br>17-Sep-2009 |
| **Lab Number:** | | 728224.16 | 728224.17 | 728224.18 | 728224.19 | 728224.20 |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | - | < 3.0 | - | - | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | - | 14 | - | - | - |
| Silicon | g/m³ | - | 6.6 | - | - | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW100B 17-Sep-2009 | SW101 17-Sep-2009 | SW101B 17-Sep-2009 | SW23 17-Sep-2009 | SW23B 17-Sep-2009 |
| **Lab Number:** | | 728224.16 | 728224.17 | 728224.18 | 728224.19 | 728224.20 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | < 0.0032 | 0.013 | 0.0053 | 0.49 | 0.056 |
| Total Antimony | g/m³ | 0.00068 | 0.00051 | 0.00046 | < 0.00021 | < 0.00021 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Barium | g/m³ | 0.025 | 0.019 | 0.018 | 0.011 | 0.0099 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.018 | 0.012 | 0.012 | 0.011 | 0.012 |
| Total Cadmium | g/m³ | 0.098 | 0.016 | 0.015 | 0.0047 | 0.0045 |
| Total Calcium | g/m³ | 62 | 8.2 | 8.0 | 11 | 11 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.0076 | 0.0051 | 0.0046 | 0.026 | 0.0078 |
| Total Iron | g/m³ | < 0.021 | < 0.021 | < 0.021 | 0.23 | < 0.021 |
| Total Lead | g/m³ | 0.0042 | 0.23 | 0.20 | 0.023 | 0.0030 |
| Total Lithium | g/m³ | 0.014 | 0.0023 | 0.0022 | 0.0032 | 0.0030 |
| Total Magnesium | g/m³ | 13 | 3.1 | 3.0 | 4.7 | 4.8 |
| Total Manganese | g/m³ | 1.1 | 0.0021 | 0.0018 | 0.22 | 0.22 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | 0.00033 | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | 0.020 | 0.0015 | 0.0014 | 0.0041 | 0.0038 |
| Total Potassium | g/m³ | 0.92 | 0.70 | 0.68 | 0.79 | 0.80 |
| Total Selenium | g/m³ | < 0.0021 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 12 | 8.2 | 8.0 | 10 | 10 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 13 | 1.7 | 1.7 | 0.84 | 0.78 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | - | 1.2 | - | - | - |
| Sum of Cations | meq/L | - | 1.0 | - | - | - |
| pH | pH Units | - | 7.2 | - | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | 10 | - | - | - |
| Bicarbonate | g/m³ at 25°C | - | 12 | - | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | - | 33 | - | - | - |
| Electrical Conductivity (EC) | mS/m | - | 12.7 | - | - | - |
| Dissolved Calcium | g/m³ | - | 8.7 | - | - | - |
| Dissolved Magnesium | g/m³ | - | 2.7 | - | - | - |
| Dissolved Potassium | g/m³ | - | 0.73 | - | - | - |
| Dissolved Sodium | g/m³ | - | 8.5 | - | - | - |
| Chloride | g/m³ | - | 12 | - | - | - |
| Nitrite-N | g/m³ | - | < 0.0020 | - | - | - |
| Nitrate-N | g/m³ | - | 0.16 | - | - | - |
| Nitrate-N + Nitrite-N | g/m³ | - | 0.16 | - | - | - |
| Sulphate | g/m³ | - | 30 | - | - | - |

| **Sample Name:** | | SW120 17-Sep-2009 | SW21 17-Sep-2009 | SW50B 18-Sep-2009 | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 728224.21 | 728224.22 | 728224.23 | | |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | 10 | - | - | - | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 16 | - | - | - | - |
| Total Cyanide | g/m³ | - | 0.0022 | - | - | - |
| Silicon | g/m³ | 7.6 | - | - | - | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | - | - | < 0.0032 | - | - |
| Total Antimony | g/m³ | - | - | < 0.00021 | - | - |
| Total Arsenic | g/m³ | - | - | < 0.0011 | - | - |
| Total Barium | g/m³ | - | - | < 0.00021 | - | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW120<br>17-Sep-2009 | SW21<br>17-Sep-2009 | SW50B<br>18-Sep-2009 | | |
| **Lab Number:** | | 728224.21 | 728224.22 | 728224.23 | | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Beryllium | g/m³ | - | - | < 0.00011 | - | - |
| Total Boron | g/m³ | - | - | < 0.0053 | - | - |
| Total Cadmium | g/m³ | - | - | < 0.000053 | - | - |
| Total Calcium | g/m³ | - | - | < 0.053 | - | - |
| Total Chromium | g/m³ | - | - | < 0.00053 | - | - |
| Total Copper | g/m³ | - | - | < 0.00053 | - | - |
| Total Iron | g/m³ | - | - | < 0.021 | - | - |
| Total Lead | g/m³ | - | - | < 0.00011 | - | - |
| Total Lithium | g/m³ | - | - | < 0.00042 | - | - |
| Total Magnesium | g/m³ | - | - | < 0.021 | - | - |
| Total Manganese | g/m³ | - | - | < 0.00053 | - | - |
| Total Mercury | g/m³ | - | - | < 0.000080 | - | - |
| Total Molybdenum | g/m³ | - | - | < 0.00021 | - | - |
| Total Nickel | g/m³ | - | - | < 0.00053 | - | - |
| Total Potassium | g/m³ | - | - | < 0.053 | - | - |
| Total Selenium | g/m³ | - | - | < 0.0011 | - | - |
| Total Silver | g/m³ | - | - | < 0.00011 | - | - |
| Total Sodium | g/m³ | - | - | < 0.021 | - | - |
| Total Tin | g/m³ | - | - | < 0.00053 | - | - |
| Total Uranium | g/m³ | - | - | < 0.000021 | - | - |
| Total Zinc | g/m³ | - | - | 0.0019 | - | - |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | 5.8 | - | - | - | - |
| Sum of Cations | meq/L | 4.9 | - | - | - | - |
| pH | pH Units | 7.4 | - | - | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 48 | - | - | - | - |
| Bicarbonate | g/m³ at 25°C | 59 | - | - | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 220 | - | - | - | - |
| Electrical Conductivity (EC) | mS/m | 52.7 | - | - | - | - |
| Dissolved Calcium | g/m³ | 65 | - | - | - | - |
| Dissolved Magnesium | g/m³ | 14 | - | - | - | - |
| Dissolved Potassium | g/m³ | 1.0 | - | - | - | - |
| Dissolved Sodium | g/m³ | 13 | - | - | - | - |
| Chloride | g/m³ | 10 | - | - | - | - |
| Nitrite-N | g/m³ | 0.0035 | - | - | - | - |
| Nitrate-N | g/m³ | 0.048 | - | - | - | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.051 | - | - | - | - |
| Sulphate | g/m³ | 220 | - | - | - | - |

# 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: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1, 3, 15, 17, 21 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-20, 23 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-20, 23 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 9, 11, 13, 22 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1, 3, 15, 17, 21 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1, 3, 15, 17, 21 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1, 3, 15, 17, 21 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1, 3, 15, 17, 21 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1, 3, 15, 17, 21 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 g/m³ | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1, 3, 15, 17, 21 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1, 3, 15, 17, 21 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1, 3, 15, 17, 21 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1, 3, 15, 17, 21 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 g/m³ as $SiO_2$ | 1, 3, 15, 17, 21 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1, 3, 15, 17, 21 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 g/m³ | 9, 11, 13, 22 |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 g/m³ | 1, 3, 15, 17, 21 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 g/m³ | 1, 3, 15, 17, 21 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1, 3, 15, 17, 21 |
| Anion / Cation profile, dissolved metals trace level | | - | 1, 3, 15, 17, 21 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-20, 23 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-20, 23 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-20, 23 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-20, 23 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-20, 23 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-20, 23 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-20, 23 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-20, 23 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-20, 23 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-20, 23 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-20, 23 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-20, 23 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |

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

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

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 728224 | SUPv1 |
| **Contact:** | A Rumsby | **Date Registered:** | 18-Sep-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 19-Oct-2009 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | AO 2277600 | |
| | | **Submitted By:** | R Sharplin | |

**Sample Type: Aqueous**

| Sample Name: | | SW3 17-Sep-2009 | SW3B 17-Sep-2009 | SW5 17-Sep-2009 | SW5B 17-Sep-2009 |
|---|---|---|---|---|---|
| **Lab Number:** | | 728224.1 | 728224.2 | 728224.3 | 728224.4 |
| Individual Tests | | | | | |
| Total Suspended Solids | g/m³ | < 3 ± 2.1 | - | 14.4 ± 2.8 | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 13.11 ± 0.79 | - | 16.7 ± 1.1 | - |
| Silicon | g/m³ | 6.13 ± 0.37 | - | 7.82 ± 0.47 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0072 ± 0.0024 | < 0.004 ± 0.0022 | 0.262 ± 0.041 | 0.0046 ± 0.0022 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 | 0.00101 ± 0.00077 | 0.00063 ± 0.00049 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | 0.0052 ± 0.0012 | < 0.003 ± 0.00080 |
| Total Barium | g/m³ | 0.00711 ± 0.00049 | 0.00677 ± 0.00047 | 0.0243 ± 0.0017 | 0.0239 ± 0.0016 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0115 ± 0.0039 | 0.0122 ± 0.0039 | 0.0228 ± 0.0047 | 0.0242 ± 0.0049 |
| Total Cadmium | g/m³ | 0.00377 ± 0.00041 | 0.00356 ± 0.00039 | 0.146 ± 0.016 | 0.132 ± 0.015 |
| Total Calcium | g/m³ | 9.69 ± 0.51 | 9.75 ± 0.51 | 84.8 ± 4.5 | 86.0 ± 4.5 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.00287 ± 0.00047 | 0.00186 ± 0.00041 | 0.204 ± 0.022 | 0.00852 ± 0.00098 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | < 0.03 ± 0.014 | 4.67 ± 0.58 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.00130 ± 0.00016 | 0.000576 ± 0.000094 | 0.0723 ± 0.0075 | 0.000253 ± 0.000078 |
| Total Lithium | g/m³ | 0.00209 ± 0.00034 | 0.00203 ± 0.00034 | 0.0194 ± 0.0018 | 0.0204 ± 0.0019 |
| Total Magnesium | g/m³ | 2.27 ± 0.27 | 2.29 ± 0.27 | 17.6 ± 2.1 | 18.3 ± 2.2 |
| Total Manganese | g/m³ | 0.00235 ± 0.00043 | 0.00238 ± 0.00043 | 1.85 ± 0.19 | 1.86 ± 0.19 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00059 ± 0.00017 | 0.00058 ± 0.00017 |
| Total Nickel | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | 0.0252 ± 0.0047 | 0.0249 ± 0.0046 |
| Total Potassium | g/m³ | 0.468 ± 0.049 | 0.461 ± 0.049 | 1.144 ± 0.090 | 1.122 ± 0.088 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.003 ± 0.0011 | < 0.003 ± 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 7.21 ± 0.51 | 7.18 ± 0.50 | 13.32 ± 0.93 | 13.40 ± 0.93 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 0.391 ± 0.031 | 0.414 ± 0.032 | 21.9 ± 1.7 | 19.8 ± 1.6 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | 1.1 | - | 7.4 | - |
| Sum of Cations | meq/L | 1.1 | - | 6.5 | - |
| pH | pH Units | 6.7 ± 0.2 | - | 7.2 ± 0.2 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 17.2 ± 1.3 | - | 68.4 ± 4.4 | - |
| Bicarbonate | g/m³ at 25°C | 21.0 ± 1.9 | - | 83.3 ± 6.4 | - |
| Total Hardness | g/m³ as $CaCO_3$ | 35.5 ± 1.8 | - | 294 ± 15 | - |
| Electrical Conductivity (EC) | mS/m | 11.7 ± 0.1 | - | 65.7 ± 0.5 | - |
| Dissolved Calcium | g/m³ | 10.31 ± 0.65 | - | 88.3 ± 5.6 | - |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW3 17-Sep-2009 | SW3B 17-Sep-2009 | SW5 17-Sep-2009 | SW5B 17-Sep-2009 |
| **Lab Number:** | | 728224.1 | 728224.2 | 728224.3 | 728224.4 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Dissolved Magnesium | g/m³ | 2.38 ± 0.17 | - | 17.8 ± 1.2 | - |
| Dissolved Potassium | g/m³ | 0.508 ± 0.050 | - | 1.252 ± 0.097 | - |
| Dissolved Sodium | g/m³ | 7.85 ± 0.85 | - | 14.7 ± 1.6 | - |
| Chloride | g/m³ | 10.42 ± 0.85 | - | 10.43 ± 0.85 | - |
| Nitrite-N | g/m³ | < 0.002 ± 0.0014 | - | < 0.002 ± 0.0014 | - |
| Nitrate-N | g/m³ | 0.139 ± 0.015 | - | 0.0243 ± 0.0032 | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.141 ± 0.015 | - | 0.0252 ± 0.0029 | - |
| Sulphate | g/m³ | 20.1 ± 1.4 | - | 273 ± 19 | - |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW7 17-Sep-2009 | SW7B 17-Sep-2009 | SW8 17-Sep-2009 | SW8B 17-Sep-2009 |
| **Lab Number:** | | 728224.5 | 728224.6 | 728224.7 | 728224.8 |
| Individual Tests | | | | | |
| pH | pH Units | 7.3 ± 0.2 | - | 7.7 ± 0.2 | - |
| Electrical Conductivity (EC) | mS/m | 36.7 ± 0.3 | - | 10.4 ± 0.1 | - |
| Total Suspended Solids | g/m³ | < 3 ± 2.1 | - | < 3 ± 2.1 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.377 ± 0.059 | 0.160 ± 0.025 | 0.0304 ± 0.0052 | 0.0158 ± 0.0033 |
| Total Antimony | g/m³ | 0.00027 ± 0.00022 | 0.00022 ± 0.00018 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.0239 ± 0.0016 | 0.0241 ± 0.0016 | 0.00630 ± 0.00044 | 0.00611 ± 0.00043 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0161 ± 0.0042 | 0.0150 ± 0.0041 | 0.0099 ± 0.0038 | 0.0094 ± 0.0037 |
| Total Cadmium | g/m³ | 0.0483 ± 0.0053 | 0.0461 ± 0.0050 | < 0.00006 ± 0.000036 | < 0.00006 ± 0.000036 |
| Total Calcium | g/m³ | 37.2 ± 2.0 | 35.7 ± 1.9 | 6.93 ± 0.37 | 6.59 ± 0.35 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.0415 ± 0.0045 | 0.0213 ± 0.0024 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Iron | g/m³ | 0.406 ± 0.052 | 0.164 ± 0.025 | 0.025 ± 0.015 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.0328 ± 0.0034 | 0.0140 ± 0.0015 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Lithium | g/m³ | 0.00973 ± 0.00092 | 0.00951 ± 0.00090 | 0.00059 ± 0.00029 | 0.00051 ± 0.00029 |
| Total Magnesium | g/m³ | 11.5 ± 1.4 | 11.1 ± 1.3 | 2.67 ± 0.32 | 2.58 ± 0.30 |
| Total Manganese | g/m³ | 0.570 ± 0.058 | 0.550 ± 0.056 | 0.00138 ± 0.00038 | < 0.0006 ± 0.00036 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 |
| Total Nickel | g/m³ | 0.0109 ± 0.0021 | 0.0107 ± 0.0020 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Potassium | g/m³ | 1.021 ± 0.082 | 0.990 ± 0.080 | 0.526 ± 0.052 | 0.512 ± 0.051 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 11.03 ± 0.77 | 11.08 ± 0.77 | 8.10 ± 0.57 | 7.95 ± 0.56 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 7.02 ± 0.55 | 6.62 ± 0.51 | 0.00130 ± 0.00074 | 0.00170 ± 0.00075 |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 17-Sep-2009 | SW11B 17-Sep-2009 | SW13 17-Sep-2009 | SW13B 17-Sep-2009 |
| **Lab Number:** | | 728224.9 | 728224.10 | 728224.11 | 728224.12 |
| Individual Tests | | | | | |
| pH | pH Units | 3.2 ± 0.2 | - | 6.6 ± 0.2 | - |
| Electrical Conductivity (EC) | mS/m | 72.2 ± 0.5 | - | 16.1 ± 0.2 | - |
| Total Suspended Solids | g/m³ | 24.0 ± 3.8 | - | < 3 ± 2.1 | - |
| Total Cyanide | g/m³ | 0.0022 ± 0.0011 | - | < 0.0010 ± 0.00067 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 10.0 ± 1.6 | 10.0 ± 1.6 | 0.495 ± 0.077 | 0.067 ± 0.011 |
| Total Antimony | g/m³ | 0.00055 ± 0.00042 | 0.00044 ± 0.00034 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 |
| Total Arsenic | g/m³ | 0.0227 ± 0.0040 | 0.0177 ± 0.0032 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.0311 ± 0.0021 | 0.0304 ± 0.0021 | 0.00977 ± 0.00066 | 0.00918 ± 0.00062 |
| Total Beryllium | g/m³ | 0.00058 ± 0.00011 | 0.00062 ± 0.00011 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0113 ± 0.0038 | 0.0116 ± 0.0039 | 0.0111 ± 0.0038 | 0.0117 ± 0.0039 |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 17-Sep-2009 | SW11B 17-Sep-2009 | SW13 17-Sep-2009 | SW13B 17-Sep-2009 |
| **Lab Number:** | | 728224.9 | 728224.10 | 728224.11 | 728224.12 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Cadmium | g/m³ | 0.110 ± 0.012 | 0.112 ± 0.013 | 0.00477 ± 0.00052 | 0.00453 ± 0.00050 |
| Total Calcium | g/m³ | 25.3 ± 1.4 | 25.8 ± 1.4 | 11.33 ± 0.59 | 11.03 ± 0.58 |
| Total Chromium | g/m³ | 0.00272 ± 0.00050 | 0.00283 ± 0.00051 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 1.02 ± 0.11 | 0.96 ± 0.11 | 0.0270 ± 0.0030 | 0.00815 ± 0.00095 |
| Total Iron | g/m³ | 21.7 ± 2.7 | 20.1 ± 2.5 | 0.211 ± 0.030 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.769 ± 0.080 | 0.709 ± 0.073 | 0.0257 ± 0.0027 | 0.00375 ± 0.00040 |
| Total Lithium | g/m³ | 0.0162 ± 0.0015 | 0.0172 ± 0.0016 | 0.00315 ± 0.00040 | 0.00310 ± 0.00040 |
| Total Magnesium | g/m³ | 13.4 ± 1.6 | 13.4 ± 1.6 | 4.69 ± 0.55 | 4.68 ± 0.55 |
| Total Manganese | g/m³ | 5.53 ± 0.56 | 5.42 ± 0.55 | 0.215 ± 0.022 | 0.211 ± 0.022 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 |
| Total Nickel | g/m³ | 0.054 ± 0.010 | 0.054 ± 0.010 | 0.00416 ± 0.00084 | 0.00406 ± 0.00083 |
| Total Potassium | g/m³ | 1.45 ± 0.11 | 1.43 ± 0.11 | 0.807 ± 0.068 | 0.783 ± 0.067 |
| Total Selenium | g/m³ | 0.0022 ± 0.0012 | 0.0022 ± 0.0012 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 9.02 ± 0.63 | 9.33 ± 0.65 | 9.51 ± 0.66 | 9.47 ± 0.66 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | 0.000204 ± 0.000038 | 0.000178 ± 0.000034 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 18.7 ± 1.5 | 18.7 ± 1.5 | 0.853 ± 0.066 | 0.784 ± 0.061 |

| **Sample Name:** | | SW15 18-Sep-2009 | SW15B 18-Sep-2009 | SW100 17-Sep-2009 | SW100B 17-Sep-2009 |
|---|---|---|---|---|---|
| **Lab Number:** | | 728224.13 | 728224.14 | 728224.15 | 728224.16 |
| Individual Tests | | | | | |
| pH | pH Units | 6.3 ± 0.2 | - | - | - |
| Electrical Conductivity (EC) | mS/m | 22.1 ± 0.2 | - | - | - |
| Total Suspended Solids | g/m³ | < 3 ± 2.1 | - | 10.4 ± 2.5 | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | - | - | 15.56 ± 0.94 | - |
| Total Cyanide | g/m³ | < 0.0010 ± 0.00067 | - | - | - |
| Silicon | g/m³ | - | - | 7.27 ± 0.44 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0323 ± 0.0055 | 0.0298 ± 0.0051 | 0.145 ± 0.023 | < 0.004 ± 0.0022 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 | 0.00096 ± 0.00073 | 0.00068 ± 0.00052 |
| Total Arsenic | g/m³ | 0.0046 ± 0.0011 | 0.00389 ± 0.00098 | 0.00278 ± 0.00086 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.0214 ± 0.0015 | 0.0203 ± 0.0014 | 0.0255 ± 0.0017 | 0.0246 ± 0.0017 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0134 ± 0.0040 | 0.0128 ± 0.0039 | 0.0205 ± 0.0045 | 0.0185 ± 0.0043 |
| Total Cadmium | g/m³ | 0.0093 ± 0.0011 | 0.0094 ± 0.0011 | 0.106 ± 0.012 | 0.098 ± 0.011 |
| Total Calcium | g/m³ | 17.46 ± 0.91 | 17.17 ± 0.90 | 65.3 ± 3.4 | 61.6 ± 3.3 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.0387 ± 0.0042 | 0.0382 ± 0.0042 | 0.118 ± 0.013 | 0.00762 ± 0.00089 |
| Total Iron | g/m³ | 0.234 ± 0.032 | 0.216 ± 0.030 | 2.39 ± 0.30 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.0671 ± 0.0070 | 0.0649 ± 0.0067 | 0.0540 ± 0.0056 | 0.00422 ± 0.00045 |
| Total Lithium | g/m³ | 0.00571 ± 0.00059 | 0.00571 ± 0.00059 | 0.0157 ± 0.0015 | 0.0145 ± 0.0014 |
| Total Magnesium | g/m³ | 6.74 ± 0.79 | 6.65 ± 0.78 | 14.6 ± 1.7 | 13.4 ± 1.6 |
| Total Manganese | g/m³ | 0.0200 ± 0.0021 | 0.0200 ± 0.0021 | 1.17 ± 0.12 | 1.15 ± 0.12 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00033 ± 0.00015 | 0.00033 ± 0.00015 |
| Total Nickel | g/m³ | 0.00221 ± 0.00053 | 0.00216 ± 0.00053 | 0.0191 ± 0.0036 | 0.0198 ± 0.0037 |
| Total Potassium | g/m³ | 0.975 ± 0.079 | 0.981 ± 0.079 | 1.008 ± 0.081 | 0.923 ± 0.076 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.003 ± 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 10.67 ± 0.75 | 10.47 ± 0.73 | 12.24 ± 0.85 | 11.55 ± 0.81 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 1.60 ± 0.13 | 1.60 ± 0.13 | 15.4 ± 1.2 | 13.3 ± 1.1 |
| Anion / Cation profile, dissolved metals trace level | | | | | |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW15 18-Sep-2009 | SW15B 18-Sep-2009 | SW100 17-Sep-2009 | SW100B 17-Sep-2009 |
| **Lab Number:** | | 728224.13 | 728224.14 | 728224.15 | 728224.16 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | - | - | 5.8 | - |
| Sum of Cations | meq/L | - | - | 4.9 | - |
| pH | pH Units | - | - | 7.2 ± 0.2 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | 48.6 ± 3.1 | - |
| Bicarbonate | g/m³ at 25°C | - | - | 59.2 ± 4.6 | - |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | 216 ± 11 | - |
| Electrical Conductivity (EC) | mS/m | - | - | 52.6 ± 0.4 | - |
| Dissolved Calcium | g/m³ | - | - | 64.4 ± 4.1 | - |
| Dissolved Magnesium | g/m³ | - | - | 13.34 ± 0.90 | - |
| Dissolved Potassium | g/m³ | - | - | 1.056 ± 0.084 | - |
| Dissolved Sodium | g/m³ | - | - | 12.8 ± 1.4 | - |
| Chloride | g/m³ | - | - | 10.58 ± 0.86 | - |
| Nitrite-N | g/m³ | - | - | 0.0040 ± 0.0014 | - |
| Nitrate-N | g/m³ | - | - | 0.0493 ± 0.0057 | - |
| Nitrate-N + Nitrite-N | g/m³ | - | - | 0.0532 ± 0.0055 | - |
| Sulphate | g/m³ | - | - | 218 ± 15 | - |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW101 17-Sep-2009 | SW101B 17-Sep-2009 | SW23 17-Sep-2009 | SW23B 17-Sep-2009 |
| **Lab Number:** | | 728224.17 | 728224.18 | 728224.19 | 728224.20 |
| Individual Tests | | | | | |
| Total Suspended Solids | g/m³ | < 3 ± 2.1 | - | - | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 14.17 ± 0.86 | - | - | - |
| Silicon | g/m³ | 6.62 ± 0.40 | - | - | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0126 ± 0.0029 | 0.0053 ± 0.0023 | 0.489 ± 0.076 | 0.0564 ± 0.0091 |
| Total Antimony | g/m³ | 0.00051 ± 0.00039 | 0.00046 ± 0.00036 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.0194 ± 0.0013 | 0.0184 ± 0.0013 | 0.01051 ± 0.00071 | 0.00993 ± 0.00067 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0116 ± 0.0039 | 0.0117 ± 0.0039 | 0.0110 ± 0.0038 | 0.0118 ± 0.0039 |
| Total Cadmium | g/m³ | 0.0157 ± 0.0017 | 0.0152 ± 0.0017 | 0.00466 ± 0.00051 | 0.00454 ± 0.00050 |
| Total Calcium | g/m³ | 8.19 ± 0.43 | 7.97 ± 0.42 | 11.29 ± 0.59 | 11.50 ± 0.60 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.00507 ± 0.00065 | 0.00461 ± 0.00061 | 0.0261 ± 0.0029 | 0.00781 ± 0.00091 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | < 0.03 ± 0.014 | 0.231 ± 0.032 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.226 ± 0.024 | 0.204 ± 0.022 | 0.0235 ± 0.0025 | 0.00297 ± 0.00032 |
| Total Lithium | g/m³ | 0.00234 ± 0.00035 | 0.00215 ± 0.00034 | 0.00318 ± 0.00040 | 0.00305 ± 0.00039 |
| Total Magnesium | g/m³ | 3.08 ± 0.36 | 3.00 ± 0.35 | 4.70 ± 0.55 | 4.75 ± 0.56 |
| Total Manganese | g/m³ | 0.00211 ± 0.00041 | 0.00176 ± 0.00040 | 0.224 ± 0.023 | 0.219 ± 0.022 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 |
| Total Nickel | g/m³ | 0.00152 ± 0.00044 | 0.00143 ± 0.00043 | 0.00408 ± 0.00083 | 0.00384 ± 0.00079 |
| Total Potassium | g/m³ | 0.697 ± 0.062 | 0.679 ± 0.061 | 0.795 ± 0.068 | 0.796 ± 0.068 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 8.23 ± 0.58 | 8.05 ± 0.56 | 10.00 ± 0.70 | 10.00 ± 0.70 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 1.74 ± 0.14 | 1.68 ± 0.13 | 0.839 ± 0.065 | 0.783 ± 0.061 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | 1.2 | - | - | - |
| Sum of Cations | meq/L | 1.0 | - | - | - |
| pH | pH Units | 7.2 ± 0.2 | - | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 10.00 ± 0.91 | - | - | - |
| Bicarbonate | g/m³ at 25°C | 12.2 ± 1.4 | - | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 33.0 ± 1.6 | - | - | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW101 17-Sep-2009 | SW101B 17-Sep-2009 | SW23 17-Sep-2009 | SW23B 17-Sep-2009 | |
| **Lab Number:** | | 728224.17 | 728224.18 | 728224.19 | 728224.20 | |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Electrical Conductivity (EC) | mS/m | 12.7 ± 0.2 | - | - | - | |
| Dissolved Calcium | g/m³ | 8.74 ± 0.55 | - | - | - | |
| Dissolved Magnesium | g/m³ | 2.72 ± 0.19 | - | - | - | |
| Dissolved Potassium | g/m³ | 0.733 ± 0.063 | - | - | - | |
| Dissolved Sodium | g/m³ | 8.48 ± 0.91 | - | - | - | |
| Chloride | g/m³ | 11.85 ± 0.94 | - | - | - | |
| Nitrite-N | g/m³ | < 0.002 ± 0.0014 | - | - | - | |
| Nitrate-N | g/m³ | 0.164 ± 0.017 | - | - | - | |
| Nitrate-N + Nitrite-N | g/m³ | 0.164 ± 0.017 | - | - | - | |
| Sulphate | g/m³ | 29.5 ± 2.0 | - | - | - | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW120 17-Sep-2009 | SW21 17-Sep-2009 | SW50B 18-Sep-2009 | | |
| **Lab Number:** | | 728224.21 | 728224.22 | 728224.23 | | |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | 10.4 ± 2.5 | - | - | - | |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 16.27 ± 0.98 | - | - | - | |
| Total Cyanide | g/m³ | - | 0.0022 ± 0.0011 | - | - | |
| Silicon | g/m³ | 7.60 ± 0.46 | - | - | - | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | - | - | < 0.004 ± 0.0022 | - | |
| Total Antimony | g/m³ | - | - | < 0.0003 ± 0.00017 | - | |
| Total Arsenic | g/m³ | - | - | < 0.0011 ± 0.00074 | - | |
| Total Barium | g/m³ | - | - | < 0.0003 ± 0.00015 | - | |
| Total Beryllium | g/m³ | - | - | < 0.00011 ± 0.000074 | - | |
| Total Boron | g/m³ | - | - | < 0.006 ± 0.0036 | - | |
| Total Cadmium | g/m³ | - | - | < 0.00006 ± 0.000036 | - | |
| Total Calcium | g/m³ | - | - | < 0.06 ± 0.036 | - | |
| Total Chromium | g/m³ | - | - | < 0.0006 ± 0.00036 | - | |
| Total Copper | g/m³ | - | - | < 0.0006 ± 0.00036 | - | |
| Total Iron | g/m³ | - | - | < 0.03 ± 0.014 | - | |
| Total Lead | g/m³ | - | - | < 0.00011 ± 0.000074 | - | |
| Total Lithium | g/m³ | - | - | < 0.0005 ± 0.00028 | - | |
| Total Magnesium | g/m³ | - | - | < 0.03 ± 0.014 | - | |
| Total Manganese | g/m³ | - | - | < 0.0006 ± 0.00036 | - | |
| Total Mercury | g/m³ | - | - | < 0.00008 ± 0.000053 | - | |
| Total Molybdenum | g/m³ | - | - | < 0.0003 ± 0.00014 | - | |
| Total Nickel | g/m³ | - | - | < 0.0006 ± 0.00036 | - | |
| Total Potassium | g/m³ | - | - | < 0.06 ± 0.036 | - | |
| Total Selenium | g/m³ | - | - | < 0.0011 ± 0.00074 | - | |
| Total Silver | g/m³ | - | - | < 0.00011 | - | |
| Total Sodium | g/m³ | - | - | < 0.03 ± 0.015 | - | |
| Total Tin | g/m³ | - | - | < 0.0006 ± 0.00036 | - | |
| Total Uranium | g/m³ | - | - | < 0.00003 ± 0.000014 | - | |
| Total Zinc | g/m³ | - | - | 0.00193 ± 0.00075 | - | |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | 5.8 | - | - | - | |
| Sum of Cations | meq/L | 4.9 | - | - | - | |
| pH | pH Units | 7.4 ± 0.2 | - | - | - | |
| Total Alkalinity | g/m³ as $CaCO_3$ | 48.4 ± 3.1 | - | - | - | |
| Bicarbonate | g/m³ at 25°C | 58.9 ± 4.6 | - | - | - | |
| Total Hardness | g/m³ as $CaCO_3$ | 218 ± 11 | - | - | - | |
| Electrical Conductivity (EC) | mS/m | 52.7 ± 0.4 | - | - | - | |
| Dissolved Calcium | g/m³ | 64.8 ± 4.1 | - | - | - | |
| Dissolved Magnesium | g/m³ | 13.53 ± 0.91 | - | - | - | |
| Dissolved Potassium | g/m³ | 1.042 ± 0.083 | - | - | - | |
| Dissolved Sodium | g/m³ | 12.6 ± 1.4 | - | - | - | |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW120 17-Sep-2009 | SW21 17-Sep-2009 | SW50B 18-Sep-2009 | |
| **Lab Number:** | | 728224.21 | 728224.22 | 728224.23 | |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Chloride | g/m³ | 10.48 ± 0.85 | - | - | - |
| Nitrite-N | g/m³ | 0.0035 ± 0.0014 | - | - | - |
| Nitrate-N | g/m³ | 0.0479 ± 0.0055 | - | - | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.0514 ± 0.0054 | - | - | - |
| Sulphate | g/m³ | 219 ± 15 | - | - | - |

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

## Analyst's Comments

Appendix No.1 - QC Report

# 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: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1, 3, 15, 17, 21 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-20, 23 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-20, 23 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 9, 11, 13, 22 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1, 3, 15, 17, 21 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1, 3, 15, 17, 21 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1, 3, 15, 17, 21 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1, 3, 15, 17, 21 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1, 3, 15, 17, 21 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 g/m³ | 1, 3, 5, 7, 9, 11, 13, 15, 17, 21 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1, 3, 15, 17, 21 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1, 3, 15, 17, 21 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1, 3, 15, 17, 21 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1, 3, 15, 17, 21 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 g/m³ as $SiO_2$ | 1, 3, 15, 17, 21 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1, 3, 15, 17, 21 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 g/m³ | 9, 11, 13, 22 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 g/m³ | 1, 3, 15, 17, 21 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 g/m³ | 1, 3, 15, 17, 21 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1, 3, 15, 17, 21 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1, 3, 15, 17, 21 |
| Anion / Cation profile, dissolved metals trace level | | - | 1, 3, 15, 17, 21 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-20, 23 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-20, 23 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-20, 23 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-20, 23 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-20, 23 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-20, 23 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-20, 23 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-20, 23 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-20, 23 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-20, 23 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-20, 23 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-20, 23 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-20, 23 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-20, 23 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-20, 23 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-20, 23 |

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.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

***Client:*** ***Pattle Delamore Partners Ltd***
***Address:*** ***P.O Box 9258***
***Newmarket,Auckland 1149***
***Contact:*** ***Rumsby, Andrew***

***Laboratory No:*** ***728224QC***
***Date Registered:*** ***18/09/2009***



***Client's Reference: AO 2277600***

# Quality Control Report for 728224

***This report includes quality control data for the following analytes:***

| | |
|---|---|
| Trace Elements - Water<br>Silicon | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements – Water<br>Dissolved Metals<br>(Calcium, Magnesium, Potassium, and Sodium). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements - Water<br>Total Metals<br>(Arsenic, Aluminium, Antimony, Barium, Beryllium, Boron, Calcium, Cadmium, Chromium, Copper, Iron, Lead, Lithium, Manganese, Magnesium, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Tin, Uranium, Zinc). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Nitrite-N,Nitrate-N,Nitrogen Oxides – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Chloride – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| | |
|---|---|
| Total Cyanide – Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Total Alkalinity - Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Electrical Conductivity, pH | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Suspended Solids – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

## *Sample Type: Water,*

### *Quality Control Data for Samples 728224.1,3,15,17,21 (EWSi 538)*

| Sample Name | Lab No | Silicon (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.01 |
| QC Standard | - | 0.00497 |
| QC Standard Range | | 0.0045 - 0.0055 |
| Sample Spike [% Recovery] | 728224.21 | 90 |
| Duplicate Sample 1 | 728224.21 | 7.60 |
| Duplicate Sample 2 | 728224.21 | 7.42 |

### *Quality Control Data for Samples 728224.1 -23 (HgBrF 166)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.00008 |
| Blank Spike [% Recovery] | - | 99 |
| QC Standard | | 0.000509 |
| QC Standard Range | | 0.00045 - 0.00055 |

### *Quality Control Data for Samples 728224.13,14,15 (HgBrF 168)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.00008 |
| Blank Spike [% Recovery] | - | 98 |
| QC Standard | | 0.000494 |
| QC Standard Range | | 0.00045 - 0.00055 |
| Sample Spike[% Recovery] | 727068.1 | 103 # |

# A spiked analysis of 728224 was not performed, however a spiked sample was analysed in the same batch as 728224 and these results are included in this QC report.

### *Quality Control Data for Samples 728224.1-17 (EWAg 247)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.0001 |
| QC Standard | - | 0.014 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 728224.17 | 107 |
| Duplicate Sample 1 | 728224.17 | <0.0001 |
| Duplicate Sample 2 | 728224.17 | <0.0001 |

### *Quality Control Data for Samples 728224.18,19,20,23 (EWAg 248)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.0001 |
| QC Standard | - | 0.012 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 728140.1 | 116 # |
| Duplicate Sample 1 | 728140.1 | <0.0001 ## |
| Duplicate Sample 2 | 728140.1 | <0.0001 ## |

# A spiked analysis of 728224 was not performed, however a spiked sample was analysed in the same batch as 728224 and these results are included in this QC report.
##A duplicate analysis of 728224 was not performed, however a duplicate sample was analysed in the same batch as 728224 and these results are included in this QC report.

### *Quality Control Data for Samples 728224.1,3,15,17,21 (EW 8001)*

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.514 | 0.052 | 0.525 | 0.528 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Duplicate Sample 1 | 726050.8 | 0.235 # | < 0.02 # | < 0.05 # | 0.392 # |
| Duplicate Sample 2 | 726050.8 | 0.244 # | < 0.02 # | < 0.05 # | 0.415 # |

#A duplicate analysis of 728224 was not performed, however a duplicate sample was analysed in the same batch as 728224 and these results are included in this QC report.

### *Quality Control Data for Samples 728224.1-20 (EWT 4919)*

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 728224.20 | 105 | 91 | 113 | 115 |
| QC Standard | - | 0.0052 | 0.0048 | 0.0051 | 0.0053 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.20 | 0.056 | < 0.001 | < 0.0002 | 0.0099 |
| Duplicate Sample 2 | 728224.20 | 0.055 | < 0.001 | < 0.0002 | 0.0100 |

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 728224.2 | 105 | 106 | N/A# | 108 |
| QC Standard | - | 0.0048 | 0.0105 | 0.494 | 0.00508 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.2 | < 0.0001 | 0.012 | 11.5 | 0.00454 |
| Duplicate Sample 2 | 728224.2 | < 0.0001 | 0.011 | 11.4 | 0.00469 |

#The spike recovery is N/A as the amount of the sample has swamped the spike

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 728244.20 | 106 | 107 | 103 | 99 |
| QC Standard | - | 0.00495 | 0.00518 | 0.058 | 0.00495 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728244.20 | < 0.0005 | 0.0078 | 0.021 | 0.0030 |
| Duplicate Sample 2 | 728244.20 | < 0.0005 | 0.0075 | 0.023 | 0.0029 |

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 728224.2 | 103 | 101 | N/A # | 109 |
| QC Standard | - | 0.00520 | 0.00503 | 0.051 | 0.00520 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.2 | 0.0031 | 0.219 | 4.75 | < 0.0002 |
| Duplicate Sample 2 | 728224.2 | 0.0031 | 0.219 | 4.60 | < 0.0002 |

#The spike recovery is N/A as the amount of the sample has swamped the spike

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 728224.2 | 108 | 90 | 98 | N/A # |
| QC Standard | - | 0.0054 | 0.512 | 0.0093 | 0.505 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 728224.2 | 0.0038 | 0.796 | < 0.001 | 9.60 |
| Duplicate Sample 2 | 728224.2 | 0.0040 | 0.767 | < 0.001 | 9.23 |

#The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 728224.2 | 111 | N/A ## | 111 |
| QC Standard | - | 0.00510 | 0.00480 | 0.0503 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 728224.2 | < 0.0005 | < 0.00005 | 0.784 |
| Duplicate Sample 2 | 728224.2 | < 0.0005 | < 0.00005 | 0.770 |

##The spike recovery has been labelled as N/A as the element is not included in our spike solution.

***Quality Control Data for Sample 728244.23 (EWT 4920)***

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 728224.23 | 95 | 85 | 99 | 105 |
| QC Standard | - | 0.0054 | 0.0047 | 0.00457 | 0.0052 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.23 | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Duplicate Sample 2 | 728224.23 | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 728224.23 | 99 | 97 | 188 # | 99 |
| QC Standard | - | 0.0051 | 0.0091 | 0.512 | 0.00498 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.23 | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Duplicate Sample 2 | 728224.23 | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |

#It was noted that the spike recovery was elevated and outside the acceptable range for this analyte. It is thought that the spiking solution is at fault. This is currently the subject of an investigation.

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 728224.23 | 100 | 97 | 102 | 102 |
| QC Standard | - | 0.00500 | 0.00489 | 0.043 | 0.00498 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.23 | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Duplicate Sample 2 | 728224.23 | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 728224.23 | 97 | 105 | 97 | 99 |
| QC Standard | - | 0.00486 | 0.00511 | 0.054 | 0.00480 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 728224.23 | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Duplicate Sample 2 | 728224.23 | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 728224.23 | 98 | 101 | 96 | 99 |
| QC Standard | - | 0.0049 | 0.516 | 0.0101 | 0.494 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 728224.23 | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Duplicate Sample 2 | 728224.23 | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 728224.23 | 96 | N/A ## | 97 |
| QC Standard | - | 0.00495 | 0.00488 | 0.0485 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 728224.23 | < 0.0005 | < 0.00005 | 0.0019 |
| Duplicate Sample 2 | 728224.23 | < 0.0005 | < 0.00005 | 0.0017 |

##The spike recovery has been labelled as N/A as the element is not included in our spike solution.

***Quality Control Data for Sample 728224.3,4,9,10,14,15,16 (EWT 4930)***

| Sample Name | Lab No | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Selenium (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.001 | < 0.0002 | < 0.001 |
| Sample Spike[% Recovery] | 729753.1 | 95 # | 107 # | 108 # |
| QC Standard | | 0.0053 | 0.00498 | 0.0103 |
| QC Standard Range | | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.009 – 0.011 |
| Duplicate Sample 1 | 729753.1 | < 0.001 ## | < 0.0002 ## | < 0.001 ## |
| Duplicate Sample 2 | 729753.1 | < 0.001 ## | < 0.0002 ## | < 0.001 ## |

# A spiked analysis of 728224 was not performed, however a spiked sample was analysed in the same batch as 728224 and these results are included in this QC report

##A duplicate analysis of 728224 was not performed, however a duplicate sample was analysed in the same batch as 728224 and these results are included in this QC report.

***Quality Control Data for Sample 728224.7,8,9,10,19,20 (EWT 4941)***

| Sample Name | Lab No | Total Sodium (g.m-3) | Total Tin (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.0005 | < 0.001 |
| Sample Spike[% Recovery] | 731555.1 | N/A ### | 100 # | 98 # |
| QC Standard | | 0.505 | 0.00507 | 0.0510 |
| QC Standard Range | | 0.45 – 0.55 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 731555.1 | 22.63 ## | < 0.0005 ## | 0.011## |
| Duplicate Sample 2 | 731555.1 | 22.97 ## | < 0.0005 ## | 0.010 ## |

# A spiked analysis of 728224 was not performed, however a spiked sample was analysed in the same batch as 728224 and these results are included in this QC report.
##A duplicate analysis of 728224 was not performed, however a duplicate sample was analysed in the same batch as 728224 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

### *Quality Control Data for Samples 728224.9,11,13,22 (Cnw 232)*

| Sample Name | Lab No | Cyanide (mg/L) |
|---|---|---|
| Procedural Blank | - | <0.003 |
| QC Standard 1 | - | 15.3 |
| QC Standard 2 | - | 15.4 |
| QC Standard Range | | 12.75 – 17.25 |

### *Quality Control Data for Samples 728224.1,3,5,7,9,11,13,15,17,21 (pHEC 1767)*

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 6.1 | < 0.1 |
| QC Standard 1 | - | 4.07 | 3.69 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 4.47 |
| QC Standard 2 | | 7.57 | 64.9 |
| QC Standard Range | | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | | N/A | 5290 |
| Saline QC Standard Range | | N/A | 5123 - 5423 |

### *Quality Control Data for Samples 728224.1,3,5,9,11,13,15,17,21 (SS 7830)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | | 1928 |
| QC Standard Range | | 1600 - 2400 |

### *Quality Control Data for Samples 728224.1,3,15,17,21 (KLGen 4205)*

| Sample Name | Lab No | Chloride (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.5 |
| Procedural Blank | | < 0.5 |
| QC Standard | | 9.84 |
| QC Standard Range | | 8.9 – 11.2 |

### *Quality Control Data for Samples 728224.1,3,15,17,21 (AutotM 122)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | | < 4 |
| QC Standard 1 | | 155.1 |
| QC Standard 2 | | 156.2 |
| QC Standard Range | | 142.5 – 157.5 |
| Duplicate Sample 1 | 728433.1 | 39.1# |
| Duplicate Sample 2 | 728433.1 | 39.1# |

# A duplicate analysis of 728224 was not performed, however a duplicate sample was analysed in the same batch as 728224 and these results are included in this QC report.

***Quality Control Data for Samples 728224.1,3,15,17,21 (IC 3194)***

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.50 |
| QC Standard 1 | | 10.67 |
| QC Standard Range | | 8.5 – 11.5 |
| QC Standard 2 | | 105.8 |
| QC Standard Range | | 85 - 115 |

***Quality Control Data for Samples 728224.1,3,15,17,21 (L4C 2823)***

| Sample Name | Lab No | Nitrite-N (g.m-3) | Nitrite-N+Nitrate-N (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | <0.0020 | <0.0020 |
| QC Standard | | N/A | 5.21 |
| QC Standard Range | | N/A | 4.25 – 5.75 |

# Hill Laboratories
A WORLD LEADER IN ANALYTICAL SERVICES

## ANALYSIS REQUEST

Time Received 18-Sep-2009 3:40:11 pm

RJ Hill Laboratories Limited
1 Clyde Street,
Private Bag 3205,
Hamilton, New Zealand

Job No: **728224**

No of Samples: 23 No of Fractions: 117

0317282241

Office use only

**Client**
Name: Remalia Shamplin (PDP Ltd)
Address: 235 Broadway, Newmarket, Auckland
Phone: 021 208 2522 Fax: (09) 5236901
Client Reference: AO 2277600
Quote No: Order No:
Primary Contact: Andrew Rumsby
Submitted By: Remalia Shamplin
Charge To: Andrew Rumsby, PDP Ltd
Results To: ☒ Mail Client ☒ Mail Submitter
☐ Fax Results
☒ Email Results remalia.shamplin@pdp.co.nz

**CHAIN OF CUSTODY RECORD**

Sent to Hill Laboratories
☑ Please tick if you require COC to be faxed back
Date & Time: 18.09.2009
Name: 1.45pm
Signature:

Received at Hill Laboratories
Date & Time: 18/9/09 14:40
Name: Tyler Salter
Signature:

Condition: ☐ Room Temp ☐ Chilled ☐ Frozen Temp: 16.6
☐ Sample & Analysis details checked
Signature:

## ADDITIONAL INFORMATION

Please place SW7 CN sample on cold hold until further notice.

**Priority**
☐ Low ☒ Normal ☑ High
☐ Urgent (ASAP, extra charge applies, please contact lab first)

Sample Types
Water
Solids
Other

Requested Reporting Date:

| No. | Sample Name | Sample Date & Time | Sample Type | Tests Required |
|---|---|---|---|---|
| 1 | SW3 + SW3B | 17.9.09 | ALL | EC, pH, TSS; total metals as per quote. + cation/anion profile + diss. $SiO_2$ |
| 2 | SW5 + SW5B | 17.9.09 | SW | EC, pH, TSS; total metals x2 as per quote; cation/anion profile + dissolved $SiO_2$ |
| 3 | SW7 + SW7B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote; T.Cyanide (COLD HOLD) |
| 4 | SW8 + SW8B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote. |
| 5 | SW11 + SW11B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote; Total CN. |
| 6 | SW13 + SW13B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote, Total CN |
| 7 | SW15 + SW15B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote Total CN. |
| 8 | SW100 + SW100B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote; cation/Anion + diss. $SiO_2$ |
| 9 | SW101 + SW101B | 17.9.09 | | EC, pH, TSS; total metals x2 as per quote; Cation/Anion profile + diss $SiO_2$ |
| 10 | SW23 + SW23B | 17.9.09 | | Total metals x2 as per quote |
| 11 | SW120 ~~+ SW120B~~ | 17.9.09 | | EC, pH, TSS; Cation/Anion profile + diss. $SiO_2$ |

Continued on back page

# Hill Laboratories

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# ANALYSIS REQUEST

R J Hill Laboratories Limited
1 Clyde Street,
Private Bag 3205,
Hamilton, New Zealand

Phone: +64 (7) 858-2000
Facsimile: +64 (7) 858-2001
Email: mail@hill-labs.co.nz
Internet: www.hill-labs.co.nz

**Client**

*Name*

*Address*

*Phone* *Fax*

*Client Reference*

*Quote No* *Order No*

**Primary Contact**

**Submitted By**

**Charge To**

**Results To** ☒ *Mail Client* ☐ *Mail Submitter*

☐ *Fax Results*

☐ *Email Results*

## ADDITIONAL INFORMATION

## CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories

Please tick if you require COC to be returned

Date & Time:

Name:

Signature:

**Priority**

☐ **Low** ☒ **Normal** ☐ **High**

☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

Sample Types

Requested Reporting Date:

| No. | Sample Name | Sample Date & Time | Sample Type | Tests Required |
|---|---|---|---|---|
| 1 | SW 21 | 17.9.09 | SW | Total CN. |
| 2 | ~~SW 50~~ SW50 B | 18.9.09 | | Total metals as per quote. |
| 3 | ~~SW~~ | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |

*Continued on back page*

# Certificate of Analysis

PATTLE DELAMORE PARTNERS

PO BOX 9528
NEWMARKET
AUCKLAND
**Attention:** ANDREW RUMSBY

Copy to 1: Remalia Sharplin
: Andrew Rumsby

**Job Description:** ON:AO2277600 Sampling/No
**Batch Number:** 09/26721

**Notes:** Please Note: No soluable metals bottle supplied for IonBalance on sample #4. Confirmed with client sample takenfrom bulk bottle. Amended Report for Total Boron Result.

***Sample Descriptions***

| Sample No. | Date Sampled | Sample Description |
|---|---|---|
| 01 | 17/09/2009 | SW13 |
| 02 | 17/09/2009 | SW13B |
| 03 | 17/09/2009 | SW11 |
| 04 | 17/09/2009 | SW100 |

***Results***

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| | | 01 | 02 | 03 | 04 | | |
| Calcium: Soluble Trace by ICPMS | mg/L | | | | 63. | | |
| Iron: Soluble Trace by ICPMS | mg/L | | | | < 0.002 | | |
| Calcium Hardness Calc Trace ICPMS | mg/L | | | | 159.81 | | |
| Magnesium Hardness Calc Trace ICPMS | mg/L | | | | 57.65 | | |
| Total Hardness Calc Trace ICPMS | mg/L | | | | 217.46 | | |
| Potassium: Soluble Trace by ICPMS | mg/L | | | | 0.93 | | |
| Filtration for Soluble Metals | | | | | Yes | | |
| Magnesium: Soluble Trace by ICPMS | mg/L | | | | 14. | | |
| Sodium: Soluble Trace by ICPMS | mg/L | | | | 12. | | |
| Silica: Soluble Trace by ICPMS | mg/L | | | | 14. | | |
| Silver Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Aluminium Trace by ICPMS | mg/L | 0.46 | 0.071 | | | | |
| Alkalinity total by Autotitrator | mg/L CaCO3 | | | | 44.3 | | |
| Alkalinity carbonate | mg/L CO3 | | | | < 1. | | |
| Alkalinity bicarbonate | mg/L HCO3 | | | | 54.1 | | |
| Arsenic Trace by ICP-MS | mg/L | 0.0004 | 0.00017 | | | | |
| Boron Trace by ICPMS | mg/L | 0.013 | 0.018 | | | | |
| Barium Trace by ICPMS | mg/L | 0.011 | 0.0099 | | | | |
| Beryllium Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Calcium Trace by ICPMS | mg/L | 12. | 12. | | 64. | | |
| Cadmium: Trace by ICPMS | mg/L | 0.0049 | 0.0047 | | | | |
| Chloride by Ion Chromatography | mg/L | | | | 10.8 | | |
| Carbon dioxide by Calculation (Nomograph) | mg/L | | | | 4. | | |
| Conductivity by Auto-titrator | mS/m 25oC | | | | 52.9 | | |

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| Chromium Trace by ICPMS | mg/L | 0.00028 | < 0.0001 | | | | |
| Copper Trace by ICPMS | mg/L | 0.026 | 0.008 | | | | |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | | 1 | 1 | | 1 | | |
| Iron Trace by ICPMS | mg/L | 0.18 | 0.022 | | | | |
| GF/C Filtration | | | | | Yes | | |
| Mercury: Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| PROFILE ONLY Ion balance | | | | | Attached | | |
| Potassium Trace by ICPMS | mg/L | 0.78 | 0.77 | | | | |
| Lithium Trace by ICPMS | mg/L | 0.0029 | 0.0029 | | | | |
| Membrane Filtration | | | | | Yes | | |
| Magnesium Trace by ICPMS | mg/L | 4.5 | 4.5 | | 14. | | |
| Manganese Trace by ICPMS | mg/L | 0.21 | 0.2 | | | | |
| Molybdenum Trace by ICPMS | mg/L | < 0.0003 | < 0.0003 | | | | |
| Sodium Trace by ICPMS | mg/L | 9.4 | 9.5 | | | | |
| Ammonia Nitrogen low level Soluble | mg/L N | | | | 0.054 | | |
| Nickel Trace by ICPMS | mg/L | 0.004 | 0.0035 | | | | |
| Nitrite Nitrogen by Ion Chromatography | mg/L N | | | | < 0.002 | | |
| Nitrate Nitrogen by Ion Chromatography | mg/L N | | | | 0.04 | | |
| Nitrate & Nitrite Nitrogen by Calculation | mg/L N | | | | 0.042 | | |
| Lead Trace by ICPMS | mg/L | 0.024 | 0.0038 | | | | |
| pH(Autotitrator) at room temp(c.20°C) | pH Unit | | | | 7.4 | | |
| Antimony Trace by ICPMS | mg/L | < 0.001 | < 0.001 | | | | |
| Selenium Trace by ICP-MS | mg/L | < 0.0005 | < 0.0005 | | | | |
| Tin Trace by ICPMS | mg/L | < 0.0001 | < 0.0001 | | | | |
| Sulphate by Ion Chromatography | mg/L SO4 | | | | 213. | | |
| Suspended solids: High Level by 125 mm GF/C | mg/L | | | | 12 | | |
| Sub Contracting | | | | subcontracted | | | |
| Total dissolved solids | mg/L | | | | 483 | | |
| Uranium Trace by ICPMS | mg/L | < 0.00001 | < 0.00001 | | | | |
| Zinc Trace by ICPMS | mg/L | 0.79 | 0.74 | | | | |

***Test Descriptions***

| Test Description | Method | Accredited |
|---|---|---|
| Alkalinity bicarbonate | APHA (2005) 2320 B | IANZ |
| Alkalinity carbonate | APHA (2005) 2320 B | IANZ |
| Alkalinity total by Autotitrator | APHA (2005) 2320 B | IANZ |
| Aluminium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Ammonia Nitrogen low level Soluble | APHA (2005) 4500-NH3 G, Mod | IANZ |
| Antimony Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Arsenic Trace by ICP-MS | USEPA 200.8 (Modified) | IANZ |
| Barium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Beryllium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Boron Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Cadmium: Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Calcium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Calcium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Calcium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Carbon dioxide by Calculation (Nomograph) | APHA (2005) 4500-CO2 B | |
| Chloride by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Chromium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

| Test Description | Method | Accredited |
|---|---|---|
| Conductivity by Auto-titrator | APHA (2005) 2510 B | IANZ |
| Copper Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Filtration for Soluble Metals | Cleanroom: nitric acid-leached 0.45um filter. | |
| GF/C Filtration | Glass Fiber Filtration 1.2 um | |
| Iron Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Iron: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lead Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lithium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Magnesium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Magnesium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Magnesium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Manganese Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Membrane Filtration | Membrane Filter, 0.45um | |
| Mercury: Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Molybdenum Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nickel Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nitrate & Nitrite Nitrogen by Calculation | Calculation | |
| Nitrate Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | APHA (2005) 3030E (Modified) | |
| Nitrite Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| pH(Autotitrator) at room temp(c.20°C) | APHA (2005) 4500-H B | IANZ |
| Potassium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Potassium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| PROFILE ONLY Ion balance | APHA (2005) 1030E | |
| Selenium Trace by ICP-MS | USEPA 200.8 (Modified) | IANZ |
| Silica: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | |
| Silver Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sodium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sodium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sub Contracting | | |
| Sulphate by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Suspended solids: High Level by 125 mm GF/C | APHA (2005) 2540 D | IANZ |
| Tin Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Total dissolved solids | APHA (2005) 2540 C (Modified) | |
| Total Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Uranium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Zinc Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

**Comments:** This report replaces 09/26721-2.

Results are reported on an as received basis.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

**This report may not be reproduced except in full.**

:

Dr You-Sing Yong
Operations Manager
16 October 2009
yyong@water.co.nz

**ION BALANCE :**

| | |
|---|---|
| **Batch No. :** | **09/26721** |
| **Date :** | **30/09/2009** |
| **Sample Description** | **PDP-MISC** |
| **Sample No . :** | 04 |

| **Cation** | **meq/L Conversion** | **mg/L** | **meq/L** |
|---|---|---|---|
| Ammonia | 0.0714 | | |
| Calcium (soluble) | 0.0499 | 63 | 3.1437 |
| Magnesium (soluble) | 0.0823 | 14 | 1.1522 |
| Sodium (soluble) | 0.0435 | 12 | 0.522 |
| Potassium (soluble) | 0.0256 | 0.93 | 0.023808 |
| Lithium (soluble) | 0.1441 | | |
| Iron (soluble) | 0.0358 | 0.002 | 7.16E-05 |
| Aluminium (soluble) | 0.1112 | | |
| Manganese (soluble) | 0.0364 | | |
| Cation meq/L total | | | 4.84178 |

| **Anion** | **meq/L Conversion** | | |
|---|---|---|---|
| S.R Phosphate | 0.0968 | | |
| Fluoride | 0.0526 | | |
| Chloride | 0.0282 | 10.8 | 0.30456 |
| Sulphate | 0.0208 | 213 | 4.4304 |
| Nitrite | 0.02174 | | |
| Nitrate | 0.01613 | 0.04 | 0.000645 |
| Alkalinity | 0.0199 | 44.31 | 0.881769 |
| Anion meq/L total | | | 5.617374 |

| | |
|---|---|
| Sum of Anions + Cations | 10 |
| meq/L difference | .78 |
| **% Difference** | 7.42% |
| Conductivity | 52.9 |

| Acceptance Criteria : APHA 21st Edition, 2005 | Anion Sum | Criteria |
|---|---|---|
| | 0-3.0 | ± 0.2 meq/L |
| | 3-10 | ± 2 % |
| | 10-800 | ± 2 -5% |

SGS Minerals
43 Victoria Street Box 135 **WAIHI**: Phone: (07) 863 8969 - Fax: (07) 863 6019

# ANALYSIS REPORT



Report # : 950878
Received : 23/09/09
Attention : Accounts Payable
Sub Sheet : SS6677
Customer : Watercare Services Limited

Date : 01/10/09

| | | APHA method : | 4500-CN C |
|---|---|---|---|
| | | analyte | Total Cyanide |
| | | units | ppm |
| | DATE | SAMPLE | CNTOT |
| 1 | 23/09/2009 | 1 | 0.019 |

APHA "Standard Methods for the Examination of Water and Wastewater, 21st edition (2005)
Details of methods are available at request
Analyses reported on samples as received

Authorised By
AB CLARE
MANAGER

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# Appendix B

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 734195 | SPv2 |
| **Contact:** | A Rumsby | **Date Registered:** | 09-Oct-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 05-Nov-2009 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | A02277600 | |
| | | **Submitted By:** | R Sharplin | |

## Amended Report

This report replaces an earlier report issued on the 16 Oct 2009 at 3:08 pm
Please refer to the Analysts Comments.

**Sample Type: Aqueous**

| Sample Name: | | SW3 09-Oct-2009 | SW5 09-Oct-2009 | SW7 09-Oct-2009 | SW8 09-Oct-2009 | SW11 09-Oct-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 734195.1 | 734195.2 | 734195.3 | 734195.4 | 734195.5 |
| Individual Tests | | | | | | |
| pH | pH Units | - | - | 7.4 | 7.7 | 3.2 |
| Electrical Conductivity (EC) | mS/m | - | - | 20.8 | 8.3 | 82.1 |
| Total Suspended Solids | g/m³ | < 3.0 | 14 | < 3.0 | < 3.0 | 11 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 12 | 17 | - | - | - |
| Total Cyanide | g/m³ | - | - | - | - | 0.0025 |
| Silicon | g/m³ | 5.8 | 7.8 | - | - | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.0046 | 0.44 | 0.29 | 0.074 | 14 |
| Total Antimony | g/m³ | < 0.00021 | 0.00073 | 0.00027 | < 0.00021 | 0.00077 |
| Total Arsenic | g/m³ | < 0.0011 | 0.0038 | 0.0041 | < 0.0011 | 0.028 |
| Total Barium | g/m³ | 0.0047 | 0.023 | 0.023 | 0.0063 | 0.030 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | 0.00072 |
| Total Boron | g/m³ | 0.0099 | 0.022 | 0.014 | 0.011 | 0.011 |
| Total Cadmium | g/m³ | 0.0015 | 0.21 | 0.029 | < 0.000053 | 0.14 |
| Total Calcium | g/m³ | 6.6 | 63 | 19 | 5.5 | 23 |
| Total Chromium | g/m³ | < 0.00053 | 0.00058 | < 0.00053 | < 0.00053 | 0.0037 |
| Total Copper | g/m³ | 0.0012 | 0.49 | 0.065 | 0.00060 | 1.6 |
| Total Iron | g/m³ | < 0.021 | 4.4 | 0.41 | 0.036 | 26 |
| Total Lead | g/m³ | 0.00080 | 0.15 | 0.10 | 0.00036 | 0.91 |
| Total Lithium | g/m³ | 0.0016 | 0.015 | 0.0050 | 0.00079 | 0.021 |
| Total Magnesium | g/m³ | 1.5 | 14 | 5.6 | 2.1 | 15 |
| Total Manganese | g/m³ | 0.00070 | 1.6 | 0.24 | 0.0028 | 6.7 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | 0.00036 | 0.0050 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | < 0.00053 | 0.021 | 0.0050 | < 0.00053 | 0.065 |
| Total Potassium | g/m³ | 0.41 | 0.94 | 1.8 | 0.49 | 1.4 |
| Total Selenium | g/m³ | < 0.0011 | 0.0029 | < 0.0011 | < 0.0011 | < 0.0053 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 6.3 | 11 | 9.6 | 7.3 | 8.9 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | 0.00024 |
| Total Zinc | g/m³ | 0.18 | 30 | 4.1 | < 0.0011 | 25 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | 0.78 | 5.6 #1 | - | - | - |
| Sum of Cations | meq/L | 0.77 | 4.9 #1 | - | - | - |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW3 09-Oct-2009 | SW5 09-Oct-2009 | SW7 09-Oct-2009 | SW8 09-Oct-2009 | SW11 09-Oct-2009 |
| **Lab Number:** | | 734195.1 | 734195.2 | 734195.3 | 734195.4 | 734195.5 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| pH | pH Units | 7.8 | 7.1 | - | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 11 | 43 | - | - | - |
| Bicarbonate | g/m³ at 25°C | 14 | 52 | - | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 23 | 220 | - | - | - |
| Electrical Conductivity (EC) | mS/m | 8.6 | 54.6 | - | - | - |
| Dissolved Calcium | g/m³ | 6.7 | 64 | - | - | - |
| Dissolved Magnesium | g/m³ | 1.5 | 14 | - | - | - |
| Dissolved Potassium | g/m³ | 0.41 | 0.93 | - | - | - |
| Dissolved Sodium | g/m³ | 6.8 | 12 | - | - | - |
| Chloride | g/m³ | 10 | 11 | - | - | - |
| Nitrite-N | g/m³ | < 0.0020 | < 0.0020 | - | - | - |
| Nitrate-N | g/m³ | 0.17 | 0.062 | - | - | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.17 | 0.063 | - | - | - |
| Sulphate | g/m³ | 12 | 210 | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW13 09-Oct-2009 | SW15 09-Oct-2009 | SW25 09-Oct-2009 | SW100 09-Oct-2009 | SW101 09-Oct-2009 |
| **Lab Number:** | | 734195.6 | 734195.7 | 734195.8 | 734195.9 | 734195.10 |
| Individual Tests | | | | | | |
| pH | pH Units | 6.5 | 6.0 | - | - | - |
| Electrical Conductivity (EC) | mS/m | 12.2 | 23.4 | - | - | - |
| Total Suspended Solids | g/m³ | 5.2 | 3.0 | 13 | 3.2 | < 3.0 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | - | - | 16 | 14 | 12 |
| Total Cyanide | g/m³ | < 0.0010 | < 0.0010 | - | - | - |
| Silicon | g/m³ | - | - | 7.7 | 6.5 | 5.5 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.39 | 0.23 | 0.44 | 0.14 | 0.018 |
| Total Antimony | g/m³ | < 0.00021 | 0.00044 | 0.00097 | 0.00050 | 0.00036 |
| Total Arsenic | g/m³ | < 0.0011 | 0.024 | 0.0054 | < 0.0021 | < 0.0011 |
| Total Barium | g/m³ | 0.0081 | 0.028 | 0.023 | 0.021 | 0.015 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.011 | 0.014 | 0.020 | 0.015 | 0.013 |
| Total Cadmium | g/m³ | 0.0038 | 0.018 | 0.21 | 0.083 | 0.014 |
| Total Calcium | g/m³ | 7.8 | 20 | 63 | 27 | 5.5 |
| Total Chromium | g/m³ | < 0.00053 | 0.00075 | 0.00055 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.026 | 0.17 | 0.49 | 0.17 | 0.0073 |
| Total Iron | g/m³ | 0.26 | 1.1 | 4.4 | 1.2 | < 0.021 |
| Total Lead | g/m³ | 0.022 | 0.24 | 0.15 | 0.075 | 0.17 |
| Total Lithium | g/m³ | 0.0024 | 0.0059 | 0.016 | 0.0069 | 0.0015 |
| Total Magnesium | g/m³ | 3.2 | 7.1 | 14 | 6.9 | 2.2 |
| Total Manganese | g/m³ | 0.16 | 0.094 | 1.6 | 0.52 | 0.0035 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | 0.0010 | 0.00033 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | 0.0029 | 0.0033 | 0.021 | 0.0091 | 0.0012 |
| Total Potassium | g/m³ | 0.72 | 1.1 | 0.90 | 0.67 | 0.60 |
| Total Selenium | g/m³ | < 0.0011 | 0.0011 | < 0.0053 | < 0.0021 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 8.4 | 11 | 12 | 8.7 | 7.7 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 0.67 | 2.8 | 30 | 12 | 1.6 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | - | - | 6.3 #1 | 2.9 #1 | 0.88 #1 |
| Sum of Cations | meq/L | - | - | 4.9 #1 | 2.4 #1 | 0.71 #1 |
| pH | pH Units | - | - | 6.8 | 6.9 | 7.0 |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | 44 | 20 | 10 |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW13<br>09-Oct-2009 | SW15<br>09-Oct-2009 | SW25<br>09-Oct-2009 | SW100<br>09-Oct-2009 | SW101<br>09-Oct-2009 |
| **Lab Number:** | | 734195.6 | 734195.7 | 734195.8 | 734195.9 | 734195.10 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Bicarbonate | g/m³ at 25°C | - | - | 54 | 24 | 12 |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | 220 | 96 | 19 |
| Electrical Conductivity (EC) | mS/m | - | - | 54.4 | 27.9 | 9.6 |
| Dissolved Calcium | g/m³ | - | - | 64 | 27 | 4.8 |
| Dissolved Magnesium | g/m³ | - | - | 15 | 7.0 | 1.7 |
| Dissolved Potassium | g/m³ | - | - | 0.95 | 0.67 | 0.54 |
| Dissolved Sodium | g/m³ | - | - | 12 | 9.5 | 7.1 |
| Chloride | g/m³ | - | - | 10 | 11 | 12 |
| Nitrite-N | g/m³ | - | - | < 0.0020 | < 0.0020 | < 0.0020 |
| Nitrate-N | g/m³ | - | - | 0.063 | 0.13 | 0.25 |
| Nitrate-N + Nitrite-N | g/m³ | - | - | 0.063 | 0.13 | 0.25 |
| Sulphate | g/m³ | - | - | 240 | 110 | 16 |

| **Sample Name:** | | SW250<br>09-Oct-2009 | SW21<br>09-Oct-2009 | SW3B<br>09-Oct-2009 | SW5B<br>09-Oct-2009 | SW7B<br>09-Oct-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 734195.11 | 734195.12 | 734195.13 | 734195.14 | 734195.15 |
| Individual Tests | | | | | | |
| Total Cyanide | g/m³ | - | 0.0021 | - | - | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | < 0.0032 | - | 0.016 | 0.0083 | 0.084 |
| Total Antimony | g/m³ | < 0.00021 | - | < 0.00021 | 0.00037 | < 0.00021 |
| Total Arsenic | g/m³ | < 0.0011 | - | < 0.0011 | < 0.0053 | < 0.0011 |
| Total Barium | g/m³ | < 0.00021 | - | 0.0044 | 0.022 | 0.021 |
| Total Beryllium | g/m³ | < 0.00011 | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | < 0.0053 | - | 0.011 | 0.019 | 0.013 |
| Total Cadmium | g/m³ | < 0.000053 | - | 0.0016 | 0.19 | 0.028 |
| Total Calcium | g/m³ | < 0.053 | - | 6.7 | 58 | 18 |
| Total Chromium | g/m³ | < 0.00053 | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | < 0.00053 | - | 0.00096 | 0.043 | 0.020 |
| Total Iron | g/m³ | < 0.021 | - | < 0.021 | < 0.021 | 0.037 |
| Total Lead | g/m³ | < 0.00011 | - | 0.00049 | 0.00077 | 0.012 |
| Total Lithium | g/m³ | < 0.00042 | - | 0.0017 | 0.015 | 0.0047 |
| Total Magnesium | g/m³ | < 0.021 | - | 1.6 | 13 | 5.5 |
| Total Manganese | g/m³ | < 0.00053 | - | < 0.00053 | 1.5 | 0.23 |
| Total Mercury | g/m³ | < 0.000080 | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | - | < 0.00021 | 0.00027 | 0.0045 |
| Total Nickel | g/m³ | < 0.00053 | - | < 0.00053 | 0.021 | 0.0046 |
| Total Potassium | g/m³ | < 0.053 | - | 0.41 | 0.85 | 1.6 |
| Total Selenium | g/m³ | < 0.0011 | - | < 0.0011 | < 0.0053 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | < 0.021 | - | 6.6 | 11 | 9.5 |
| Total Tin | g/m³ | < 0.00053 | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | < 0.0011 | - | 0.18 | 27 | 3.9 |

| **Sample Name:** | | SW8B<br>09-Oct-2009 | SW11B<br>09-Oct-2009 | SW13B<br>09-Oct-2009 | SW15B<br>09-Oct-2009 | SW25B<br>09-Oct-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 734195.16 | 734195.17 | 734195.18 | 734195.19 | 734195.20 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.051 | 14 | 0.051 | 0.17 | 0.0082 |
| Total Antimony | g/m³ | < 0.00021 | 0.00072 | < 0.00021 | < 0.00021 | 0.00038 |
| Total Arsenic | g/m³ | < 0.0011 | 0.026 | < 0.0011 | 0.021 | < 0.0053 |
| Total Barium | g/m³ | 0.0054 | 0.031 | 0.0075 | 0.028 | 0.024 |
| Total Beryllium | g/m³ | < 0.00011 | 0.00080 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.0095 | 0.012 | 0.012 | 0.012 | 0.020 |
| Total Cadmium | g/m³ | < 0.000053 | 0.14 | 0.0037 | 0.018 | 0.20 |
| Total Calcium | g/m³ | 5.1 | 24 | 7.8 | 19 | 65 |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW8B 09-Oct-2009 | SW11B 09-Oct-2009 | SW13B 09-Oct-2009 | SW15B 09-Oct-2009 | SW25B 09-Oct-2009 |
| **Lab Number:** | | 734195.16 | 734195.17 | 734195.18 | 734195.19 | 734195.20 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Chromium | g/m³ | < 0.00053 | 0.0037 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | < 0.00053 | 1.7 | 0.0075 | 0.17 | 0.042 |
| Total Iron | g/m³ | 0.026 | 26 | 0.022 | 1.1 | < 0.021 |
| Total Lead | g/m³ | < 0.00011 | 0.89 | 0.0023 | 0.24 | 0.00090 |
| Total Lithium | g/m³ | 0.00070 | 0.022 | 0.0026 | 0.0059 | 0.016 |
| Total Magnesium | g/m³ | 2.0 | 15 | 3.4 | 7.1 | 15 |
| Total Manganese | g/m³ | 0.0014 | 6.9 | 0.16 | 0.099 | 1.7 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | 0.00098 | 0.00026 |
| Total Nickel | g/m³ | < 0.00053 | 0.066 | 0.0026 | 0.0032 | 0.022 |
| Total Potassium | g/m³ | 0.45 | 1.5 | 0.70 | 1.1 | 0.95 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0053 | < 0.0011 | < 0.0011 | < 0.0053 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 7.0 | 9.4 | 8.2 | 9.9 | 12 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | 0.00023 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 0.0015 | 25 | 0.62 | 2.8 | 29 |

| **Sample Name:** | | SW250B 09-Oct-2009 | SW100B 09-Oct-2009 | SW101B 09-Oct-2009 | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 734195.21 | 734195.22 | 734195.23 | | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | < 0.0032 | 0.014 | 0.012 | - | - |
| Total Antimony | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | - | - |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0021 | < 0.0011 | - | - |
| Total Barium | g/m³ | < 0.00021 | 0.019 | 0.015 | - | - |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | - | - |
| Total Boron | g/m³ | < 0.0053 | 0.014 | 0.012 | - | - |
| Total Cadmium | g/m³ | < 0.000053 | 0.077 | 0.014 | - | - |
| Total Calcium | g/m³ | < 0.053 | 26 | 5.6 | - | - |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | - | - |
| Total Copper | g/m³ | < 0.00053 | 0.033 | 0.0073 | - | - |
| Total Iron | g/m³ | < 0.021 | 0.033 | < 0.021 | - | - |
| Total Lead | g/m³ | < 0.00011 | 0.0050 | 0.16 | - | - |
| Total Lithium | g/m³ | < 0.00042 | 0.0074 | 0.0015 | - | - |
| Total Magnesium | g/m³ | < 0.021 | 6.5 | 2.1 | - | - |
| Total Manganese | g/m³ | < 0.00053 | 0.49 | 0.0030 | - | - |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | - | - |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | - | - |
| Total Nickel | g/m³ | < 0.00053 | 0.0091 | 0.0011 | - | - |
| Total Potassium | g/m³ | < 0.053 | 0.62 | 0.61 | - | - |
| Total Selenium | g/m³ | < 0.0011 | < 0.0021 | < 0.0011 | - | - |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | - | - |
| Total Sodium | g/m³ | < 0.021 | 8.4 | 7.6 | - | - |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | - | - |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | - | - |
| Total Zinc | g/m³ | < 0.0011 | 11 | 1.6 | - | - |

## Analyst's Comments

The client raised a number of queries which were booked in as separate QOWQ's. A summary of each QOWQ is presented below:

QOWQ 36393: Positive metal results detected in sample 734195.11 (Trip Blank)
The investigation confirmed the presence of metals in the original digest but not in the re-digested sample, indicating that the contamination was not in the sample but occurred during analysis, possibly by a contaminated digestion tube. The levels observed were not sufficiently high compared with the results of the other samples to allow a conclusion as to whether this contamination was isolated to this sample alone or whether other samples were affected.

## Analyst's Comments

QOWQ 36395: Zinc positive detected in sample 734195.21 (Field Blank)
The sample was re-digested and zinc was still detected but it was now below the detection limit. This may reflect the uncertainty of measurement (UoM) at this level of detection.

QOWQ 36396: Samples 734195.14 and 20 are duplicates but the aluminum did not agree within the DQO.
The samples were re-analysed and the result for sample 734195.14 confirmed but the aluminium result for 734195.20 was lower. Again, this may reflect the UoM at this level of detection.

QOWQ 36483: Following the results of QOWQ 36395, it was thought that the zinc positive in sample 734195.4 should be checked.
The sample was re-analysed and it was found that the zinc positive was not confirmed.

A QC Report has also been included at the request of the client.

#1 It has been noted that the results for the anion and cation balance were not in good agreement, but within the analytical variation of these methods.

Appendix No.1 - QC Report

# 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: Aqueous**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-2, 8-10 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-11, 13-23 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-11, 13-23 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 5-7, 12 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-2, 8-10 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-2, 8-10 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1-10 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 $g/m^3$ as $CaCO_3$ | 1-2, 8-10 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 $g/m^3$ at 25°C | 1-2, 8-10 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 $g/m^3$ as $CaCO_3$ | 1-2, 8-10 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1-10 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 $g/m^3$ | 1-10 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-2, 8-10 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 $g/m^3$ | 1-2, 8-10 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 $g/m^3$ | 1-2, 8-10 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 $g/m^3$ | 1-2, 8-10 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 $g/m^3$ as $SiO_2$ | 1-2, 8-10 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 $g/m^3$ | 1-2, 8-10 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 $g/m^3$ | 5-7, 12 |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 $g/m^3$ | 1-2, 8-10 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 $g/m^3$ | 1-2, 8-10 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 $g/m^3$ | 1-2, 8-10 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1-2, 8-10 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-2, 8-10 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1-2, 8-10 |
| Anion / Cation profile, dissolved metals trace level | | - | 1-2, 8-10 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-11, 13-23 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-11, 13-23 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-11, 13-23 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-11, 13-23 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-11, 13-23 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-11, 13-23 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-11, 13-23 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-11, 13-23 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |

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

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

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

***Client:*** ***Pattle Delamore Partners Ltd***
***Address:*** ***P.O Box 9258***
***Newmarket,Auckland 1149***
***Contact:*** ***Rumsby, Andrew***

***Laboratory No:*** ***734195 QC***
***Date Registered:*** ***09/10/2009***



***Client's Reference: A02277600***

# Quality Control Report for 734195

***This report includes quality control data for the following analytes:***

| | |
|---|---|
| Trace Elements - Water<br>Silicon | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements – Water<br>Dissolved Metals<br>(Calcium, Magnesium, Potassium,<br>and Sodium). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements - Water<br>Total Metals<br>(Arsenic, Aluminium, Antimony,<br>Barium, Beryllium, Boron, Calcium,<br>Cadmium, Chromium, Copper, Iron,<br>Lead, Lithium, Manganese, Magnesium,<br>Mercury, Molybdenum, Nickel, Potassium,<br>Selenium, Silver, Sodium, Tin, Uranium, Zinc). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Nitrite-N,Nitrate-N,Nitrogen Oxides – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Chloride – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| | |
|---|---|
| Total Cyanide – Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Total Alkalinity - Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Electrical Conductivity, pH | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Suspended Solids – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

## *Sample Type: Water*

### *Quality Control Data for Samples 734195.1,2,8,9,10 (EWSi 543)*

| Sample Name | Lab No | Silicon (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.01 |
| QC Standard | - | 5.14 |
| QC Standard Range | - | 4.5 – 5.5 |
| Sample Spike [% Recovery] | 734078.2 | 96 # |
| Duplicate Sample 1 | 734078.2 | 0.69 ## |
| Duplicate Sample 2 | 734078.2 | 0.67 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

### *Quality Control Data for Samples 734195.1 - 23 (HgBrF 177)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.00008 |
| Blank Spike [% Recovery] | - | 94 |
| QC Standard | - | 0.000542 |
| QC Standard Range | - | 0.00045 - 0.00055 |
| Sample Spike [% Recovery] | 734195.23 | 88 |
| Duplicate Sample 1 | 734195.23 | < 0.00008 |
| Duplicate Sample 2 | 734195.23 | < 0.00008 |

## *Quality Control Data for Samples 734195.1 - 16 (EWAg 252)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.01300 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 733891.1 | 114 # |
| Duplicate Sample 1 | 733891.1 | <0.0001 ## |
| Duplicate Sample 2 | 733891.1 | <0.0001 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.17 - 23 (EWAg 253)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.013 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 734195.23 | 113 |
| Duplicate Sample 1 | 734195.23 | < 0.0001 |
| Duplicate Sample 2 | 734195.23 | < 0.0001 |

## *Quality Control Data for Samples 734195.10 (EW 8047)*

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.508 | 0.048 | 0.506 | 0.510 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Duplicate Sample 1 | 733613.2 | 58.47 ## | 5.11 ## | 1.13 ## | 19.47 ## |
| Duplicate Sample 2 | 733613.2 | 57.15 ## | 5.09 ## | 1.13 ## | 19.96 ## |

##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1,2,8,9 (EW 8048)*

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.514 | 0.050 | 0.502 | 0.473 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Sample Spike[% Recovery] | 734389.10 | 107 # | 108 # | 100 # | 106 # |
| Duplicate Sample 1 | 734389.3 | 11.97 ## | 6.57 ## | 2.80 ## | 14.02 ## |
| Duplicate Sample 2 | 734389.3 | 11.96 ## | 6.66 ## | 2.83 ## | 14.45 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1-11, 13 - 23 (EWT 4956)*

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 733630.1 | 99 # | 94 # | 102 # | 101 # |
| QC Standard | - | 0.0050 | 0.0047 | 0.00487 | 0.00524 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | 0.019 ## | < 0.001 ## | < 0.0002 ## | 0.0041 ## |
| Duplicate Sample 2 | 733630.1 | 0.021 ## | < 0.001 ## | < 0.0002 ## | 0.0040 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 733630.1 | 97 # | 103 # | N\A ### | 101 # |
| QC Standard | | 0.0051 | 0.0108 | 0.503 | 0.004942 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | < 0.0001 ## | 0.0194 ## | 22.78## | < 0.00005 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0001 ## | 0.0210 ## | 22.49 ## | < 0.00005 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 733630.1 | 99 # | 93 # | 89 # | 99 # |
| QC Standard | | 0.0050 | 0.0050 | 0.042 | 0.00522 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 0.00079 ## | 0.264 ## | 0.0002 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 0.00086 ## | 0.244 ## | 0.0001 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 733630.1 | 96 # | 102 # | N\A ### | 103 # |
| QC Standard | | 0.00516 | 0.0052 | 0.050 | 0.00486 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | 0.0026 ## | 0.0037 ## | 5.43 ## | < 0.0002 ## |
| Duplicate Sample 2 | 733630.1 | 0.0024 ## | 0.0034 ## | 5.38 ## | < 0.0002 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

## *Quality Control Data for Samples 734195.1-11,13 - 23 (EWT 4956)*

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 733630.1 | 95 # | 90 # | 100 # | N\A ### |
| QC Standard | | 0.00494 | 0.496 | 0.0097 | 0.496 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 1.56 ## | < 0.001 ## | 14.49 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 1.54 ## | < 0.001 ## | 14.42 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 733630.1 | 102 # | N\A ### | 95 # |
| QC Standard | | 0.00487 | 0.00518 | 0.05 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 0.00014 ## | 0.017 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 0.00014 ## | 0.016 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the element is not included in our spike solution.

## *Quality Control Data for Samples 734195.2,5,8,9,14,17,20,22. (EWT 4961)*

| Sample Name | Lab No | Total Arsenic (g.m-3) | Total Selenium (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.02 |
| QC Standard | | 0.0051 | 0.0097 |
| QC Standard Range | | 0.0045 – 0.0055 | 0.009 – 0.011 |
| Duplicate Sample 1 # | 734760.2 | < 0.02 | < 0.02 |
| Duplicate Sample 2 # | 734760.2 | < 0.02 | < 0.02 |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1 – 10, 13 – 23 (Lithium), 20, 22 (Copper), 4, 21 (Zinc). (EWT 4961)*

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Copper (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.004 | < 0.01 | 0.024 |
| QC Standard | - | 0.0053 | 0.005 | 0.0511 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 # | 734760.2 | 0.016 | 0.057 | 4.824 |
| Duplicate Sample 2 # | 734760.2 | 0.015 | 0.058 | 4.763 |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Sample 734195.11, Aluminium only for 14,20 (EWT 4974)*

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Barium (g.m-3) | Total Calcium (g.m-3) | Total Copper (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 100 # | N\A ## | 93 # |
| QC Standard | - | 0.0052 | 0.0052 | 0.517 | 0.0050 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 734195.11 | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |
| Duplicate Sample 2 | 734195.11 | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Iron (g.m-3) | Total Lead (g.m-3) | Total Manganese (g.m-3) | Total Potassium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 100 # | 87 # | N\A ## |
| QC Standard | | 0.0450 | 0.0052 | 0.00528 | 0.511 |
| QC Standard Range | - | 0.03 – 0.07 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.45 – 0.55 |
| Duplicate Sample 1 | 734195.11 | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |
| Duplicate Sample 2 | 734195.11 | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Sodium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.001 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 96 # |
| QC Standard | | 0.515 | 0.0500 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 |
| Duplicate Sample 1 | 734195.11 | < 0.02 | < 0.001 |
| Duplicate Sample 2 | 734195.11 | < 0.02 | < 0.001 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

### *Quality Control Data for Samples 734195.5,6,7,12 (Cnw 238)*

| Sample Name | Lab No | Cyanide (mg/L) |
|---|---|---|
| Procedural Blank | - | < 0.003 |
| QC Standard 1 | - | 15.54 |
| QC Standard 2 | - | 15.55 |
| QC Standard Range | | 12.75 – 17.25 |

### *Quality Control Data for Samples 734195.1 - 10 (pHEC 1812)*

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 6.27 | < 0.1 |
| QC Standard 1 | - | 4.02 | 3.91 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 4.47 |
| QC Standard 2 | | 7.53 | 63.9 |
| QC Standard Range | | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | | N/A | 5360 |
| Saline QC Standard Range | | N/A | 5123 - 5423 |

### *Quality Control Data for Samples 734195.1 – 6 (SS 7881)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | | 1840 |
| QC Standard Range | | 1600 - 2400 |

### *Quality Control Data for Samples 734195.7 – 10 (SS 7882)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | | 2032 |
| QC Standard Range | | 1600 - 2400 |

### *Quality Control Data for Samples 734195.1,2 (KLGen 4359)*

| Sample Name | Lab No | Chloride (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.5 |
| Procedural Blank | | < 0.5 |
| QC Standard | | 9.86 |
| QC Standard Range | | 8.9 – 11.2 |

## *Quality Control Data for Samples 734195.8,9,10 (AutotM 138)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | | < 4 |
| QC Standard 1 | | 152.9 |
| QC Standard 2 | | 153.6 |
| QC Standard Range | | 142.5 – 157.5 |
| Duplicate Sample 1 | 734195.2 | 47.5 |
| Duplicate Sample 2 | 734195.2 | 45.5 |

## *Quality Control Data for Samples 734195.1,2 (AutotM 140)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | | < 4 |
| QC Standard 1 | | 154.9 |
| QC Standard 2 | | 155 |
| QC Standard Range | | 142.5 – 157.5 |
| Duplicate Sample 1 | 734494.1 | 20.8# |
| Duplicate Sample 2 | 734494.1 | 21.1# |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1,2,8,9,10 (IC 3221)*

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.50 |
| QC Standard 1 | | 9.86 |
| QC Standard Range | | 8.5 – 11.5 |
| QC Standard 2 | | 96.96 |
| QC Standard Range | | 85 - 115 |

## *Quality Control Data for Samples 734195.1,2,8,9,10 (L4C 2839)*

| Sample Name | Lab No | Nitrite-N (g.m-3) | Nitrite-N+Nitrate-N (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.0020 | < 0.0020 |
| QC Standard | | N/A | 5.267 |
| QC Standard Range | | N/A | 4.25 – 5.75 |

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R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 734195 | SUPv1 |
| **Contact:** | A Rumsby | **Date Registered:** | 09-Oct-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 05-Nov-2009 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | A02277600 | |
| | | **Submitted By:** | R Sharplin | |

**Sample Type: Aqueous**

| Sample Name: | | SW3 09-Oct-2009 | SW5 09-Oct-2009 | SW7 09-Oct-2009 | SW8 09-Oct-2009 |
|---|---|---|---|---|---|
| **Lab Number:** | | 734195.1 | 734195.2 | 734195.3 | 734195.4 |
| Individual Tests | | | | | |
| pH | pH Units | - | - | 7.4 ± 0.2 | 7.7 ± 0.2 |
| Electrical Conductivity (EC) | mS/m | - | - | 20.8 ± 0.2 | 8.3 ± 0.1 |
| Total Suspended Solids | g/m³ | < 3 ± 2.1 | 13.8 ± 2.7 | < 3 ± 2.1 | < 3 ± 2.1 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 12.38 ± 0.75 | 16.7 ± 1.1 | - | - |
| Silicon | g/m³ | 5.79 ± 0.35 | 7.80 ± 0.47 | - | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0046 ± 0.0022 | 0.441 ± 0.069 | 0.293 ± 0.046 | 0.074 ± 0.012 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00017 | 0.00073 ± 0.00056 | 0.00027 ± 0.00022 | < 0.0003 ± 0.00017 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | 0.00383 ± 0.00097 | 0.0041 ± 0.0011 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.00468 ± 0.00034 | 0.0227 ± 0.0016 | 0.0231 ± 0.0016 | 0.00627 ± 0.00044 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0099 ± 0.0038 | 0.0216 ± 0.0046 | 0.0137 ± 0.0040 | 0.0108 ± 0.0038 |
| Total Cadmium | g/m³ | 0.00152 ± 0.00017 | 0.207 ± 0.023 | 0.0289 ± 0.0032 | < 0.00006 ± 0.000036 |
| Total Calcium | g/m³ | 6.61 ± 0.35 | 63.4 ± 3.3 | 18.82 ± 0.98 | 5.53 ± 0.29 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | 0.00058 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.00121 ± 0.00038 | 0.491 ± 0.053 | 0.0646 ± 0.0070 | 0.00060 ± 0.00036 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | 4.40 ± 0.54 | 0.406 ± 0.052 | 0.036 ± 0.015 |
| Total Lead | g/m³ | 0.00080 ± 0.00011 | 0.150 ± 0.016 | 0.103 ± 0.011 | 0.000355 ± 0.000082 |
| Total Lithium | g/m³ | 0.00158 ± 0.00032 | 0.0154 ± 0.0015 | 0.00496 ± 0.00053 | 0.00079 ± 0.00029 |
| Total Magnesium | g/m³ | 1.49 ± 0.18 | 14.4 ± 1.7 | 5.56 ± 0.65 | 2.06 ± 0.24 |
| Total Manganese | g/m³ | 0.00070 ± 0.00036 | 1.60 ± 0.17 | 0.244 ± 0.025 | 0.00276 ± 0.00045 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | 0.00036 ± 0.00015 | 0.00502 ± 0.00081 | < 0.0003 ± 0.00014 |
| Total Nickel | g/m³ | < 0.0006 ± 0.00036 | 0.0214 ± 0.0040 | 0.00497 ± 0.00098 | < 0.0006 ± 0.00036 |
| Total Potassium | g/m³ | 0.414 ± 0.047 | 0.940 ± 0.077 | 1.76 ± 0.14 | 0.494 ± 0.050 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | 0.0029 ± 0.0015 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 6.29 ± 0.44 | 11.50 ± 0.80 | 9.63 ± 0.67 | 7.32 ± 0.51 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 0.175 ± 0.014 | 29.9 ± 2.4 | 4.13 ± 0.32 | < 0.0011 ± 0.00074 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | 0.78 | 5.6 #1 | - | - |
| Sum of Cations | meq/L | 0.77 | 4.9 #1 | - | - |
| pH | pH Units | 7.8 ± 0.2 | 7.1 ± 0.2 | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 11.20 ± 0.97 | 43.1 ± 2.8 | - | - |
| Bicarbonate | g/m³ at 25°C | 13.5 ± 1.5 | 52.5 ± 4.1 | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 23.1 ± 1.2 | 219 ± 11 | - | - |

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW3 09-Oct-2009 | SW5 09-Oct-2009 | SW7 09-Oct-2009 | SW8 09-Oct-2009 |
| **Lab Number:** | | 734195.1 | 734195.2 | 734195.3 | 734195.4 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Electrical Conductivity (EC) | mS/m | 8.6 ± 0.1 | 54.6 ± 0.4 | - | - |
| Dissolved Calcium | g/m³ | 6.72 ± 0.43 | 64.2 ± 4.1 | - | - |
| Dissolved Magnesium | g/m³ | 1.54 ± 0.11 | 14.28 ± 0.96 | - | - |
| Dissolved Potassium | g/m³ | 0.408 ± 0.045 | 0.929 ± 0.076 | - | - |
| Dissolved Sodium | g/m³ | 6.76 ± 0.73 | 12.3 ± 1.4 | - | - |
| Chloride | g/m³ | 10.07 ± 0.82 | 10.99 ± 0.88 | - | - |
| Nitrite-N | g/m³ | < 0.002 ± 0.0014 | < 0.002 ± 0.0014 | - | - |
| Nitrate-N | g/m³ | 0.170 ± 0.018 | 0.0619 ± 0.0066 | - | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.170 ± 0.018 | 0.0632 ± 0.0065 | - | - |
| Sulphate | g/m³ | 12.48 ± 0.90 | 213 ± 15 | - | - |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 09-Oct-2009 | SW13 09-Oct-2009 | SW15 09-Oct-2009 | SW25 09-Oct-2009 |
| **Lab Number:** | | 734195.5 | 734195.6 | 734195.7 | 734195.8 |
| Individual Tests | | | | | |
| pH | pH Units | 3.2 ± 0.2 | 6.5 ± 0.2 | 6.0 ± 0.2 | - |
| Electrical Conductivity (EC) | mS/m | 82.1 ± 0.6 | 12.2 ± 0.2 | 23.4 ± 0.2 | - |
| Total Suspended Solids | g/m³ | 11.4 ± 2.5 | 5.2 ± 2.2 | 3.0 ± 2.1 | 13.4 ± 2.7 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | - | - | - | 16.47 ± 0.99 |
| Total Cyanide | g/m³ | 0.0025 ± 0.0012 | < 0.0010 ± 0.00067 | < 0.0010 ± 0.00067 | - |
| Silicon | g/m³ | - | - | - | 7.70 ± 0.47 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 14.0 ± 2.2 | 0.386 ± 0.061 | 0.233 ± 0.037 | 0.444 ± 0.070 |
| Total Antimony | g/m³ | 0.00077 ± 0.00059 | < 0.0003 ± 0.00017 | 0.00044 ± 0.00034 | 0.00097 ± 0.00074 |
| Total Arsenic | g/m³ | 0.0278 ± 0.0049 | < 0.0011 ± 0.00074 | 0.0242 ± 0.0043 | 0.0054 ± 0.0012 |
| Total Barium | g/m³ | 0.0300 ± 0.0020 | 0.00809 ± 0.00056 | 0.0283 ± 0.0019 | 0.0228 ± 0.0016 |
| Total Beryllium | g/m³ | 0.00072 ± 0.00012 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0114 ± 0.0038 | 0.0114 ± 0.0039 | 0.0140 ± 0.0040 | 0.0203 ± 0.0045 |
| Total Cadmium | g/m³ | 0.139 ± 0.015 | 0.00375 ± 0.00041 | 0.0181 ± 0.0020 | 0.209 ± 0.023 |
| Total Calcium | g/m³ | 23.3 ± 1.3 | 7.83 ± 0.41 | 19.6 ± 1.1 | 62.8 ± 3.3 |
| Total Chromium | g/m³ | 0.00372 ± 0.00060 | < 0.0006 ± 0.00036 | 0.00075 ± 0.00037 | 0.00055 ± 0.00036 |
| Total Copper | g/m³ | 1.65 ± 0.18 | 0.0256 ± 0.0028 | 0.172 ± 0.019 | 0.487 ± 0.053 |
| Total Iron | g/m³ | 26.1 ± 3.3 | 0.264 ± 0.036 | 1.07 ± 0.14 | 4.41 ± 0.55 |
| Total Lead | g/m³ | 0.910 ± 0.094 | 0.0217 ± 0.0023 | 0.244 ± 0.026 | 0.153 ± 0.016 |
| Total Lithium | g/m³ | 0.0206 ± 0.0019 | 0.00238 ± 0.00035 | 0.00587 ± 0.00060 | 0.0158 ± 0.0015 |
| Total Magnesium | g/m³ | 14.7 ± 1.8 | 3.18 ± 0.37 | 7.08 ± 0.83 | 14.4 ± 1.7 |
| Total Manganese | g/m³ | 6.72 ± 0.68 | 0.155 ± 0.016 | 0.0941 ± 0.0095 | 1.62 ± 0.17 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00105 ± 0.00022 | 0.00033 ± 0.00015 |
| Total Nickel | g/m³ | 0.065 ± 0.012 | 0.00286 ± 0.00063 | 0.00335 ± 0.00071 | 0.0213 ± 0.0040 |
| Total Potassium | g/m³ | 1.42 ± 0.11 | 0.717 ± 0.063 | 1.149 ± 0.090 | 0.897 ± 0.074 |
| Total Selenium | g/m³ | < 0.006 ± 0.0025 | < 0.0011 ± 0.00074 | 0.00112 ± 0.00074 | < 0.006 ± 0.0025 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 8.91 ± 0.62 | 8.45 ± 0.59 | 10.64 ± 0.74 | 11.56 ± 0.81 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | 0.000237 ± 0.000043 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 25.0 ± 2.0 | 0.666 ± 0.052 | 2.79 ± 0.22 | 29.6 ± 2.3 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | - | - | - | 6.3 #1 |
| Sum of Cations | meq/L | - | - | - | 4.9 #1 |
| pH | pH Units | - | - | - | 6.8 ± 0.2 |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | - | 44.4 ± 2.9 |
| Bicarbonate | g/m³ at 25°C | - | - | - | 54.1 ± 4.3 |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | - | 219 ± 11 |
| Electrical Conductivity (EC) | mS/m | - | - | - | 54.4 ± 0.4 |
| Dissolved Calcium | g/m³ | - | - | - | 63.7 ± 4.0 |
| Dissolved Magnesium | g/m³ | - | - | - | 14.64 ± 0.99 |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 09-Oct-2009 | SW13 09-Oct-2009 | SW15 09-Oct-2009 | SW25 09-Oct-2009 |
| **Lab Number:** | | 734195.5 | 734195.6 | 734195.7 | 734195.8 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Dissolved Potassium | g/m³ | - | - | - | 0.949 ± 0.077 |
| Dissolved Sodium | g/m³ | - | - | - | 12.3 ± 1.4 |
| Chloride | g/m³ | - | - | - | 10.25 ± 0.83 |
| Nitrite-N | g/m³ | - | - | - | < 0.002 ± 0.0014 |
| Nitrate-N | g/m³ | - | - | - | 0.0630 ± 0.0066 |
| Nitrate-N + Nitrite-N | g/m³ | - | - | - | 0.0630 ± 0.0065 |
| Sulphate | g/m³ | - | - | - | 245 ± 17 |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW100 09-Oct-2009 | SW101 09-Oct-2009 | SW250 09-Oct-2009 | SW21 09-Oct-2009 |
| **Lab Number:** | | 734195.9 | 734195.10 | 734195.11 | 734195.12 |
| Individual Tests | | | | | |
| Total Suspended Solids | g/m³ | 3.2 ± 2.1 | < 3 ± 2.1 | - | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 13.96 ± 0.84 | 11.83 ± 0.71 | - | - |
| Total Cyanide | g/m³ | - | - | - | 0.0021 ± 0.0011 |
| Silicon | g/m³ | 6.52 ± 0.40 | 5.53 ± 0.34 | - | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.144 ± 0.023 | 0.0184 ± 0.0036 | < 0.004 ± 0.0022 | - |
| Total Antimony | g/m³ | 0.00050 ± 0.00039 | 0.00036 ± 0.00028 | < 0.0003 ± 0.00017 | - |
| Total Arsenic | g/m³ | < 0.003 ± 0.00080 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | - |
| Total Barium | g/m³ | 0.0209 ± 0.0014 | 0.0152 ± 0.0011 | < 0.0003 ± 0.00015 | - |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - |
| Total Boron | g/m³ | 0.0148 ± 0.0041 | 0.0127 ± 0.0039 | < 0.006 ± 0.0036 | - |
| Total Cadmium | g/m³ | 0.0825 ± 0.0090 | 0.0140 ± 0.0016 | < 0.00006 ± 0.000036 | - |
| Total Calcium | g/m³ | 27.1 ± 1.5 | 5.53 ± 0.29 | < 0.06 ± 0.036 | - |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - |
| Total Copper | g/m³ | 0.169 ± 0.019 | 0.00726 ± 0.00086 | < 0.0006 ± 0.00036 | - |
| Total Iron | g/m³ | 1.17 ± 0.15 | < 0.03 ± 0.014 | < 0.03 ± 0.014 | - |
| Total Lead | g/m³ | 0.0752 ± 0.0078 | 0.175 ± 0.018 | < 0.00011 ± 0.000074 | - |
| Total Lithium | g/m³ | 0.00694 ± 0.00069 | 0.00150 ± 0.00031 | < 0.0005 ± 0.00028 | - |
| Total Magnesium | g/m³ | 6.89 ± 0.80 | 2.17 ± 0.26 | < 0.03 ± 0.014 | - |
| Total Manganese | g/m³ | 0.518 ± 0.052 | 0.00346 ± 0.00050 | < 0.0006 ± 0.00036 | - |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | - |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | - |
| Total Nickel | g/m³ | 0.0091 ± 0.0018 | 0.00121 ± 0.00041 | < 0.0006 ± 0.00036 | - |
| Total Potassium | g/m³ | 0.667 ± 0.060 | 0.600 ± 0.056 | < 0.06 ± 0.036 | - |
| Total Selenium | g/m³ | < 0.003 ± 0.0011 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | - |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - |
| Total Sodium | g/m³ | 8.72 ± 0.61 | 7.72 ± 0.54 | < 0.03 ± 0.015 | - |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | - |
| Total Zinc | g/m³ | 11.54 ± 0.89 | 1.59 ± 0.13 | < 0.0011 ± 0.00074 | - |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | 2.9 #1 | 0.88 #1 | - | - |
| Sum of Cations | meq/L | 2.4 #1 | 0.71 #1 | - | - |
| pH | pH Units | 6.9 ± 0.2 | 7.0 ± 0.2 | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 19.7 ± 1.4 | 10.00 ± 0.91 | - | - |
| Bicarbonate | g/m³ at 25°C | 24.0 ± 2.1 | 12.2 ± 1.4 | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | 96.1 ± 4.7 | 19.04 ± 0.90 | - | - |
| Electrical Conductivity (EC) | mS/m | 27.9 ± 0.2 | 9.6 ± 0.1 | - | - |
| Dissolved Calcium | g/m³ | 27.0 ± 1.7 | 4.82 ± 0.31 | - | - |
| Dissolved Magnesium | g/m³ | 6.95 ± 0.47 | 1.70 ± 0.12 | - | - |
| Dissolved Potassium | g/m³ | 0.668 ± 0.059 | 0.544 ± 0.052 | - | - |
| Dissolved Sodium | g/m³ | 9.5 ± 1.1 | 7.14 ± 0.77 | - | - |
| Chloride | g/m³ | 10.60 ± 0.86 | 11.68 ± 0.93 | - | - |
| Nitrite-N | g/m³ | < 0.002 ± 0.0014 | < 0.002 ± 0.0014 | - | - |
| Nitrate-N | g/m³ | 0.132 ± 0.014 | 0.254 ± 0.026 | - | - |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW100 09-Oct-2009 | SW101 09-Oct-2009 | SW250 09-Oct-2009 | SW21 09-Oct-2009 |
| **Lab Number:** | | 734195.9 | 734195.10 | 734195.11 | 734195.12 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Nitrate-N + Nitrite-N | g/m³ | 0.132 ± 0.014 | 0.254 ± 0.026 | - | - |
| Sulphate | g/m³ | 106.1 ± 7.1 | 16.0 ± 1.2 | - | - |

| **Sample Name:** | | SW3B 09-Oct-2009 | SW5B 09-Oct-2009 | SW7B 09-Oct-2009 | SW8B 09-Oct-2009 |
|---|---|---|---|---|---|
| **Lab Number:** | | 734195.13 | 734195.14 | 734195.15 | 734195.16 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0158 ± 0.0033 | 0.0083 ± 0.0025 | 0.084 ± 0.014 | 0.0512 ± 0.0083 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00017 | 0.00037 ± 0.00029 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.006 ± 0.0012 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.00436 ± 0.00032 | 0.0216 ± 0.0015 | 0.0212 ± 0.0015 | 0.00536 ± 0.00038 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0110 ± 0.0038 | 0.0185 ± 0.0043 | 0.0132 ± 0.0040 | 0.0095 ± 0.0037 |
| Total Cadmium | g/m³ | 0.00161 ± 0.00018 | 0.189 ± 0.021 | 0.0278 ± 0.0031 | < 0.00006 ± 0.000036 |
| Total Calcium | g/m³ | 6.74 ± 0.36 | 58.3 ± 3.1 | 18.12 ± 0.95 | 5.10 ± 0.27 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.00096 ± 0.00037 | 0.0430 ± 0.0047 | 0.0201 ± 0.0022 | < 0.0006 ± 0.00036 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | < 0.03 ± 0.014 | 0.037 ± 0.015 | 0.026 ± 0.015 |
| Total Lead | g/m³ | 0.000488 ± 0.000089 | 0.00077 ± 0.00011 | 0.0118 ± 0.0013 | < 0.00011 ± 0.000074 |
| Total Lithium | g/m³ | 0.00172 ± 0.00032 | 0.0149 ± 0.0014 | 0.00473 ± 0.00051 | 0.00070 ± 0.00029 |
| Total Magnesium | g/m³ | 1.58 ± 0.19 | 13.4 ± 1.6 | 5.49 ± 0.64 | 2.01 ± 0.24 |
| Total Manganese | g/m³ | < 0.0006 ± 0.00036 | 1.51 ± 0.16 | 0.234 ± 0.024 | 0.00138 ± 0.00038 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | 0.00027 ± 0.00015 | 0.00453 ± 0.00073 | < 0.0003 ± 0.00014 |
| Total Nickel | g/m³ | < 0.0006 ± 0.00036 | 0.0206 ± 0.0039 | 0.00457 ± 0.00091 | < 0.0006 ± 0.00036 |
| Total Potassium | g/m³ | 0.411 ± 0.046 | 0.851 ± 0.071 | 1.63 ± 0.13 | 0.446 ± 0.048 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.006 ± 0.0025 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 6.59 ± 0.46 | 10.81 ± 0.75 | 9.55 ± 0.67 | 6.98 ± 0.49 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 0.183 ± 0.015 | 26.6 ± 2.1 | 3.92 ± 0.31 | 0.00147 ± 0.00074 |

| **Sample Name:** | | SW11B 09-Oct-2009 | SW13B 09-Oct-2009 | SW15B 09-Oct-2009 | SW25B 09-Oct-2009 |
|---|---|---|---|---|---|
| **Lab Number:** | | 734195.17 | 734195.18 | 734195.19 | 734195.20 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 14.3 ± 2.3 | 0.0514 ± 0.0083 | 0.169 ± 0.027 | 0.0082 ± 0.0025 |
| Total Antimony | g/m³ | 0.00072 ± 0.00055 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 | 0.00038 ± 0.00030 |
| Total Arsenic | g/m³ | 0.0262 ± 0.0046 | < 0.0011 ± 0.00074 | 0.0215 ± 0.0038 | < 0.006 ± 0.0012 |
| Total Barium | g/m³ | 0.0308 ± 0.0021 | 0.00752 ± 0.00052 | 0.0281 ± 0.0019 | 0.0236 ± 0.0016 |
| Total Beryllium | g/m³ | 0.00080 ± 0.00013 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0121 ± 0.0039 | 0.0121 ± 0.0039 | 0.0121 ± 0.0039 | 0.0201 ± 0.0045 |
| Total Cadmium | g/m³ | 0.142 ± 0.016 | 0.00372 ± 0.00041 | 0.0181 ± 0.0020 | 0.203 ± 0.022 |
| Total Calcium | g/m³ | 23.9 ± 1.3 | 7.81 ± 0.41 | 19.3 ± 1.1 | 65.4 ± 3.4 |
| Total Chromium | g/m³ | 0.00369 ± 0.00060 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 1.67 ± 0.18 | 0.00747 ± 0.00088 | 0.170 ± 0.019 | 0.0424 ± 0.0046 |
| Total Iron | g/m³ | 26.2 ± 3.3 | 0.022 ± 0.015 | 1.09 ± 0.14 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.886 ± 0.092 | 0.00232 ± 0.00025 | 0.238 ± 0.025 | 0.00090 ± 0.00012 |
| Total Lithium | g/m³ | 0.0216 ± 0.0020 | 0.00265 ± 0.00037 | 0.00591 ± 0.00060 | 0.0156 ± 0.0015 |
| Total Magnesium | g/m³ | 15.0 ± 1.8 | 3.38 ± 0.40 | 7.09 ± 0.83 | 15.0 ± 1.8 |
| Total Manganese | g/m³ | 6.85 ± 0.69 | 0.159 ± 0.016 | 0.099 ± 0.010 | 1.68 ± 0.17 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00098 ± 0.00021 | 0.00026 ± 0.00015 |
| Total Nickel | g/m³ | 0.066 ± 0.013 | 0.00263 ± 0.00060 | 0.00323 ± 0.00069 | 0.0220 ± 0.0041 |
| Total Potassium | g/m³ | 1.49 ± 0.12 | 0.697 ± 0.062 | 1.088 ± 0.086 | 0.955 ± 0.078 |
| Total Selenium | g/m³ | < 0.006 ± 0.0025 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.006 ± 0.0025 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW 11B 09-Oct-2009 | SW 13B 09-Oct-2009 | SW 15B 09-Oct-2009 | SW 25B 09-Oct-2009 |
| **Lab Number:** | | 734195.17 | 734195.18 | 734195.19 | 734195.20 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Sodium | g/m³ | 9.43 ± 0.66 | 8.17 ± 0.57 | 9.88 ± 0.69 | 11.72 ± 0.82 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | 0.000235 ± 0.000043 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 25.2 ± 2.0 | 0.623 ± 0.049 | 2.75 ± 0.22 | 28.6 ± 2.3 |

| **Sample Name:** | | SW 250B 09-Oct-2009 | SW 100B 09-Oct-2009 | SW 101B 09-Oct-2009 | |
|---|---|---|---|---|---|
| **Lab Number:** | | 734195.21 | 734195.22 | 734195.23 | |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | < 0.004 ± 0.0022 | 0.0140 ± 0.0030 | 0.0120 ± 0.0028 | - |
| Total Antimony | g/m³ | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 | < 0.0003 ± 0.00017 | - |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.003 ± 0.00080 | < 0.0011 ± 0.00074 | - |
| Total Barium | g/m³ | < 0.0003 ± 0.00015 | 0.0191 ± 0.0013 | 0.01456 ± 0.00097 | - |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - |
| Total Boron | g/m³ | < 0.006 ± 0.0036 | 0.0137 ± 0.0040 | 0.0119 ± 0.0039 | - |
| Total Cadmium | g/m³ | < 0.00006 ± 0.000036 | 0.0771 ± 0.0084 | 0.0141 ± 0.0016 | - |
| Total Calcium | g/m³ | < 0.06 ± 0.036 | 26.2 ± 1.4 | 5.56 ± 0.30 | - |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - |
| Total Copper | g/m³ | < 0.0006 ± 0.00036 | 0.0332 ± 0.0036 | 0.00729 ± 0.00086 | - |
| Total Iron | g/m³ | < 0.03 ± 0.014 | 0.033 ± 0.015 | < 0.03 ± 0.014 | - |
| Total Lead | g/m³ | < 0.00011 ± 0.000074 | 0.00502 ± 0.00053 | 0.159 ± 0.017 | - |
| Total Lithium | g/m³ | < 0.0005 ± 0.00028 | 0.00736 ± 0.00072 | 0.00152 ± 0.00031 | - |
| Total Magnesium | g/m³ | < 0.03 ± 0.014 | 6.53 ± 0.76 | 2.08 ± 0.25 | - |
| Total Manganese | g/m³ | < 0.0006 ± 0.00036 | 0.492 ± 0.050 | 0.00299 ± 0.00047 | - |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | - |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | - |
| Total Nickel | g/m³ | < 0.0006 ± 0.00036 | 0.0091 ± 0.0018 | 0.00112 ± 0.00040 | - |
| Total Potassium | g/m³ | < 0.06 ± 0.036 | 0.625 ± 0.057 | 0.607 ± 0.056 | - |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.003 ± 0.0011 | < 0.0011 ± 0.00074 | - |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - |
| Total Sodium | g/m³ | < 0.03 ± 0.015 | 8.36 ± 0.58 | 7.59 ± 0.53 | - |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | - |
| Total Zinc | g/m³ | < 0.0011 ± 0.00074 | 10.98 ± 0.85 | 1.62 ± 0.13 | - |

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

## Analyst's Comments

The client raised an number of queries which were booked in as separate QOWQ's. A summary of each QOWQ is presented below:

QOWQ 36393: Positive metal results detected in sample 734195.11 (Trip Blank)
The investigation confirmed the presence of metals in the original digest but not in the re-digested sample, indicating that the contamination was not in the sample but occurred during analysis, possibly by a contaminated digestion tube. The levels observed were not sufficiently high compared with the results of the other samples to allow a conclusion as to whether this contamination was isolated to this sample alone or whether other samples were affected.

QOWQ 36395: Zinc positive detected in sample 734195.21 (Field Blank)
The sample was re-digested and zinc was still detected but it was now below the detection limit. This may reflect the uncertainty of measurement (UoM) at this level of detection.

QOWQ 36396: Samples 734195.14 and 20 are duplicates but the aluminum did not agree within the DQO.
The samples were re-analysed and the result for sample 734195.14 confirmed but the aluminium result for 734195.20 was lower. Again, this may reflect the UoM at this level of detection.

QOWQ 36483: Following the results of QOWQ 36395, it was thought that the zinc positive in sample 734195.4 should be

## Analyst's Comments

checked.
The sample was re-analysed and it was found that the zinc positive was not confirmed.

A QC Report has also been included at the request of the client.

#1 It has been noted that the results for the anion and cation balance were not in good agreement, but within the analytical variation of these methods.

Appendix No.1 - QC Report

# 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: Aqueous**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-2, 8-10 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-11, 13-23 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-11, 13-23 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 5-7, 12 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-2, 8-10 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-2, 8-10 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1-10 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1-2, 8-10 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1-2, 8-10 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1-2, 8-10 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1-10 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 g/m³ | 1-10 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-2, 8-10 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-2, 8-10 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-2, 8-10 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-2, 8-10 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 g/m³ as $SiO_2$ | 1-2, 8-10 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-2, 8-10 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 g/m³ | 5-7, 12 |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 g/m³ | 1-2, 8-10 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 g/m³ | 1-2, 8-10 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-2, 8-10 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1-2, 8-10 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-2, 8-10 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1-2, 8-10 |
| Anion / Cation profile, dissolved metals trace level | | - | 1-2, 8-10 |
| Drinking water metals suite, totals, trace | | | |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-11, 13-23 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-11, 13-23 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-11, 13-23 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-11, 13-23 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-11, 13-23 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-11, 13-23 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-11, 13-23 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-11, 13-23 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-11, 13-23 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-11, 13-23 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-11, 13-23 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-11, 13-23 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-11, 13-23 |

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.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

***Client:*** ***Pattle Delamore Partners Ltd***
***Address:*** ***P.O Box 9258***
***Newmarket,Auckland 1149***
***Contact:*** ***Rumsby, Andrew***

***Laboratory No:*** ***734195 QC***
***Date Registered:*** ***09/10/2009***



***Client's Reference: A02277600***

# Quality Control Report for 734195

***This report includes quality control data for the following analytes:***

| | |
|---|---|
| Trace Elements - Water<br>Silicon | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements – Water<br>Dissolved Metals<br>(Calcium, Magnesium, Potassium,<br>and Sodium). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements - Water<br>Total Metals<br>(Arsenic, Aluminium, Antimony,<br>Barium, Beryllium, Boron, Calcium,<br>Cadmium, Chromium, Copper, Iron,<br>Lead, Lithium, Manganese, Magnesium,<br>Mercury, Molybdenum, Nickel, Potassium,<br>Selenium, Silver, Sodium, Tin, Uranium, Zinc). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Nitrite-N,Nitrate-N,Nitrogen Oxides – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Chloride – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| | |
|---|---|
| Total Cyanide – Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Total Alkalinity - Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Electrical Conductivity, pH | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Suspended Solids – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

## *Sample Type: Water*

### *Quality Control Data for Samples 734195.1,2,8,9,10 (EWSi 543)*

| Sample Name | Lab No | Silicon (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.01 |
| QC Standard | - | 5.14 |
| QC Standard Range | - | 4.5 – 5.5 |
| Sample Spike [% Recovery] | 734078.2 | 96 # |
| Duplicate Sample 1 | 734078.2 | 0.69 ## |
| Duplicate Sample 2 | 734078.2 | 0.67 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

### *Quality Control Data for Samples 734195.1 - 23 (HgBrF 177)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.00008 |
| Blank Spike [% Recovery] | - | 94 |
| QC Standard | - | 0.000542 |
| QC Standard Range | - | 0.00045 - 0.00055 |
| Sample Spike [% Recovery] | 734195.23 | 88 |
| Duplicate Sample 1 | 734195.23 | < 0.00008 |
| Duplicate Sample 2 | 734195.23 | < 0.00008 |

## *Quality Control Data for Samples 734195.1 - 16 (EWAg 252)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.01300 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 733891.1 | 114 # |
| Duplicate Sample 1 | 733891.1 | <0.0001 ## |
| Duplicate Sample 2 | 733891.1 | <0.0001 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.17 - 23 (EWAg 253)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.013 |
| QC Standard Range | | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 734195.23 | 113 |
| Duplicate Sample 1 | 734195.23 | < 0.0001 |
| Duplicate Sample 2 | 734195.23 | < 0.0001 |

## *Quality Control Data for Samples 734195.10 (EW 8047)*

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.508 | 0.048 | 0.506 | 0.510 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Duplicate Sample 1 | 733613.2 | 58.47 ## | 5.11 ## | 1.13 ## | 19.47 ## |
| Duplicate Sample 2 | 733613.2 | 57.15 ## | 5.09 ## | 1.13 ## | 19.96 ## |

##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1,2,8,9 (EW 8048)*

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.514 | 0.050 | 0.502 | 0.473 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Sample Spike[% Recovery] | 734389.10 | 107 # | 108 # | 100 # | 106 # |
| Duplicate Sample 1 | 734389.3 | 11.97 ## | 6.57 ## | 2.80 ## | 14.02 ## |
| Duplicate Sample 2 | 734389.3 | 11.96 ## | 6.66 ## | 2.83 ## | 14.45 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1-11, 13 - 23 (EWT 4956)*

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 733630.1 | 99 # | 94 # | 102 # | 101 # |
| QC Standard | - | 0.0050 | 0.0047 | 0.00487 | 0.00524 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | 0.019 ## | < 0.001 ## | < 0.0002 ## | 0.0041 ## |
| Duplicate Sample 2 | 733630.1 | 0.021 ## | < 0.001 ## | < 0.0002 ## | 0.0040 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 733630.1 | 97 # | 103 # | N\A ### | 101 # |
| QC Standard | | 0.0051 | 0.0108 | 0.503 | 0.004942 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | < 0.0001 ## | 0.0194 ## | 22.78## | < 0.00005 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0001 ## | 0.0210 ## | 22.49 ## | < 0.00005 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 733630.1 | 99 # | 93 # | 89 # | 99 # |
| QC Standard | | 0.0050 | 0.0050 | 0.042 | 0.00522 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 0.00079 ## | 0.264 ## | 0.0002 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 0.00086 ## | 0.244 ## | 0.0001 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 733630.1 | 96 # | 102 # | N\A ### | 103 # |
| QC Standard | | 0.00516 | 0.0052 | 0.050 | 0.00486 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 733630.1 | 0.0026 ## | 0.0037 ## | 5.43 ## | < 0.0002 ## |
| Duplicate Sample 2 | 733630.1 | 0.0024 ## | 0.0034 ## | 5.38 ## | < 0.0002 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

## *Quality Control Data for Samples 734195.1-11,13 - 23 (EWT 4956)*

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 733630.1 | 95 # | 90 # | 100 # | N\A ### |
| QC Standard | | 0.00494 | 0.496 | 0.0097 | 0.496 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 1.56 ## | < 0.001 ## | 14.49 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 1.54 ## | < 0.001 ## | 14.42 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 733630.1 | 102 # | N\A ### | 95 # |
| QC Standard | | 0.00487 | 0.00518 | 0.05 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 733630.1 | < 0.0005 ## | 0.00014 ## | 0.017 ## |
| Duplicate Sample 2 | 733630.1 | < 0.0005 ## | 0.00014 ## | 0.016 ## |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report.
##A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.
###The spike recovery has been labelled as N/A as the element is not included in our spike solution.

## *Quality Control Data for Samples 734195.2,5,8,9,14,17,20,22. (EWT 4961)*

| Sample Name | Lab No | Total Arsenic (g.m-3) | Total Selenium (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.02 |
| QC Standard | | 0.0051 | 0.0097 |
| QC Standard Range | | 0.0045 – 0.0055 | 0.009 – 0.011 |
| Duplicate Sample 1 # | 734760.2 | < 0.02 | < 0.02 |
| Duplicate Sample 2 # | 734760.2 | < 0.02 | < 0.02 |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1 – 10, 13 – 23 (Lithium), 20, 22 (Copper), 4, 21 (Zinc). (EWT 4961)*

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Copper (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.004 | < 0.01 | 0.024 |
| QC Standard | - | 0.0053 | 0.005 | 0.0511 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 # | 734760.2 | 0.016 | 0.057 | 4.824 |
| Duplicate Sample 2 # | 734760.2 | 0.015 | 0.058 | 4.763 |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Sample 734195.11, Aluminium only for 14,20 (EWT 4974)*

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Barium (g.m-3) | Total Calcium (g.m-3) | Total Copper (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 100 # | N\A ## | 93 # |
| QC Standard | - | 0.0052 | 0.0052 | 0.517 | 0.0050 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 734195.11 | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |
| Duplicate Sample 2 | 734195.11 | < 0.003 | < 0.0001 | < 0.05 | < 0.0005 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Iron (g.m-3) | Total Lead (g.m-3) | Total Manganese (g.m-3) | Total Potassium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 100 # | 87 # | N\A ## |
| QC Standard | | 0.0450 | 0.0052 | 0.00528 | 0.511 |
| QC Standard Range | - | 0.03 – 0.07 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.45 – 0.55 |
| Duplicate Sample 1 | 734195.11 | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |
| Duplicate Sample 2 | 734195.11 | < 0.02 | < 0.0001 | < 0.0005 | < 0.05 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

| Sample Name | Lab No | Total Sodium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.001 |
| Sample Spike[% Recovery] | 736891.1 | N\A ## | 96 # |
| QC Standard | | 0.515 | 0.0500 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 |
| Duplicate Sample 1 | 734195.11 | < 0.02 | < 0.001 |
| Duplicate Sample 2 | 734195.11 | < 0.02 | < 0.001 |

# A spiked analysis of 734195 was not performed, however a spiked sample was analysed in the same batch as 734195 and these results are included in this QC report
##The spike recovery has been labelled as N/A as the amount of the target analyte in the sample has swamped the spike.

### *Quality Control Data for Samples 734195.5,6,7,12 (Cnw 238)*

| Sample Name | Lab No | Cyanide (mg/L) |
|---|---|---|
| Procedural Blank | - | < 0.003 |
| QC Standard 1 | - | 15.54 |
| QC Standard 2 | - | 15.55 |
| QC Standard Range | | 12.75 – 17.25 |

### *Quality Control Data for Samples 734195.1 - 10 (pHEC 1812)*

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 6.27 | < 0.1 |
| QC Standard 1 | - | 4.02 | 3.91 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 4.47 |
| QC Standard 2 | | 7.53 | 63.9 |
| QC Standard Range | | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | | N/A | 5360 |
| Saline QC Standard Range | | N/A | 5123 - 5423 |

### *Quality Control Data for Samples 734195.1 – 6 (SS 7881)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | | 1840 |
| QC Standard Range | | 1600 - 2400 |

### *Quality Control Data for Samples 734195.7 – 10 (SS 7882)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | | 2032 |
| QC Standard Range | | 1600 - 2400 |

### *Quality Control Data for Samples 734195.1,2 (KLGen 4359)*

| Sample Name | Lab No | Chloride (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.5 |
| Procedural Blank | | < 0.5 |
| QC Standard | | 9.86 |
| QC Standard Range | | 8.9 – 11.2 |

## *Quality Control Data for Samples 734195.8,9,10 (AutotM 138)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | | < 4 |
| QC Standard 1 | | 152.9 |
| QC Standard 2 | | 153.6 |
| QC Standard Range | | 142.5 – 157.5 |
| Duplicate Sample 1 | 734195.2 | 47.5 |
| Duplicate Sample 2 | 734195.2 | 45.5 |

## *Quality Control Data for Samples 734195.1,2 (AutotM 140)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | | < 4 |
| QC Standard 1 | | 154.9 |
| QC Standard 2 | | 155 |
| QC Standard Range | | 142.5 – 157.5 |
| Duplicate Sample 1 | 734494.1 | 20.8# |
| Duplicate Sample 2 | 734494.1 | 21.1# |

#A duplicate analysis of 734195 was not performed, however a duplicate sample was analysed in the same batch as 734195 and these results are included in this QC report.

## *Quality Control Data for Samples 734195.1,2,8,9,10 (IC 3221)*

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.50 |
| QC Standard 1 | | 9.86 |
| QC Standard Range | | 8.5 – 11.5 |
| QC Standard 2 | | 96.96 |
| QC Standard Range | | 85 - 115 |

## *Quality Control Data for Samples 734195.1,2,8,9,10 (L4C 2839)*

| Sample Name | Lab No | Nitrite-N (g.m-3) | Nitrite-N+Nitrate-N (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | < 0.0020 | < 0.0020 |
| QC Standard | | N/A | 5.267 |
| QC Standard Range | | N/A | 4.25 – 5.75 |

# Request for Analyses

**NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.**

PATTLE DELAMORE PARTNERS LTD

solutions for your environment

**From: Pattle Delamore Partners Ltd**

Address (Refer to base of sheet): ☑ PDP Auckland ☐ PDP Wellington ☐ PDP Christchurch

Submitted by: Renalia Sharplin Ph No.: 09 523 6947

**To:** Hill Laboratories, Hamilton

Quote No.: 37478

PDP Job No.: A02277600

## Chain of Custody Record

Time Received: 09-Oct-2009 2:01:38 pm

Job No: **734195**

No of Samples: **23** No of Fractions **120**

0317341958

**Sent:**

Name: Renalia Sharplin

Signature:

Date and time: 1.45 pm 9/10/09

**Received:** ☐ Room temp. ☐ Chilled Temp.: 4.9°C

Name:

Signature:

Date and time:

**Note**

**Results by:** ☑ Email submitter: renalia.sharplin @pdp.co.nz ☑ Mail (address below)

☐ Email other: @pdp.co.nz ☐ Fax (number below)

**Priority:** ☐ Normal ☑ High ☐ Urgent

Results required by: ___ / ___ / ___

**Invoice to:** ☑ PDP ☐ Other:

| Sample ID | Sample type | No. bottles | Analyses requested | Notes |
|---|---|---|---|---|
| SW3 | FW | 3 | EC, pH, TSS; T. metals; Cation/Anion profile + diss. $SiO_2$ | |
| SW5 | " | 3 | EC, pH, TSS; T. metals; Cat/An profile + diss $SiO_2$ | All taken 9/10/09 11 AM |
| SW7 | " | 2 | EC, pH, TSS; T. metals; T. Cyanide (COLD HOLD) | CN only cold-hold. |
| SW8 | " | 2 | EC, pH, TSS; T. metals | |
| SW11 | " | 3 | EC, pH, TSS; T. metals; T. Cyanide | |
| SW13 | " | 3 | EC, pH, TSS; T. metals; T. cyanide | |
| SW15 | " | 3 | EC, pH, TSS; T. metals; T. Cyanide | |
| SW25 | " | 3 | EC, pH, TSS; T. metals; ~~T. Cyanide~~ Cat/Anion + diss $SiO_2$ | ALL TAKEN 9/10/09 11 AM |
| SW100 | " | 3 | EC, pH, TSS; T. metals; Cat/Anion + diss $SiO_2$ | |
| SW101 | " | 3 | As above | |
| SW250 | " | 1 | ~~As above~~ T. metals | All Taken 9/10/09 11 AM |
| SW21 | " | 1 | T. Cyanide | |
| SW3B | " | 1 | T. metals | |
| SW5B | " | 1 | T. metals | |
| SW7B | " | 1 | T. metals | |
| SW8B | " | 1 | T. metals | |
| SW11B | " | 1 | T. metals | |
| SW13B | " | 1 | T. metals | |
| SW15B | " | 1 | T. metals | |
| SW25B | " | 1 | As above | TAKEN 9/10/09 |
| SW250B | " | 1 | As above | TAKEN 9/10/09 |
| | | | | |

**Sample type:** S Soil GW Groundwater SAL Seawater/saline FW Freshwater LEACH Leachate GEO Geothermal
SED Sediment BIO Biota TW Tradewaste WW Wastewater P Potable Other:

**Note: Samples may contain dangerous or hazardous substances**

Page ___ of ___


PDP Auckland
PDP House, 235 Broadway, Newmarket, Auckland
PO Box 9528, Newmarket, Auckland 1149

PDP Wellington
iSDFT House, Level 1, 111 Customhouse Quay, Wellington
PO Box 6136, Wellington 6141

PDP Christchurch
Radio NZ House, 51 Chester St West, Christchur
PO Box 389, Christchurch 8140

# Certificate of Analysis

PATTLE DELAMORE PARTNERS

PO BOX 9528
NEWMARKET
AUCKLAND
**Attention:** ANDREW RUMSBY

Copy to 1: Remalia Sharplin
2: Andrew Rumsby

**Job Description:** ON:AO2277600 Sampling/No
**Batch Number:** 09/29012

***Sample Descriptions***

| Sample No. | Date Sampled | Sample Description |
|---|---|---|
| 01 | 09/10/2009 | SW5 |
| 02 | 09/10/2009 | SW5B |
| 03 | 09/10/2009 | SW11 |

***Results***

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| | | 01 | 02 | 03 | | | |
| Silver: Soluble Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Aluminium: Soluble Trace by ICPMS | mg/L | 0.39 | 0.0067 | | | | |
| Arsenic: Soluble Trace by ICPMS | mg/L | 0.0037 | 0.00097 | | | | |
| Boron: Soluble Trace by ICPMS | mg/L | 0.018 | 0.018 | | | | |
| Barium: Soluble Trace by ICPMS | mg/L | 0.022 | 0.022 | | | | |
| Beryllium: Soluble Trace by ICPMS | mg/L | 0.00005 | < 0.00005 | | | | |
| Calcium: Soluble Trace by ICPMS | mg/L | 59. | 61. | | | | |
| Cadmium: Soluble Trace by ICPMS | mg/L | 02 | 0.19 | | | | |
| Chromium: Soluble Trace by ICPMS | mg/L | 0.0005 | < 0.0001 | | | | |
| Copper: Soluble Trace by ICPMS | mg/L | 0.41 | 0.04 | | | | |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | | 1 | 1 | | | | |
| Iron: Soluble Trace by ICPMS | mg/L | 4.1 | 0.0041 | | | | |
| Calcium Hardness Calc Trace ICPMS | mg/L | 147.32 | | | | | |
| Magnesium Hardness Calc Trace ICPMS | mg/L | 57.65 | | | | | |
| Soluble Hardness Calc Trace ICPMS | mg/L | 204.98 | | | | | |
| Mercury: Soluble Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Potassium: Soluble Trace by ICPMS | mg/L | 0.93 | 0.96 | | | | |
| Lithium: Soluble Trace by ICPMS | mg/L | 0.014 | 0.014 | | | | |
| Magnesium: Soluble Trace by ICPMS | mg/L | 14. | 14. | | | | |

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| Manganese: Soluble Trace by ICPMS | mg/L | 1.4 | 1.4 | | | | |
| Molybdenum: Soluble Trace by ICPMS | mg/L | 0.00031 | 0.0003 | | | | |
| Sodium: Soluble Trace by ICPMS | mg/L | 14. | 11. | | | | |
| Nickel: Soluble Trace by ICPMS | mg/L | 0.021 | 0.021 | | | | |
| Lead: Soluble Trace by ICPMS | mg/L | 0.14 | 0.00075 | | | | |
| Antimony: Soluble Trace by ICPMS | mg/L | < 0.001 | < 0.001 | | | | |
| Selenium: Soluble Trace by ICPMS | mg/L | < 0.0005 | < 0.0005 | | | | |
| Silica: Soluble Trace by ICPMS | mg/L | 15. | | | | | |
| Tin: Soluble Trace by ICPMS | mg/L | < 0.0001 | < 0.0001 | | | | |
| Uranium: Soluble Trace by ICPMS | mg/L | 0.00001 | < 0.00001 | | | | |
| Zinc: Soluble Trace by ICPMS | mg/L | 27. | 25. | | | | |
| Alkalinity total by Autotitrator | mg/L CaCO3 | 40 | | | | | |
| Alkalinity carbonate | mg/L CO3 | < 1 | | | | | |
| Alkalinity bicarbonate | mg/L HCO3 | 48 | | | | | |
| Chloride by Ion Chromatography | mg/L | 10.7 | | | | | |
| Carbon dioxide by Calculation (Nomograph) | mg/L | 12. | | | | | |
| Comments | | | | Cyanide sample deleted from our system. Sent to ALS Wellington for an | | | |
| Conductivity by Auto-titrator | mS/m 25oC | 54.6 | | | | | |
| GF/C Filtration | | Yes | | | | | |
| PROFILE ONLY Ion balance | | Attached | | | | | |
| Ammonia Nitrogen low level Soluble | mg/L N | < 0.01 | | | | | |
| Nitrite Nitrogen by Ion Chromatography | mg/L N | < 0.002 | | | | | |
| Nitrate Nitrogen by Ion Chromatography | mg/L N | 0.048 | | | | | |
| pH(Autotitrator) at room temp(c.20°C) | pH Unit | 6.9 | | | | | |
| Sulphate by Ion Chromatography | mg/L SO4 | 228. | | | | | |
| Total dissolved solids | mg/L | 461 | | | | | |
| Temperature | oC | 20.0 | | | | | |

***Test Descriptions***

| Test Description | Method | Accredited |
|---|---|---|
| Alkalinity bicarbonate | APHA (2005) 2320 B | IANZ |
| Alkalinity carbonate | APHA (2005) 2320 B | IANZ |
| Alkalinity total by Autotitrator | APHA (2005) 2320 B | IANZ |
| Aluminium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Ammonia Nitrogen low level Soluble | APHA (2005) 4500-NH3 G, Mod | IANZ |
| Antimony: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Arsenic: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

| Test Description | Method | Accredited |
|---|---|---|
| Barium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Beryllium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Boron: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Cadmium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Calcium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Calcium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Carbon dioxide by Calculation (Nomograph) | APHA (2005) 4500-CO2 B | |
| Chloride by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Chromium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Comments | Visual Observation | |
| Conductivity by Auto-titrator | APHA (2005) 2510 B | IANZ |
| Copper: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| GF/C Filtration | Glass Fiber Filtration 1.2 um | |
| Iron: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lead: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lithium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Magnesium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Magnesium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Manganese: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Mercury: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Molybdenum: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nickel: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nitrate Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | APHA (2005) 3030E (Modified) | |
| Nitrite Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| pH(Autotitrator) at room temp(c.20°C) | APHA (2005) 4500-H B | IANZ |
| Potassium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| PROFILE ONLY Ion balance | APHA (2005) 1030E | |
| Selenium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Silica: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | |
| Silver: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sodium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Soluble Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Sulphate by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Temperature | Thermometer | IANZ |
| Tin: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Total dissolved solids | APHA (2005) 2540 C (Modified) | |
| Uranium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Zinc: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

Results are reported on an as received basis.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

**This report may not be reproduced except in full.**

:

Dr You-Sing Yong
Operations Manager
22 October 2009
yyong@water.co.nz

**ION BALANCE :**

| | |
|---|---|
| **Batch No. :** | **09/29012** |
| **Date :** | **21/10/2009** |
| **Sample Description** | **PDP-MISC** |
| **Sample No . :** | 01 |

| **Cation** | **meq/L Conversion** | **mg/L** | **meq/L** |
|---|---|---|---|
| Ammonia | 0.0714 | | |
| Calcium (soluble) | 0.0499 | 59 | 2.9441 |
| Magnesium (soluble) | 0.0823 | 14 | 1.1522 |
| Sodium (soluble) | 0.0435 | 14 | 0.609 |
| Potassium (soluble) | 0.0256 | 0.93 | 0.023808 |
| Lithium (soluble) | 0.1441 | | |
| Iron (soluble) | 0.0358 | 4.1 | 0.14678 |
| Aluminium (soluble) | 0.1112 | 0.39 | 0.043368 |
| Manganese (soluble) | 0.0364 | 1.4 | 0.05096 |
| Cation meq/L total | | | 4.970216 |

| **Anion** | **meq/L Conversion** | | |
|---|---|---|---|
| S.R Phosphate | 0.0968 | | |
| Fluoride | 0.0526 | | |
| Chloride | 0.0282 | 10.7 | 0.30174 |
| Sulphate | 0.0208 | 228 | 4.7424 |
| Nitrite | 0.02174 | | |
| Nitrate | 0.01613 | 0.048 | 0.000774 |
| Alkalinity | 0.0199 | 37 | 0.7363 |
| Anion meq/L total | | | 5.781214 |

| | |
|---|---|
| Sum of Anions + Cations | 11 |
| meq/L difference | .81 |
| **% Difference** | 7.54% |
| Conductivity | 54.6 |

| Acceptance Criteria : APHA 21st Edition, 2005 | Anion Sum | Criteria |
|---|---|---|
| | 0-3.0 | $\pm$ 0.2 meq/L |
| | 3-10 | $\pm$ 2 % |
| | 10-800 | $\pm$ 2 -5% |

# Appendix C

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 744474 | SPv5 |
| **Contact:** | A Rumsby | **Date Registered:** | 17-Nov-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 07-Jan-2010 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | A02277600 | |
| | | **Submitted By:** | R Sharplin | |

## Amended Report

This report replaces an earlier report issued on the 14 Dec 2009 at 6:10 pm
Following a query from the client, sample 744474.18 was repeated [QOWQ36952]. It was found that the initial analysis had spot contamination effecting the results for Li, Zn and Pb, the repeated results are now reported below.

**Sample Type: Aqueous**

| Sample Name: | | SW3 17-Nov-2009 | SW5 17-Nov-2009 | SW100 17-Nov-2009 | SW101 17-Nov-2009 | SW3B 17-Nov-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 744474.1 | 744474.2 | 744474.3 | 744474.4 | 744474.5 |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | < 3.0 | 14 | 7.7 | < 3.0 | - |
| Total Dissolved Silica | g/m³ as $SiO_2$ | 13 | 18 | 16 | 13 | - |
| Silicon | g/m³ | 6.1 | 8.5 | 7.6 | 5.9 | - |
| Reactive Silica | g/m³ as $SiO_2$ | 12 | 16 | 15 | 12 | - |
| Sulphate | g/m³ | - | 280 | 210 | 32 | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | < 0.0032 | 0.26 | 0.12 | 0.0080 | < 0.0032 |
| Total Antimony | g/m³ | < 0.00021 | 0.0010 | 0.00076 | 0.00047 | < 0.00021 |
| Total Arsenic | g/m³ | < 0.0011 | 0.0048 | 0.0020 | < 0.0011 | < 0.0011 |
| Total Barium | g/m³ | 0.0067 | 0.027 | 0.027 | 0.018 | 0.0063 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.011 | 0.026 | 0.019 | 0.012 | 0.012 |
| Total Cadmium | g/m³ | 0.0040 | 0.14 | 0.099 | 0.017 | 0.0038 |
| Total Calcium | g/m³ | 9.7 | 89 | 60 | 7.3 | 9.9 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.016 | 0.21 | 0.10 | 0.0057 | 0.0013 |
| Total Iron | g/m³ | < 0.021 | 4.2 | 2.1 | < 0.021 | < 0.021 |
| Total Lead | g/m³ | 0.0011 | 0.077 | 0.053 | 0.23 | 0.00093 |
| Total Lithium | g/m³ | 0.0019 | 0.020 | 0.014 | 0.0021 | 0.0019 |
| Total Magnesium | g/m³ | 2.0 #1 | 19 | 12 | 2.5 #1 | 2.2 |
| Total Manganese | g/m³ | 0.00077 | 1.7 | 1.0 | 0.0013 | 0.00086 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | 0.00046 | 0.00031 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | < 0.00053 | 0.023 | 0.016 | 0.0011 | < 0.00053 |
| Total Potassium | g/m³ | 0.44 #1 | 1.1 #1 | 0.95 #1 | 0.68 #1 | 0.43 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0021 | < 0.0011 | < 0.0011 | < 0.0011 |
| Total Silver | g/m³ | 0.0047 | 0.00030 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 7.5 | 14 | 13 | 8.6 | 7.3 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 0.42 | 22 | 14 | 1.7 | 0.43 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | 1.2 | 7.5 #2 | 5.6 #2 | 1.2 #2 | - |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW3<br>17-Nov-2009 | SW5<br>17-Nov-2009 | SW100<br>17-Nov-2009 | SW101<br>17-Nov-2009 | SW3B<br>17-Nov-2009 |
| **Lab Number:** | | 744474.1 | 744474.2 | 744474.3 | 744474.4 | 744474.5 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Cations | meq/L | 1.0 | 6.8 #2 | 4.5 #2 | 0.98 #2 | - |
| pH | pH Units | 6.7 | 7.3 | 7.6 | 7.5 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | 16 | 64 | 44 | 9.8 | - |
| Bicarbonate | g/m³ at 25°C | 19 | 78 | 54 | 12 | - |
| Total Hardness | g/m³ as $CaCO_3$ | 33 | 300 | 200 | 30 | - |
| Electrical Conductivity (EC) | mS/m | 11.2 | 62.8 | 48.4 | 11.6 | - |
| Dissolved Calcium | g/m³ | 9.9 | 91 | 59 | 7.6 | - |
| Dissolved Magnesium | g/m³ | 2.1 #1 | 18 | 12 | 2.7 #1 | - |
| Dissolved Potassium | g/m³ | 0.47 #1 | 1.3 #1 | 0.99 #1 | 0.72 #1 | - |
| Dissolved Sodium | g/m³ | 7.3 | 15 | 12 | 8.5 | - |
| Chloride | g/m³ | 9.9 | 10 | 10 | 12 | - |
| Nitrite-N | g/m³ | < 0.0020 | < 0.0020 | 0.0052 | < 0.0020 | - |
| Nitrate-N | g/m³ | 0.16 | 0.033 | 0.061 | 0.14 | - |
| Nitrate-N + Nitrite-N | g/m³ | 0.16 | 0.033 | 0.066 | 0.14 | - |
| Sulphate | g/m³ | 28 | - | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW5B<br>17-Nov-2009 | SW100B<br>17-Nov-2009 | SW101B<br>17-Nov-2009 | SW11<br>17-Nov-2009 | SW13<br>17-Nov-2009 |
| **Lab Number:** | | 744474.6 | 744474.7 | 744474.8 | 744474.9 | 744474.10 |
| Individual Tests | | | | | | |
| pH | pH Units | - | - | - | 3.3 | 6.8 |
| Electrical Conductivity (EC) | mS/m | - | - | - | 71.9 | 15.8 |
| Total Suspended Solids | g/m³ | - | - | - | 25 | < 3.0 |
| Total Cyanide | g/m³ | - | - | - | 0.0026 | < 0.0010 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.0044 | < 0.0032 | 0.0065 | 12 | 0.46 |
| Total Antimony | g/m³ | 0.00061 | 0.00049 | 0.00037 | 0.00041 | < 0.00021 |
| Total Arsenic | g/m³ | 0.0014 | < 0.0011 | < 0.0011 | 0.014 | < 0.0011 |
| Total Barium | g/m³ | 0.026 | 0.026 | 0.017 | 0.031 | 0.0097 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | 0.00070 | < 0.00011 |
| Total Boron | g/m³ | 0.027 | 0.024 | 0.013 | 0.014 | 0.013 |
| Total Cadmium | g/m³ | 0.12 | 0.088 | 0.016 | 0.11 | 0.0054 |
| Total Calcium | g/m³ | 84 | 61 | 7.6 | 26 | 12 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | 0.0030 | < 0.00053 |
| Total Copper | g/m³ | 0.0093 | 0.0085 | 0.0057 | 0.99 | 0.027 |
| Total Iron | g/m³ | < 0.021 | < 0.021 | < 0.021 | 19 | 0.15 |
| Total Lead | g/m³ | 0.00026 | 0.0028 | 0.21 | 0.87 | 0.025 |
| Total Lithium | g/m³ | 0.021 | 0.015 | 0.0022 | 0.021 | 0.0034 |
| Total Magnesium | g/m³ | 18 | 14 | 2.7 | 15 | 4.7 |
| Total Manganese | g/m³ | 1.7 | 1.1 | 0.0014 | 6.1 | 0.25 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | 0.00043 | 0.00032 | < 0.00021 | < 0.00021 | < 0.00021 |
| Total Nickel | g/m³ | 0.023 | 0.017 | 0.0012 | 0.054 | 0.0040 |
| Total Potassium | g/m³ | 1.2 | 0.97 | 0.67 | 1.5 | 0.78 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | 0.0024 | < 0.0011 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 15 | 13 | 8.4 | 11 | 10 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | 0.00022 | < 0.000021 |
| Total Zinc | g/m³ | 19 | 13 | 1.8 | 20 | 0.98 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW15<br>17-Nov-2009 | SW11B<br>17-Nov-2009 | SW13B<br>17-Nov-2009 | SW15B<br>17-Nov-2009 | SW7<br>17-Nov-2009 |
| **Lab Number:** | | 744474.11 | 744474.12 | 744474.13 | 744474.14 | 744474.15 |
| Individual Tests | | | | | | |
| pH | pH Units | 6.2 | - | - | - | 7.0 |
| Electrical Conductivity (EC) | mS/m | 22.1 | - | - | - | 35.8 |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW15<br>17-Nov-2009 | SW11B<br>17-Nov-2009 | SW13B<br>17-Nov-2009 | SW15B<br>17-Nov-2009 | SW7<br>17-Nov-2009 |
| **Lab Number:** | | 744474.11 | 744474.12 | 744474.13 | 744474.14 | 744474.15 |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | < 3.0 | - | - | - | < 3.0 |
| Total Cyanide | g/m³ | < 0.0010 | - | - | - | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.019 | 10 | 0.099 | 0.019 | 0.34 |
| Total Antimony | g/m³ | < 0.00021 | 0.00039 | < 0.00021 | < 0.00021 | 0.0013 |
| Total Arsenic | g/m³ | 0.0030 | 0.012 | < 0.0011 | 0.0022 | < 0.0011 |
| Total Barium | g/m³ | 0.021 | 0.033 | 0.0095 | 0.024 | 0.025 |
| Total Beryllium | g/m³ | < 0.00011 | 0.00067 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Boron | g/m³ | 0.016 | 0.013 | 0.013 | 0.015 | 0.017 |
| Total Cadmium | g/m³ | 0.010 | 0.12 | 0.0054 | 0.012 | 0.049 |
| Total Calcium | g/m³ | 19 | 25 | 12 | 20 | 36 |
| Total Chromium | g/m³ | < 0.00053 | 0.0030 | < 0.00053 | < 0.00053 | < 0.00053 |
| Total Copper | g/m³ | 0.028 | 0.97 | 0.011 | 0.029 | 0.042 |
| Total Iron | g/m³ | 0.12 | 17 | 0.024 | 0.12 | 0.55 |
| Total Lead | g/m³ | 0.079 | 0.87 | 0.0061 | 0.089 | 0.036 |
| Total Lithium | g/m³ | 0.0062 | 0.021 | 0.0033 | 0.0059 | 0.0098 |
| Total Magnesium | g/m³ | 7.2 | 14 | 4.7 | 7.1 | 11 |
| Total Manganese | g/m³ | 0.033 | 5.9 | 0.25 | 0.032 | 0.63 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | < 0.00021 | 0.00023 |
| Total Nickel | g/m³ | 0.0022 | 0.053 | 0.0040 | 0.0024 | 0.010 |
| Total Potassium | g/m³ | 1.0 | 1.5 | 0.75 | 1.0 | 1.0 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0021 | < 0.0011 | < 0.0011 | 0.0012 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 | < 0.00011 |
| Total Sodium | g/m³ | 12 | 11 | 10 | 11 | 12 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | < 0.00053 | 0.00057 |
| Total Uranium | g/m³ | < 0.000021 | 0.00023 | < 0.000021 | < 0.000021 | < 0.000021 |
| Total Zinc | g/m³ | 1.7 | 20 | 0.92 | 1.8 | 7.2 |

| **Sample Name:** | | SW8<br>17-Nov-2009 | SW7B<br>17-Nov-2009 | SW8B<br>17-Nov-2009 | SW201<br>17-Nov-2009 | SW21<br>17-Nov-2009 |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 744474.16 | 744474.17 | 744474.18 | 744474.19 | 744474.20 |
| Individual Tests | | | | | | |
| pH | pH Units | 7.3 | - | - | - | 3.3 |
| Electrical Conductivity (EC) | mS/m | 9.2 | - | - | - | 72.0 |
| Total Suspended Solids | g/m³ | < 3.0 | - | - | - | 9.5 |
| Total Cyanide | g/m³ | - | - | - | - | < 0.0010 |
| Sulphate | g/m³ | - | - | - | 30 | - |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 0.048 | 0.055 | 0.030 | - | 12 |
| Total Antimony | g/m³ | 0.00066 | 0.00074 | 0.00027 | - | 0.00080 |
| Total Arsenic | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | - | 0.017 |
| Total Barium | g/m³ | 0.0061 | 0.025 | 0.0058 | - | 0.033 |
| Total Beryllium | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | - | 0.00079 |
| Total Boron | g/m³ | 0.0087 | 0.015 | 0.010 | - | 0.014 |
| Total Cadmium | g/m³ | < 0.000053 | 0.049 | < 0.000053 | - | 0.12 |
| Total Calcium | g/m³ | 6.0 | 36 | 6.4 | - | 26 |
| Total Chromium | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | - | 0.0030 |
| Total Copper | g/m³ | 0.00076 | 0.0099 | 0.00063 | - | 0.98 |
| Total Iron | g/m³ | 0.052 | < 0.021 | 0.029 | - | 21 |
| Total Lead | g/m³ | 0.00041 | 0.0036 | < 0.00011 | - | 0.91 |
| Total Lithium | g/m³ | 0.00059 | 0.0092 | 0.00050 | - | 0.022 |
| Total Magnesium | g/m³ | 2.0 | 10 | 2.3 | - | 15 |
| Total Manganese | g/m³ | 0.0019 | 0.55 | 0.0011 | - | 6.3 |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | < 0.000080 | - | < 0.000080 |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | < 0.00021 | - | < 0.00021 |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW8<br>17-Nov-2009 | SW7B<br>17-Nov-2009 | SW8B<br>17-Nov-2009 | SW201<br>17-Nov-2009 | SW21<br>17-Nov-2009 |
| **Lab Number:** | | 744474.16 | 744474.17 | 744474.18 | 744474.19 | 744474.20 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Nickel | g/m³ | < 0.00053 | 0.0094 | < 0.00053 | - | 0.055 |
| Total Potassium | g/m³ | 0.45 | 0.94 | 0.46 | - | 1.5 |
| Total Selenium | g/m³ | < 0.0011 | < 0.0011 | < 0.0011 | - | 0.0015 |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | < 0.00011 | - | < 0.00011 |
| Total Sodium | g/m³ | 7.2 | 12 | 7.8 | - | 11 |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | < 0.00053 | - | < 0.00053 |
| Total Uranium | g/m³ | < 0.000021 | < 0.000021 | < 0.000021 | - | 0.00021 |
| Total Zinc | g/m³ | 0.0024 | 6.8 | < 0.0011 | - | 20 |
| Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn | | | | | | |
| Total Arsenic | g/m³ | - | - | < 0.0011 | - | - |
| Total Cadmium | g/m³ | - | - | < 0.000053 | - | - |
| Total Chromium | g/m³ | - | - | < 0.00053 | - | - |
| Total Copper | g/m³ | - | - | 0.00063 | - | - |
| Total Lead | g/m³ | - | - | < 0.00011 | - | - |
| Total Nickel | g/m³ | - | - | < 0.00053 | - | - |
| Total Zinc | g/m³ | - | - | < 0.0011 | - | - |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | - | - | - | 1.2 #2 | - |
| Sum of Cations | meq/L | - | - | - | 0.96 #2 | - |
| pH | pH Units | - | - | - | 6.8 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | - | 9.7 | - |
| Bicarbonate | g/m³ at 25°C | - | - | - | 12 | - |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | - | 29 | - |
| Electrical Conductivity (EC) | mS/m | - | - | - | 11.6 | - |
| Dissolved Calcium | g/m³ | - | - | - | 7.4 | - |
| Dissolved Magnesium | g/m³ | - | - | - | 2.6 | - |
| Dissolved Potassium | g/m³ | - | - | - | 0.71 | - |
| Dissolved Sodium | g/m³ | - | - | - | 8.2 | - |
| Chloride | g/m³ | - | - | - | 11 | - |
| Nitrite-N | g/m³ | - | - | - | < 0.0020 | - |
| Nitrate-N | g/m³ | - | - | - | 0.14 | - |
| Nitrate-N + Nitrite-N | g/m³ | - | - | - | 0.14 | - |

| **Sample Name:** | | SW21B<br>17-Nov-2009 | SW23B<br>17-Nov-2009 | | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 744474.21 | 744474.22 | | | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 10 | < 0.0032 | - | - | - |
| Total Antimony | g/m³ | 0.00067 | < 0.00021 | - | - | - |
| Total Arsenic | g/m³ | 0.012 | < 0.0011 | - | - | - |
| Total Barium | g/m³ | 0.033 | < 0.00021 | - | - | - |
| Total Beryllium | g/m³ | 0.00079 | < 0.00011 | - | - | - |
| Total Boron | g/m³ | 0.015 | < 0.0053 | - | - | - |
| Total Cadmium | g/m³ | 0.12 | < 0.000053 | - | - | - |
| Total Calcium | g/m³ | 25 | < 0.053 | - | - | - |
| Total Chromium | g/m³ | 0.0029 | < 0.00053 | - | - | - |
| Total Copper | g/m³ | 0.92 | < 0.00053 | - | - | - |
| Total Iron | g/m³ | 17 | < 0.021 | - | - | - |
| Total Lead | g/m³ | 0.89 | < 0.00011 | - | - | - |
| Total Lithium | g/m³ | 0.021 | < 0.00042 | - | - | - |
| Total Magnesium | g/m³ | 14 | < 0.021 | - | - | - |
| Total Manganese | g/m³ | 5.6 | < 0.00053 | - | - | - |
| Total Mercury | g/m³ | < 0.000080 | < 0.000080 | - | - | - |
| Total Molybdenum | g/m³ | < 0.00021 | < 0.00021 | - | - | - |
| Total Nickel | g/m³ | 0.050 | < 0.00053 | - | - | - |
| Total Potassium | g/m³ | 1.5 | < 0.053 | - | - | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW21B 17-Nov-2009 | SW23B 17-Nov-2009 | | | |
| **Lab Number:** | | 744474.21 | 744474.22 | | | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Selenium | g/m³ | 0.0017 | < 0.0011 | - | - | - |
| Total Silver | g/m³ | < 0.00011 | < 0.00011 | - | - | - |
| Total Sodium | g/m³ | 11 | < 0.021 | - | - | - |
| Total Tin | g/m³ | < 0.00053 | < 0.00053 | - | - | - |
| Total Uranium | g/m³ | 0.00023 | < 0.000021 | - | - | - |
| Total Zinc | g/m³ | 20 | < 0.0011 | - | - | - |

## Analyst's Comments

#1 It has been noted that the results for the dissolved fraction were greater than those for the total fraction, but within analytical variation of the method.

#2 It has been noted that the results for the anion and cation balance were not in good agreement, but within the analytical variation of these methods.

Appendix No.1 - QC Report

# 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: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-4, 19 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-18, 20-22 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-18, 20-22 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 9-11, 20 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-4, 19 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-4, 19 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1-4, 9-11, 15-16, 19-20 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1-4, 19 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1-4, 19 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1-4, 19 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1-4, 9-11, 15-16, 19-20 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 g/m³ | 1-4, 9-11, 15-16, 20 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-4, 19 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-4, 19 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-4, 19 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-4, 19 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 g/m³ as $SiO_2$ | 1-4 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-4, 19 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 g/m³ | 9-11, 20 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 g/m³ | 1-4, 19 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 g/m³ | 1-4 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-4, 19 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1-4, 19 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-4, 19 |
| Reactive Silica | Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-$SiO_2$ F (modified from flow injection analysis) 21st ed. 2005. | 0.10 g/m³ as $SiO_2$ | 1-4 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1-4, 19 |
| Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn | Nitric acid digestion, ICP-MS, trace level | - | 18 |
| Anion / Cation profile, dissolved metals trace level | | - | 1-4, 19 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-18, 20-22 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-17, 20-22 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-18, 20-22 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-18, 20-22 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-17, 20-22 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-18, 20-22 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-17, 20-22 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-18, 20-22 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-18, 20-22 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-18, 20-22 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-18, 20-22 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-18, 20-22 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-18, 20-22 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-18, 20-22 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-18, 20-22 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m$^3$ | 1-17, 20-22 |

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

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

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

***Client:*** ***Pattle Delamore Partners Ltd***
***Address:*** ***P.O Box 9258***
***Newmarket,Auckland 1149***
***Contact:*** ***Rumsby, Andrew***

***Laboratory No:*** ***744474QC***
***Date Registered:*** ***17/11/2009***



***Client's Reference: A02277600***

# Quality Control Report for 744474

***This report includes quality control data for the following analytes:***

| | |
|---|---|
| Trace Elements – Water<br>Silicon | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Sample Spikes***<br>***- Duplicate Sample Analysis*** |
| Trace Elements – Water<br>Dissolved Metals<br>(Calcium, Magnesium, Potassium,<br>and Sodium). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements - Water<br>Total Metals<br>(Arsenic, Aluminium, Antimony,<br>Barium, Beryllium, Boron, Calcium,<br>Cadmium, Chromium, Copper, Iron,<br>Lead, Lithium, Manganese, Magnesium,<br>Mercury, Molybdenum, Nickel, Potassium,<br>Selenium, Silver, Sodium, Tin, Uranium, Zinc). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis***<br>***- Sample Spikes*** |
| Nitrite-N, Nitrate-N, Nitrogen Oxides – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| | |
|---|---|
| Chloride – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Cyanide – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Alkalinity - Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Electrical Conductivity, pH | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Suspended Solids – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Reactive Silica – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

## *Sample Type: Water,*

### *Quality Control Data for Samples 744474.1 - 4 (EWSi 553)*

| Sample Name | Lab No | Silicon (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.01 |
| QC Standard | - | 5.17 |
| QC Standard Range | - | 4.5 – 5.5 |
| Sample Spike [% Recovery] | 744474.4 | 93 |
| Duplicate Sample 1 | 744474.4 | 5.85 |
| Duplicate Sample 2 | 744474.4 | 5.83 |

### *Quality Control Data for Samples 744474.1 - 22 (HgBrF 199)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.00008 |
| Duplicate Sample 1 | 744474.22 | < 0.00008 |
| Duplicate Sample 2 | 744474.22 | < 0.00008 |
| QC Standard | - | 0.00054 |
| QC Standard Range | - | 0.00045 - 0.00055 |

### *Quality Control Data for Samples 744474.13 – 18,20 - 22(EWAg 261 )*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.0115 |
| QC Standard Range | - | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 744474.22 | 91 |
| Duplicate Sample 1 | 744474.22 | < 0.0001 |
| Duplicate Sample 2 | 744474.22 | < 0.0001 |

### *Quality Control Data for Samples 744474.1 – 12 (EWAg 262)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.0123 |
| QC Standard Range | - | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 744474.12 | 103 |
| Duplicate Sample 1 | 744474.12 | < 0.0001 |
| Duplicate Sample 2 | 744474.12 | < 0.0001 |

***Quality Control Data for Samples 744474.1,2,3,4,19 (EW 8135)***

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.516 | 0.052 | 0.524 | 0.520 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Duplicate Sample 1 # | 744953.12 | 6.94 | 2.83 | 1.98 | 12.64 |
| Duplicate Sample 2 # | 744953.12 | 6.94 | 2.88 | 2.03 | 12.90 |

# A duplicate analysis of 744474 was not performed, however a duplicate sample was analysed in the same batch as 744474 and these results are included in this QC report.

***Quality Control Data for Samples 744474.1 – 18,20- 22 (EWT 5033 )***

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 744474.14 | 94 | 92 | 103 | 95 |
| QC Standard | - | 0.0053 | 0.0052 | 0.0049 | 0.0051 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | 0.019 | 0.0022 | < 0.0002 | 0.0242 |
| Duplicate Sample 2 | 744474.14 | 0.016 | 0.0020 | < 0.0002 | 0.0216 |

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 744474.14 | 102 | 107 | N\A## | 102 |
| QC Standard | - | 0.0053 | 0.010 | 0.54 | 0.0051 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | < 0.0001 | 0.0155 | 19.64 | 0.0117 |
| Duplicate Sample 2 | 744474.14 | < 0.0001 | 0.0145 | 19.36 | 0.0105 |

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 744474.14 | 96 | 98 | 103 | 95 |
| QC Standard | - | 0.0052 | 0.0052 | 0.060 | 0.0055 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | < 0.0005 | 0.0287 | 0.117 | 0.0893 |
| Duplicate Sample 2 | 744474.14 | < 0.0005 | 0.0267 | 0.104 | 0.0824 |

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 744474.14 | 104 | 110 | N\A ## | 104 |
| QC Standard | - | 0.0055 | 0.0052 | 0.053 | 0.0050 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | 0.0059 | 0.0323 | 7.08 | < 0.0002 |
| Duplicate Sample 2 | 744474.14 | 0.0055 | 0.0310 | 6.79 | < 0.0002 |

## The spike recovery is N/A as the amount of the sample has swamped the spike

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 744474.14 | 101 | 94 | 105 | N\A ## |
| QC Standard | - | 0.0053 | 0.515 | 0.011 | 0.524 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 744474.14 | 0.0024 | 1.016 | < 0.001 | 11.15 |
| Duplicate Sample 2 | 744474.14 | 0.0022 | 0.955 | < 0.001 | 10.61 |

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 744474.14 | 102 | N\A ### | N\A ## |
| QC Standard | - | 0.0050 | 0.0052 | 0.0530 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 744474.14 | < 0.0005 | < 0.00005 | 1.763 |
| Duplicate Sample 2 | 744474.14 | < 0.0005 | < 0.00005 | 1.680 |

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##The spike recovery is N/A as the amount of the sample has swamped the spike

###The spike recovery has been labeled as N/A as the element is not included in our spike solution.

***Quality Control Data for Sample 744474.10,11,13 (iron); 2,9,12 (selenium); 22 (zinc)*** ***(EWT 5037)***

| Sample Name | Lab No | Total Iron (g.m-3) | Total Selenium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.001 | < 0.001 |
| QC Standard | - | 0.043 | 0.0107 | 0.049 |
| QC Standard Range | - | 0.03 – 0.07 | 0.009 – 0.011 | 0.045 – 0.055 |
| Duplicate Sample 1 # | 742378.1 | 0.301 | < 0.001 | 0.0945 |
| Duplicate Sample 2 # | 742378.1 | 0.280 | < 0.001 | 0.0900 |

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# A duplicate analysis of 744474 was not performed, however a duplicate sample was analysed in the same batch as 744474 and these results are included in this QC report.

***Quality Control Data for Samples 744474.9,10 (Cnw 255)***

| Sample Name | Lab No | Cyanide (g.m-3) |
|---|---|---|
| Procedural Blank | - | 0.0012 |
| QC Standard 1 | - | 15.75 |
| QC Standard Range | - | 12.75 – 17.25 |
| QC Standard 2 | - | 15.99 |
| QC Standard Range | - | 13.5 – 16.5 |

***Quality Control Data for Samples 744474.11,20 (Cnw 256)***

| Sample Name | Lab No | Cyanide (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.001 |
| QC Standard 1 | - | 13.20 |
| QC Standard Range | - | 12.75 – 17.25 |
| QC Standard 2 | - | 16.24 |
| QC Standard Range | - | 13.5 – 16.5 |

***Quality Control Data for Samples 744474.1 – 4,9 – 11,15,16,19,20 (pHEC 1890)***

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 7.09 | < 0.1 |
| QC Standard 1 | - | 4.02 | 3.58 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 5.1 |
| QC Standard 2 | - | 7.59 | 66.5 |
| QC Standard Range | - | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | - | N/A | 5290 |
| Saline QC Standard Range | - | N/A | 5123 - 5423 |

***Quality Control Data for Samples 744474.10 (pHEC 1892)***

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 6.43 | < 0.1 |
| QC Standard 1 | - | 4.0 | 4.3 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 5.1 |
| QC Standard 2 | - | 7.56 | 65.60 |
| QC Standard Range | - | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | - | N/A | 5290 |
| Saline QC Standard Range | - | N/A | 5123 - 5423 |

***Quality Control Data for Samples 744474.1 – 4,10,11,15,16,20 (SS 7961)***

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | - | 1833 |
| QC Standard Range | - | 1600 - 2400 |

### *Quality Control Data for Samples 744474.9 (SS 7964)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | - | 1803 |
| QC Standard Range | - | 1600 - 2400 |

### *Quality Control Data for Samples 744474.1 – 4,19 (KLGen 4642 )*

| Sample Name | Lab No | Chloride (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.5 |
| Procedural Blank | - | < 0.5 |
| QC Standard | - | 9.86 |
| QC Standard Range | - | 8.9 – 11.2 |

### *Quality Control Data for Samples 744474.1 – 4 (KLGen 4665 )*

| Sample Name | Lab No | Silica (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.1 |
| Procedural Blank | - | <0.1 |
| QC Standard | - | 5.20 |
| QC Standard Range | - | 4.25 – 5.75 |

### *Quality Control Data for Samples 744474.1 – 4,19 (AutotM 176)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | - | < 4 |
| QC Standard 1 | - | 153.9 |
| QC Standard 2 | - | 154.8 |
| QC Standard Range | - | 150.7 – 157.4 |
| Duplicate Sample 1 | 744474.19 | 9.7 |
| Duplicate Sample 2 | 744474.19 | 9.7 |

### *Quality Control Data for Samples 744474.1 – 4,19 (IC 3267)*

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | 1.57#### |
| QC Standard 1 | - | 10.27 |
| QC Standard Range | - | 8.5 – 11.5 |
| QC Standard 2 | - | 97.36 |
| QC Standard Range | - | 85 - 115 |

####This result is > detection limit, therefore all samples where this result is over 10% of the sample have been repeated on IC 3269

***Quality Control Data for Samples 744474.2 – 4,19 (IC 3269)***

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.50 |
| QC Standard 1 | - | 10.31 |
| QC Standard Range | - | 8.5 – 11.5 |
| QC Standard 2 | - | 102.99 |
| QC Standard Range | - | 85 - 115 |

***Quality Control Data for Samples 744474.1 – 4,19 (L4C 2868 )***

| Sample Name | Lab No | Nitrite-N (g.m-3) | Nitrite-N+Nitrate-N (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | <0.0020 | <0.0020 |
| QC Standard | - | N/A | 5.29 |
| QC Standard Range | - | N/A | 4.25 – 5.75 |

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R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 744474 | SUPv6 |
| **Contact:** | A Rumsby | **Date Registered:** | 17-Nov-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 07-Jan-2010 | |
| | PO Box 9528 | **Quote No:** | 37478 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | A02277600 | |
| | | **Submitted By:** | R Sharplin | |

## Amended Report

This report replaces an earlier report issued on the 14 Dec 2009 at 6:10 pm
Following a query from the client, sample 744474.18 was repeated [QOWQ36952]. It was found that the initial analysis had spot contamination effecting the results for Li, Zn and Pb, the repeated results are now reported below.

**Sample Type: Aqueous**

| | | Sample Name: | SW3 17-Nov-2009 | SW5 17-Nov-2009 | SW100 17-Nov-2009 | SW101 17-Nov-2009 |
|---|---|---|---|---|---|---|
| | | Lab Number: | 744474.1 | 744474.2 | 744474.3 | 744474.4 |
| Individual Tests | | | | | | |
| Total Suspended Solids | g/m³ | | < 3 ± 2.1 | 13.5 ± 2.7 | 7.7 ± 2.3 | < 3 ± 2.1 |
| Total Dissolved Silica | g/m³ as $SiO_2$ | | 13.15 ± 0.79 | 18.2 ± 1.1 | 16.18 ± 0.98 | 12.53 ± 0.76 |
| Silicon | g/m³ | | 6.15 ± 0.37 | 8.49 ± 0.51 | 7.56 ± 0.46 | 5.85 ± 0.36 |
| Reactive Silica | g/m³ as $SiO_2$ | | 12.46 ± 0.26 | 16.21 ± 0.34 | 14.52 ± 0.30 | 12.34 ± 0.26 |
| Sulphate | g/m³ | | - | 283 ± 19 | 213 ± 15 | 31.6 ± 2.2 |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | | < 0.004 ± 0.0022 | 0.259 ± 0.037 | 0.118 ± 0.017 | 0.0080 ± 0.0024 |
| Total Antimony | g/m³ | | < 0.0003 ± 0.00014 | 0.00103 ± 0.00057 | 0.00076 ± 0.00042 | 0.00047 ± 0.00027 |
| Total Arsenic | g/m³ | | < 0.0011 ± 0.00074 | 0.00479 ± 0.00079 | 0.00201 ± 0.00075 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | | 0.00669 ± 0.00056 | 0.0265 ± 0.0022 | 0.0269 ± 0.0022 | 0.0184 ± 0.0015 |
| Total Beryllium | g/m³ | | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | | 0.0107 ± 0.0038 | 0.0262 ± 0.0051 | 0.0187 ± 0.0044 | 0.0120 ± 0.0039 |
| Total Cadmium | g/m³ | | 0.00405 ± 0.00033 | 0.136 ± 0.011 | 0.0985 ± 0.0079 | 0.0169 ± 0.0014 |
| Total Calcium | g/m³ | | 9.70 ± 0.39 | 89.0 ± 3.6 | 59.5 ± 2.4 | 7.32 ± 0.30 |
| Total Chromium | g/m³ | | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | | 0.0162 ± 0.0017 | 0.210 ± 0.021 | 0.104 ± 0.011 | 0.00570 ± 0.00067 |
| Total Iron | g/m³ | | < 0.03 ± 0.014 | 4.20 ± 0.59 | 2.07 ± 0.30 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | | 0.001113 ± 0.000099 | 0.0767 ± 0.0047 | 0.0526 ± 0.0032 | 0.228 ± 0.014 |
| Total Lithium | g/m³ | | 0.00189 ± 0.00036 | 0.0196 ± 0.0024 | 0.0143 ± 0.0018 | 0.00212 ± 0.00038 |
| Total Magnesium | g/m³ | | 1.98 ± 0.16 #1 | 18.5 ± 1.5 | 12.37 ± 0.99 | 2.45 ± 0.20 #1 |
| Total Manganese | g/m³ | | 0.00077 ± 0.00036 | 1.73 ± 0.18 | 1.00 ± 0.11 | 0.00135 ± 0.00038 |
| Total Mercury | g/m³ | | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | | < 0.0003 ± 0.00015 | 0.00046 ± 0.00015 | 0.00031 ± 0.00015 | < 0.0003 ± 0.00015 |
| Total Nickel | g/m³ | | < 0.0006 ± 0.00036 | 0.0230 ± 0.0028 | 0.0157 ± 0.0020 | 0.00115 ± 0.00038 |
| Total Potassium | g/m³ | | 0.443 ± 0.045 #1 | 1.135 ± 0.077 #1 | 0.953 ± 0.068 #1 | 0.675 ± 0.054 #1 |
| Total Selenium | g/m³ | | < 0.0011 ± 0.00074 | < 0.003 ± 0.0012 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | | 0.00472 ± 0.00048 | 0.000297 ± 0.000079 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | | 7.48 ± 0.45 | 14.11 ± 0.85 | 12.53 ± 0.76 | 8.60 ± 0.52 |
| Total Tin | g/m³ | | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | | 0.422 ± 0.034 | 21.6 ± 1.8 | 13.9 ± 1.2 | 1.73 ± 0.14 |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | | 1.2 | 7.5 #2 | 5.6 #2 | 1.2 #2 |

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The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW3 17-Nov-2009 | SW5 17-Nov-2009 | SW100 17-Nov-2009 | SW101 17-Nov-2009 |
| **Lab Number:** | | 744474.1 | 744474.2 | 744474.3 | 744474.4 |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Cations | meq/L | 1.0 | 6.8 #2 | 4.5 #2 | 0.98 #2 |
| pH | pH Units | 6.7 ± 0.2 | 7.3 ± 0.2 | 7.6 ± 0.2 | 7.5 ± 0.2 |
| Total Alkalinity | g/m³ as $CaCO_3$ | 15.5 ± 1.2 | 64.4 ± 4.1 | 44.4 ± 2.9 | 9.80 ± 0.91 |
| Bicarbonate | g/m³ at 25°C | 18.9 ± 1.8 | 78.3 ± 6.1 | 53.9 ± 4.3 | 11.9 ± 1.4 |
| Total Hardness | g/m³ as $CaCO_3$ | 33.5 ± 1.7 | 303 ± 16 | 198.1 ± 9.9 | 29.9 ± 1.5 |
| Electrical Conductivity (EC) | mS/m | 11.2 ± 0.1 | 62.8 ± 0.4 | 48.4 ± 0.4 | 11.6 ± 0.1 |
| Dissolved Calcium | g/m³ | 9.89 ± 0.62 | 91.0 ± 5.7 | 58.8 ± 3.7 | 7.61 ± 0.48 |
| Dissolved Magnesium | g/m³ | 2.13 ± 0.15 #1 | 18.4 ± 1.3 | 12.48 ± 0.84 | 2.65 ± 0.18 #1 |
| Dissolved Potassium | g/m³ | 0.468 ± 0.048 #1 | 1.253 ± 0.097 #1 | 0.989 ± 0.080 #1 | 0.723 ± 0.063 #1 |
| Dissolved Sodium | g/m³ | 7.34 ± 0.79 | 15.3 ± 1.7 | 12.1 ± 1.3 | 8.45 ± 0.91 |
| Chloride | g/m³ | 9.94 ± 0.81 | 10.29 ± 0.84 | 10.37 ± 0.84 | 11.58 ± 0.92 |
| Nitrite-N | g/m³ | < 0.002 ± 0.0014 | < 0.002 ± 0.0014 | 0.0052 ± 0.0014 | < 0.002 ± 0.0014 |
| Nitrate-N | g/m³ | 0.160 ± 0.017 | 0.0335 ± 0.0039 | 0.0606 ± 0.0069 | 0.142 ± 0.015 |
| Nitrate-N + Nitrite-N | g/m³ | 0.162 ± 0.017 | 0.0335 ± 0.0036 | 0.0658 ± 0.0068 | 0.144 ± 0.015 |
| Sulphate | g/m³ | 28.1 ± 2.0 | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW3B 17-Nov-2009 | SW5B 17-Nov-2009 | SW100B 17-Nov-2009 | SW101B 17-Nov-2009 |
| **Lab Number:** | | 744474.5 | 744474.6 | 744474.7 | 744474.8 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | < 0.004 ± 0.0022 | 0.0044 ± 0.0022 | < 0.004 ± 0.0022 | 0.0065 ± 0.0023 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00014 | 0.00061 ± 0.00034 | 0.00049 ± 0.00028 | 0.00037 ± 0.00022 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | 0.00139 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.00626 ± 0.00052 | 0.0256 ± 0.0021 | 0.0261 ± 0.0021 | 0.0173 ± 0.0014 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0119 ± 0.0039 | 0.0268 ± 0.0051 | 0.0236 ± 0.0048 | 0.0126 ± 0.0039 |
| Total Cadmium | g/m³ | 0.00382 ± 0.00031 | 0.1220 ± 0.0098 | 0.0879 ± 0.0071 | 0.0162 ± 0.0013 |
| Total Calcium | g/m³ | 9.86 ± 0.40 | 83.6 ± 3.4 | 61.1 ± 2.5 | 7.56 ± 0.31 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.00125 ± 0.00038 | 0.00926 ± 0.00099 | 0.00854 ± 0.00093 | 0.00568 ± 0.00067 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | < 0.03 ± 0.014 | < 0.03 ± 0.014 | < 0.03 ± 0.014 |
| Total Lead | g/m³ | 0.000932 ± 0.000092 | 0.000265 ± 0.000075 | 0.00279 ± 0.00019 | 0.208 ± 0.013 |
| Total Lithium | g/m³ | 0.00195 ± 0.00037 | 0.0205 ± 0.0025 | 0.0152 ± 0.0019 | 0.00220 ± 0.00039 |
| Total Magnesium | g/m³ | 2.19 ± 0.18 | 18.5 ± 1.5 | 14.3 ± 1.2 | 2.73 ± 0.22 |
| Total Manganese | g/m³ | 0.00086 ± 0.00036 | 1.73 ± 0.18 | 1.07 ± 0.11 | 0.00136 ± 0.00038 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00015 | 0.00043 ± 0.00015 | 0.00032 ± 0.00015 | < 0.0003 ± 0.00015 |
| Total Nickel | g/m³ | < 0.0006 ± 0.00036 | 0.0234 ± 0.0029 | 0.0171 ± 0.0021 | 0.00123 ± 0.00038 |
| Total Potassium | g/m³ | 0.431 ± 0.044 | 1.155 ± 0.078 | 0.967 ± 0.068 | 0.670 ± 0.054 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 7.28 ± 0.44 | 15.01 ± 0.91 | 12.66 ± 0.76 | 8.37 ± 0.51 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 0.433 ± 0.035 | 19.0 ± 1.6 | 12.8 ± 1.1 | 1.77 ± 0.15 |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 17-Nov-2009 | SW13 17-Nov-2009 | SW15 17-Nov-2009 | SW11B 17-Nov-2009 |
| **Lab Number:** | | 744474.9 | 744474.10 | 744474.11 | 744474.12 |
| Individual Tests | | | | | |
| pH | pH Units | 3.3 ± 0.2 | 6.8 ± 0.2 | 6.2 ± 0.2 | - |
| Electrical Conductivity (EC) | mS/m | 71.9 ± 0.5 | 15.8 ± 0.2 | 22.1 ± 0.2 | - |
| Total Suspended Solids | g/m³ | 25.4 ± 3.9 | < 3 ± 2.1 | < 3 ± 2.1 | - |
| Total Cyanide | g/m³ | 0.0026 ± 0.0013 | < 0.0010 ± 0.00067 | < 0.0010 ± 0.00067 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 11.8 ± 1.7 | 0.459 ± 0.065 | 0.0192 ± 0.0035 | 10.5 ± 1.5 |
| Total Antimony | g/m³ | 0.00041 ± 0.00024 | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00039 ± 0.00023 |
| Total Arsenic | g/m³ | 0.0141 ± 0.0012 | < 0.0011 ± 0.00074 | 0.00298 ± 0.00076 | 0.0115 ± 0.0011 |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW11 17-Nov-2009 | SW13 17-Nov-2009 | SW15 17-Nov-2009 | SW11B 17-Nov-2009 |
| **Lab Number:** | | 744474.9 | 744474.10 | 744474.11 | 744474.12 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Barium | g/m³ | 0.0305 ± 0.0025 | 0.00968 ± 0.00079 | 0.0213 ± 0.0018 | 0.0329 ± 0.0027 |
| Total Beryllium | g/m³ | 0.00070 ± 0.00017 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | 0.00067 ± 0.00017 |
| Total Boron | g/m³ | 0.0145 ± 0.0041 | 0.0127 ± 0.0039 | 0.0165 ± 0.0042 | 0.0126 ± 0.0039 |
| Total Cadmium | g/m³ | 0.1120 ± 0.0090 | 0.00536 ± 0.00044 | 0.00999 ± 0.00081 | 0.1191 ± 0.0096 |
| Total Calcium | g/m³ | 26.3 ± 1.1 | 11.59 ± 0.47 | 18.62 ± 0.75 | 25.4 ± 1.1 |
| Total Chromium | g/m³ | 0.00302 ± 0.00043 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | 0.00301 ± 0.00043 |
| Total Copper | g/m³ | 0.990 ± 0.099 | 0.0274 ± 0.0028 | 0.0276 ± 0.0028 | 0.967 ± 0.097 |
| Total Iron | g/m³ | 19.0 ± 2.7 | 0.153 ± 0.026 | 0.120 ± 0.022 | 17.4 ± 2.5 |
| Total Lead | g/m³ | 0.869 ± 0.053 | 0.0252 ± 0.0016 | 0.0790 ± 0.0048 | 0.866 ± 0.052 |
| Total Lithium | g/m³ | 0.0213 ± 0.0026 | 0.00339 ± 0.00050 | 0.00624 ± 0.00080 | 0.0214 ± 0.0026 |
| Total Magnesium | g/m³ | 15.3 ± 1.3 | 4.67 ± 0.38 | 7.19 ± 0.58 | 14.1 ± 1.2 |
| Total Manganese | g/m³ | 6.14 ± 0.62 | 0.246 ± 0.025 | 0.0329 ± 0.0034 | 5.86 ± 0.59 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 |
| Total Nickel | g/m³ | 0.0542 ± 0.0066 | 0.00404 ± 0.00060 | 0.00224 ± 0.00044 | 0.0533 ± 0.0065 |
| Total Potassium | g/m³ | 1.522 ± 0.098 | 0.775 ± 0.059 | 1.025 ± 0.071 | 1.507 ± 0.098 |
| Total Selenium | g/m³ | 0.0024 ± 0.0013 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | < 0.003 ± 0.0012 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 10.52 ± 0.64 | 10.37 ± 0.63 | 11.57 ± 0.70 | 10.81 ± 0.65 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | 0.000218 ± 0.000023 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | 0.000230 ± 0.000024 |
| Total Zinc | g/m³ | 19.8 ± 1.6 | 0.982 ± 0.079 | 1.65 ± 0.14 | 19.9 ± 1.6 |

| | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW13B 17-Nov-2009 | SW15B 17-Nov-2009 | SW7 17-Nov-2009 | SW8 17-Nov-2009 |
| **Lab Number:** | | 744474.13 | 744474.14 | 744474.15 | 744474.16 |
| Individual Tests | | | | | |
| pH | pH Units | - | - | 7.0 ± 0.2 | 7.3 ± 0.2 |
| Electrical Conductivity (EC) | mS/m | - | - | 35.8 ± 0.3 | 9.2 ± 0.1 |
| Total Suspended Solids | g/m³ | - | - | < 3 ± 2.1 | < 3 ± 2.1 |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.099 ± 0.014 | 0.0194 ± 0.0035 | 0.335 ± 0.047 | 0.0480 ± 0.0071 |
| Total Antimony | g/m³ | < 0.0003 ± 0.00014 | < 0.0003 ± 0.00014 | 0.00129 ± 0.00071 | 0.00066 ± 0.00037 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | 0.00225 ± 0.00075 | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 |
| Total Barium | g/m³ | 0.00949 ± 0.00078 | 0.0242 ± 0.0020 | 0.0254 ± 0.0021 | 0.00609 ± 0.00051 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Boron | g/m³ | 0.0130 ± 0.0040 | 0.0155 ± 0.0041 | 0.0167 ± 0.0042 | 0.0087 ± 0.0037 |
| Total Cadmium | g/m³ | 0.00536 ± 0.00044 | 0.01174 ± 0.00094 | 0.0486 ± 0.0039 | < 0.00006 ± 0.000036 |
| Total Calcium | g/m³ | 11.84 ± 0.48 | 19.64 ± 0.79 | 36.3 ± 1.5 | 6.03 ± 0.25 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 |
| Total Copper | g/m³ | 0.0110 ± 0.0012 | 0.0287 ± 0.0029 | 0.0421 ± 0.0043 | 0.00076 ± 0.00036 |
| Total Iron | g/m³ | 0.024 ± 0.015 | 0.117 ± 0.022 | 0.546 ± 0.078 | 0.052 ± 0.016 |
| Total Lead | g/m³ | 0.00608 ± 0.00038 | 0.0893 ± 0.0054 | 0.0360 ± 0.0022 | 0.000414 ± 0.000078 |
| Total Lithium | g/m³ | 0.00328 ± 0.00049 | 0.00594 ± 0.00077 | 0.0098 ± 0.0013 | 0.00059 ± 0.00029 |
| Total Magnesium | g/m³ | 4.68 ± 0.38 | 7.08 ± 0.57 | 11.12 ± 0.89 | 1.98 ± 0.16 |
| Total Manganese | g/m³ | 0.248 ± 0.025 | 0.0323 ± 0.0033 | 0.630 ± 0.063 | 0.00194 ± 0.00040 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 | 0.00023 ± 0.00015 | < 0.0003 ± 0.00015 |
| Total Nickel | g/m³ | 0.00402 ± 0.00060 | 0.00241 ± 0.00046 | 0.0100 ± 0.0013 | < 0.0006 ± 0.00036 |
| Total Potassium | g/m³ | 0.752 ± 0.058 | 1.016 ± 0.071 | 0.999 ± 0.070 | 0.446 ± 0.045 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | 0.00117 ± 0.00076 | < 0.0011 ± 0.00074 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 10.03 ± 0.61 | 11.15 ± 0.67 | 12.08 ± 0.73 | 7.17 ± 0.44 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | 0.00057 ± 0.00037 | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 |
| Total Zinc | g/m³ | 0.921 ± 0.074 | 1.76 ± 0.15 | 7.24 ± 0.58 | 0.00244 ± 0.00076 |

| Sample Type: Aqueous | | | | | |
|---|---|---|---|---|---|
| **Sample Name:** | | SW7B 17-Nov-2009 | SW8B 17-Nov-2009 | SW201 17-Nov-2009 | SW21 17-Nov-2009 |
| **Lab Number:** | | 744474.17 | 744474.18 | 744474.19 | 744474.20 |
| Individual Tests | | | | | |
| pH | pH Units | - | - | - | 3.3 ± 0.2 |
| Electrical Conductivity (EC) | mS/m | - | - | - | 72.0 ± 0.5 |
| Total Suspended Solids | g/m³ | - | - | - | 9.5 ± 2.4 |
| Total Cyanide | g/m³ | - | - | - | < 0.0010 ± 0.00067 |
| Sulphate | g/m³ | - | - | 30.2 ± 2.1 | - |
| Drinking water metals suite, totals, trace | | | | | |
| Total Aluminium | g/m³ | 0.0548 ± 0.0080 | 0.0299 ± 0.0047 | - | 11.6 ± 1.7 |
| Total Antimony | g/m³ | 0.00074 ± 0.00041 | 0.00027 ± 0.00017 | - | 0.00080 ± 0.00045 |
| Total Arsenic | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | - | 0.0166 ± 0.0013 |
| Total Barium | g/m³ | 0.0252 ± 0.0021 | 0.00577 ± 0.00049 | - | 0.0335 ± 0.0027 |
| Total Beryllium | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - | 0.00079 ± 0.00019 |
| Total Boron | g/m³ | 0.0147 ± 0.0041 | 0.0101 ± 0.0038 | - | 0.0144 ± 0.0040 |
| Total Cadmium | g/m³ | 0.0489 ± 0.0040 | < 0.00006 ± 0.000036 | - | 0.1164 ± 0.0094 |
| Total Calcium | g/m³ | 36.3 ± 1.5 | 6.36 ± 0.26 | - | 25.8 ± 1.1 |
| Total Chromium | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - | 0.00302 ± 0.00043 |
| Total Copper | g/m³ | 0.0099 ± 0.0011 | 0.00063 ± 0.00036 | - | 0.985 ± 0.099 |
| Total Iron | g/m³ | < 0.03 ± 0.014 | 0.029 ± 0.015 | - | 21.0 ± 3.0 |
| Total Lead | g/m³ | 0.00364 ± 0.00024 | < 0.00011 ± 0.000074 | - | 0.906 ± 0.055 |
| Total Lithium | g/m³ | 0.0092 ± 0.0012 | 0.00050 ± 0.00029 | - | 0.0217 ± 0.0027 |
| Total Magnesium | g/m³ | 10.21 ± 0.82 | 2.33 ± 0.19 | - | 15.1 ± 1.3 |
| Total Manganese | g/m³ | 0.550 ± 0.056 | 0.00106 ± 0.00037 | - | 6.32 ± 0.64 |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | - | < 0.00008 ± 0.000053 |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 | - | < 0.0003 ± 0.00015 |
| Total Nickel | g/m³ | 0.0094 ± 0.0012 | < 0.0006 ± 0.00036 | - | 0.0549 ± 0.0066 |
| Total Potassium | g/m³ | 0.942 ± 0.067 | 0.465 ± 0.045 | - | 1.507 ± 0.098 |
| Total Selenium | g/m³ | < 0.0011 ± 0.00074 | < 0.0011 ± 0.00074 | - | 0.00146 ± 0.00087 |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - | < 0.00011 ± 0.000074 |
| Total Sodium | g/m³ | 11.58 ± 0.70 | 7.78 ± 0.47 | - | 11.03 ± 0.67 |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - | < 0.0006 ± 0.00036 |
| Total Uranium | g/m³ | < 0.00003 ± 0.000014 | < 0.00003 ± 0.000014 | - | 0.000213 ± 0.000023 |
| Total Zinc | g/m³ | 6.82 ± 0.55 | < 0.0011 ± 0.00074 | - | 19.9 ± 1.6 |
| Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn | | | | | |
| Total Arsenic | g/m³ | - | < 0.0011 ± 0.00074 | - | - |
| Total Cadmium | g/m³ | - | < 0.00006 ± 0.000036 | - | - |
| Total Chromium | g/m³ | - | < 0.0006 ± 0.00036 | - | - |
| Total Copper | g/m³ | - | 0.00063 ± 0.00036 | - | - |
| Total Lead | g/m³ | - | < 0.00011 ± 0.000074 | - | - |
| Total Nickel | g/m³ | - | < 0.0006 ± 0.00036 | - | - |
| Total Zinc | g/m³ | - | < 0.0011 ± 0.00074 | - | - |
| Anion / Cation profile, dissolved metals trace level | | | | | |
| Sum of Anions | meq/L | - | - | 1.2 #2 | - |
| Sum of Cations | meq/L | - | - | 0.96 #2 | - |
| pH | pH Units | - | - | 6.8 ± 0.2 | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | - | - | 9.70 ± 0.90 | - |
| Bicarbonate | g/m³ at 25°C | - | - | 11.8 ± 1.4 | - |
| Total Hardness | g/m³ as $CaCO_3$ | - | - | 29.3 ± 1.4 | - |
| Electrical Conductivity (EC) | mS/m | - | - | 11.6 ± 0.1 | - |
| Dissolved Calcium | g/m³ | - | - | 7.43 ± 0.47 | - |
| Dissolved Magnesium | g/m³ | - | - | 2.62 ± 0.18 | - |
| Dissolved Potassium | g/m³ | - | - | 0.711 ± 0.062 | - |
| Dissolved Sodium | g/m³ | - | - | 8.17 ± 0.88 | - |
| Chloride | g/m³ | - | - | 11.48 ± 0.92 | - |
| Nitrite-N | g/m³ | - | - | < 0.002 ± 0.0014 | - |
| Nitrate-N | g/m³ | - | - | 0.142 ± 0.015 | - |
| Nitrate-N + Nitrite-N | g/m³ | - | - | 0.143 ± 0.015 | - |

| Sample Type: Aqueous | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | SW21B 17-Nov-2009 | SW23B 17-Nov-2009 | | | |
| **Lab Number:** | | 744474.21 | 744474.22 | | | |
| Drinking water metals suite, totals, trace | | | | | | |
| Total Aluminium | g/m³ | 10.3 ± 1.5 | < 0.004 ± 0.0022 | - | - | |
| Total Antimony | g/m³ | 0.00067 ± 0.00038 | < 0.0003 ± 0.00014 | - | - | |
| Total Arsenic | g/m³ | 0.0118 ± 0.0011 | < 0.0011 ± 0.00074 | - | - | |
| Total Barium | g/m³ | 0.0327 ± 0.0027 | < 0.0003 ± 0.00014 | - | - | |
| Total Beryllium | g/m³ | 0.00079 ± 0.00019 | < 0.00011 ± 0.000074 | - | - | |
| Total Boron | g/m³ | 0.0148 ± 0.0041 | < 0.006 ± 0.0036 | - | - | |
| Total Cadmium | g/m³ | 0.1228 ± 0.0099 | < 0.00006 ± 0.000036 | - | - | |
| Total Calcium | g/m³ | 25.5 ± 1.1 | < 0.06 ± 0.036 | - | - | |
| Total Chromium | g/m³ | 0.00291 ± 0.00043 | < 0.0006 ± 0.00036 | - | - | |
| Total Copper | g/m³ | 0.919 ± 0.092 | < 0.0006 ± 0.00036 | - | - | |
| Total Iron | g/m³ | 16.9 ± 2.4 | < 0.03 ± 0.014 | - | - | |
| Total Lead | g/m³ | 0.889 ± 0.054 | < 0.00011 ± 0.000074 | - | - | |
| Total Lithium | g/m³ | 0.0210 ± 0.0026 | < 0.0005 ± 0.00029 | - | - | |
| Total Magnesium | g/m³ | 13.7 ± 1.1 | < 0.03 ± 0.014 | - | - | |
| Total Manganese | g/m³ | 5.60 ± 0.57 | < 0.0006 ± 0.00036 | - | - | |
| Total Mercury | g/m³ | < 0.00008 ± 0.000053 | < 0.00008 ± 0.000053 | - | - | |
| Total Molybdenum | g/m³ | < 0.0003 ± 0.00015 | < 0.0003 ± 0.00015 | - | - | |
| Total Nickel | g/m³ | 0.0505 ± 0.0061 | < 0.0006 ± 0.00036 | - | - | |
| Total Potassium | g/m³ | 1.458 ± 0.095 | < 0.06 ± 0.036 | - | - | |
| Total Selenium | g/m³ | 0.00170 ± 0.00097 | < 0.0011 ± 0.00074 | - | - | |
| Total Silver | g/m³ | < 0.00011 ± 0.000074 | < 0.00011 ± 0.000074 | - | - | |
| Total Sodium | g/m³ | 10.64 ± 0.64 | < 0.03 ± 0.014 | - | - | |
| Total Tin | g/m³ | < 0.0006 ± 0.00036 | < 0.0006 ± 0.00036 | - | - | |
| Total Uranium | g/m³ | 0.000229 ± 0.000024 | < 0.00003 ± 0.000014 | - | - | |
| Total Zinc | g/m³ | 19.7 ± 1.6 | < 0.0011 ± 0.00074 | - | - | |

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

## Analyst's Comments

#1 It has been noted that the results for the dissolved fraction were greater than those for the total fraction, but within analytical variation of the method.

#2 It has been noted that the results for the anion and cation balance were not in good agreement, but within the analytical variation of these methods.

Appendix No.1 - QC Report

# 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: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Individual Tests | | | |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-4, 19 |
| Total Digestion | Boiling nitric acid digestion. APHA 3030 E 21st ed. 2005. | - | 1-18, 20-22 |
| Total acid digest for Silver/Tin analysis | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) 21st ed. 2005. | - | 1-18, 20-22 |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 9-11, 20 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-4, 19 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-4, 19 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1-4, 9-11, 15-16, 19-20 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 g/m³ as $CaCO_3$ | 1-4, 19 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 g/m³ at 25°C | 1-4, 19 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 g/m³ as $CaCO_3$ | 1-4, 19 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1-4, 9-11, 15-16, 19-20 |
| Total Suspended Solids | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 21st ed. 2005. | 3.0 g/m³ | 1-4, 9-11, 15-16, 20 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-4, 19 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-4, 19 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-4, 19 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 g/m³ | 1-4, 19 |
| Total Dissolved Silica | Calculation: Silicon x 2.14. | 0.010 g/m³ as $SiO_2$ | 1-4 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 g/m³ | 1-4, 19 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 g/m³ | 9-11, 20 |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 g/m³ | 1-4, 19 |
| Silicon | Analysed as received (filtration, if required), ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0050 g/m³ | 1-4 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-4, 19 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 g/m³ | 1-4, 19 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 g/m³ | 1-4, 19 |
| Reactive Silica | Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-$SiO_2$ F (modified from flow injection analysis) 21st ed. 2005. | 0.10 g/m³ as $SiO_2$ | 1-4 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 g/m³ | 1-4, 19 |
| Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn | Nitric acid digestion, ICP-MS, trace level | - | 18 |
| Anion / Cation profile, dissolved metals trace level | | - | 1-4, 19 |
| Drinking water metals suite, totals, trace | | | |
| Total Aluminium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0032 g/m³ | 1-18, 20-22 |
| Total Antimony | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Arsenic | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-17, 20-22 |
| Total Barium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Beryllium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-18, 20-22 |
| Total Boron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.0053 g/m³ | 1-18, 20-22 |
| Total Cadmium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000053 g/m³ | 1-17, 20-22 |
| Total Calcium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-18, 20-22 |
| Total Chromium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Copper | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |
| Total Iron | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Lead | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00011 g/m³ | 1-17, 20-22 |
| Total Lithium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00042 g/m³ | 1-18, 20-22 |
| Total Magnesium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Manganese | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-18, 20-22 |
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.000080 g/m³ | 1-18, 20-22 |
| Total Molybdenum | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00021 g/m³ | 1-18, 20-22 |
| Total Nickel | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.00053 g/m³ | 1-17, 20-22 |
| Total Potassium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.053 g/m³ | 1-18, 20-22 |
| Total Selenium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-18, 20-22 |
| Total Silver | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00011 g/m³ | 1-18, 20-22 |
| Total Sodium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.021 g/m³ | 1-18, 20-22 |
| Total Tin | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00053 g/m³ | 1-18, 20-22 |
| Total Uranium | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.000021 g/m³ | 1-18, 20-22 |
| Total Zinc | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 21st ed. 2005 / US EPA 200.8. | 0.0011 g/m³ | 1-17, 20-22 |

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.

This report must not be reproduced, except in full, without the written consent of the signatory.

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

***Client:*** ***Pattle Delamore Partners Ltd***
***Address:*** ***P.O Box 9258***
***Newmarket,Auckland 1149***
***Contact:*** ***Rumsby, Andrew***

***Laboratory No:*** ***744474QC***
***Date Registered:*** ***17/11/2009***



***Client's Reference: A02277600***

# Quality Control Report for 744474

***This report includes quality control data for the following analytes:***

| | |
|---|---|
| Trace Elements – Water<br>Silicon | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Sample Spikes***<br>***- Duplicate Sample Analysis*** |
| Trace Elements – Water<br>Dissolved Metals<br>(Calcium, Magnesium, Potassium,<br>and Sodium). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Trace Elements - Water<br>Total Metals<br>(Arsenic, Aluminium, Antimony,<br>Barium, Beryllium, Boron, Calcium,<br>Cadmium, Chromium, Copper, Iron,<br>Lead, Lithium, Manganese, Magnesium,<br>Mercury, Molybdenum, Nickel, Potassium,<br>Selenium, Silver, Sodium, Tin, Uranium, Zinc). | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis***<br>***- Sample Spikes*** |
| Nitrite-N, Nitrate-N, Nitrogen Oxides – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| | |
|---|---|
| Chloride – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Cyanide – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Alkalinity - Water | ***- Procedural Blanks***<br>***- QC Standard***<br>***- Duplicate Sample Analysis*** |
| Electrical Conductivity, pH | ***- Procedural Blanks***<br>***- QC Standard*** |
| Total Suspended Solids – Water | ***- Procedural Blanks***<br>***- QC Standard*** |
| Reactive Silica – Water | ***- Procedural Blanks***<br>***- QC Standard*** |

## *Sample Type: Water,*

### *Quality Control Data for Samples 744474.1 - 4 (EWSi 553)*

| Sample Name | Lab No | Silicon (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.01 |
| QC Standard | - | 5.17 |
| QC Standard Range | - | 4.5 – 5.5 |
| Sample Spike [% Recovery] | 744474.4 | 93 |
| Duplicate Sample 1 | 744474.4 | 5.85 |
| Duplicate Sample 2 | 744474.4 | 5.83 |

### *Quality Control Data for Samples 744474.1 - 22 (HgBrF 199)*

| Sample Name | Lab No | Total Mercury (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.00008 |
| Duplicate Sample 1 | 744474.22 | < 0.00008 |
| Duplicate Sample 2 | 744474.22 | < 0.00008 |
| QC Standard | - | 0.00054 |
| QC Standard Range | - | 0.00045 - 0.00055 |

### *Quality Control Data for Samples 744474.13 – 18,20 - 22(EWAg 261 )*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.0115 |
| QC Standard Range | - | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 744474.22 | 91 |
| Duplicate Sample 1 | 744474.22 | < 0.0001 |
| Duplicate Sample 2 | 744474.22 | < 0.0001 |

### *Quality Control Data for Samples 744474.1 – 12 (EWAg 262)*

| Sample Name | Lab No | Total Silver (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.0001 |
| QC Standard | - | 0.0123 |
| QC Standard Range | - | 0.010 - 0.016 |
| Sample Spike [% Recovery] | 744474.12 | 103 |
| Duplicate Sample 1 | 744474.12 | < 0.0001 |
| Duplicate Sample 2 | 744474.12 | < 0.0001 |

***Quality Control Data for Samples 744474.1,2,3,4,19 (EW 8135)***

| Sample Name | Lab No | Dissolved Calcium (g.m-3) | Dissolved Magnesium (g.m-3) | Dissolved Potassium (g.m-3) | Dissolved Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.05 | < 0.02 | < 0.05 | < 0.02 |
| QC Standard | - | 0.516 | 0.052 | 0.524 | 0.520 |
| QC Standard Range | - | 0.45 – 0.55 | 0.045 – 0.055 | 0.45 – 0.55 | 0.45 – 0.55 |
| Duplicate Sample 1 # | 744953.12 | 6.94 | 2.83 | 1.98 | 12.64 |
| Duplicate Sample 2 # | 744953.12 | 6.94 | 2.88 | 2.03 | 12.90 |

# A duplicate analysis of 744474 was not performed, however a duplicate sample was analysed in the same batch as 744474 and these results are included in this QC report.

***Quality Control Data for Samples 744474.1 – 18,20- 22 (EWT 5033 )***

| Sample Name | Lab No | Total Aluminium (g.m-3) | Total Arsenic (g.m-3) | Total Antimony (g.m-3) | Total Barium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.003 | < 0.001 | < 0.0002 | < 0.0001 |
| Sample Spike[% Recovery] | 744474.14 | 94 | 92 | 103 | 95 |
| QC Standard | - | 0.0053 | 0.0052 | 0.0049 | 0.0051 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | 0.019 | 0.0022 | < 0.0002 | 0.0242 |
| Duplicate Sample 2 | 744474.14 | 0.016 | 0.0020 | < 0.0002 | 0.0216 |

| Sample Name | Lab No | Total Beryllium (g.m-3) | Total Boron (g.m-3) | Total Calcium (g.m-3) | Total Cadmium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0001 | < 0.005 | < 0.05 | < 0.00005 |
| Sample Spike[% Recovery] | 744474.14 | 102 | 107 | N\A## | 102 |
| QC Standard | - | 0.0053 | 0.010 | 0.54 | 0.0051 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.008 - 0.012 | 0.45 – 0.55 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | < 0.0001 | 0.0155 | 19.64 | 0.0117 |
| Duplicate Sample 2 | 744474.14 | < 0.0001 | 0.0145 | 19.36 | 0.0105 |

| Sample Name | Lab No | Total Chromium (g.m-3) | Total Copper (g.m-3) | Total Iron (g.m-3) | Total Lead (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.0005 | < 0.02 | < 0.0001 |
| Sample Spike[% Recovery] | 744474.14 | 96 | 98 | 103 | 95 |
| QC Standard | - | 0.0052 | 0.0052 | 0.060 | 0.0055 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | < 0.0005 | 0.0287 | 0.117 | 0.0893 |
| Duplicate Sample 2 | 744474.14 | < 0.0005 | 0.0267 | 0.104 | 0.0824 |

| Sample Name | Lab No | Total Lithium (g.m-3) | Total Manganese (g.m-3) | Total Magnesium (g.m-3) | Total Molybdenum (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0002 | < 0.0005 | < 0.02 | < 0.0002 |
| Sample Spike[% Recovery] | 744474.14 | 104 | 110 | N\A ## | 104 |
| QC Standard | - | 0.0055 | 0.0052 | 0.053 | 0.0050 |
| QC Standard Range | - | 0.0040 – 0.0060 | 0.0045 – 0.0055 | 0.03 – 0.07 | 0.0045 – 0.0055 |
| Duplicate Sample 1 | 744474.14 | 0.0059 | 0.0323 | 7.08 | < 0.0002 |
| Duplicate Sample 2 | 744474.14 | 0.0055 | 0.0310 | 6.79 | < 0.0002 |

## The spike recovery is N/A as the amount of the sample has swamped the spike

| Sample Name | Lab No | Total Nickel (g.m-3) | Total Potassium (g.m-3) | Total Selenium (g.m-3) | Total Sodium (g.m-3) |
|---|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.05 | < 0.001 | < 0.02 |
| Sample Spike[% Recovery] | 744474.14 | 101 | 94 | 105 | N\A ## |
| QC Standard | - | 0.0053 | 0.515 | 0.011 | 0.524 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.45 – 0.55 | 0.009 – 0.011 | 0.45 – 0.55 |
| Duplicate Sample 1 | 744474.14 | 0.0024 | 1.016 | < 0.001 | 11.15 |
| Duplicate Sample 2 | 744474.14 | 0.0022 | 0.955 | < 0.001 | 10.61 |

| Sample Name | Lab No | Total Tin (g.m-3) | Total Uranium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.0005 | < 0.00005 | < 0.001 |
| Sample Spike[% Recovery] | 744474.14 | 102 | N\A ### | N\A ## |
| QC Standard | - | 0.0050 | 0.0052 | 0.0530 |
| QC Standard Range | - | 0.0045 – 0.0055 | 0.0045 – 0.0055 | 0.045 – 0.055 |
| Duplicate Sample 1 | 744474.14 | < 0.0005 | < 0.00005 | 1.763 |
| Duplicate Sample 2 | 744474.14 | < 0.0005 | < 0.00005 | 1.680 |

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##The spike recovery is N/A as the amount of the sample has swamped the spike

###The spike recovery has been labeled as N/A as the element is not included in our spike solution.

***Quality Control Data for Sample 744474.10,11,13 (iron); 2,9,12 (selenium); 22 (zinc)*** ***(EWT 5037)***

| Sample Name | Lab No | Total Iron (g.m-3) | Total Selenium (g.m-3) | Total Zinc (g.m-3) |
|---|---|---|---|---|
| Procedural Blank | - | < 0.02 | < 0.001 | < 0.001 |
| QC Standard | - | 0.043 | 0.0107 | 0.049 |
| QC Standard Range | - | 0.03 – 0.07 | 0.009 – 0.011 | 0.045 – 0.055 |
| Duplicate Sample 1 # | 742378.1 | 0.301 | < 0.001 | 0.0945 |
| Duplicate Sample 2 # | 742378.1 | 0.280 | < 0.001 | 0.0900 |

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# A duplicate analysis of 744474 was not performed, however a duplicate sample was analysed in the same batch as 744474 and these results are included in this QC report.

***Quality Control Data for Samples 744474.9,10 (Cnw 255)***

| Sample Name | Lab No | Cyanide (g.m-3) |
|---|---|---|
| Procedural Blank | - | 0.0012 |
| QC Standard 1 | - | 15.75 |
| QC Standard Range | - | 12.75 – 17.25 |
| QC Standard 2 | - | 15.99 |
| QC Standard Range | - | 13.5 – 16.5 |

***Quality Control Data for Samples 744474.11,20 (Cnw 256)***

| Sample Name | Lab No | Cyanide (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.001 |
| QC Standard 1 | - | 13.20 |
| QC Standard Range | - | 12.75 – 17.25 |
| QC Standard 2 | - | 16.24 |
| QC Standard Range | - | 13.5 – 16.5 |

***Quality Control Data for Samples 744474.1 – 4,9 – 11,15,16,19,20 (pHEC 1890)***

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 7.09 | < 0.1 |
| QC Standard 1 | - | 4.02 | 3.58 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 5.1 |
| QC Standard 2 | - | 7.59 | 66.5 |
| QC Standard Range | - | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | - | N/A | 5290 |
| Saline QC Standard Range | - | N/A | 5123 - 5423 |

***Quality Control Data for Samples 744474.10 (pHEC 1892)***

| Sample Name | Lab No | pH | EC (mS/m) |
|---|---|---|---|
| Procedural Blank | - | 6.43 | < 0.1 |
| QC Standard 1 | - | 4.0 | 4.3 |
| QC Standard Range | - | 3.63 – 4.23 | 2.4 – 5.1 |
| QC Standard 2 | - | 7.56 | 65.60 |
| QC Standard Range | - | 7.3 – 7.7 | 63.6 – 69.6 |
| Saline QC | - | N/A | 5290 |
| Saline QC Standard Range | - | N/A | 5123 - 5423 |

***Quality Control Data for Samples 744474.1 – 4,10,11,15,16,20 (SS 7961)***

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | - | 1833 |
| QC Standard Range | - | 1600 - 2400 |

### *Quality Control Data for Samples 744474.9 (SS 7964)*

| Sample Name | Lab No | Total suspended solids (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 3 |
| Procedural Blank | - | < 3 |
| QC Standard | - | 1803 |
| QC Standard Range | - | 1600 - 2400 |

### *Quality Control Data for Samples 744474.1 – 4,19 (KLGen 4642 )*

| Sample Name | Lab No | Chloride (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.5 |
| Procedural Blank | - | < 0.5 |
| QC Standard | - | 9.86 |
| QC Standard Range | - | 8.9 – 11.2 |

### *Quality Control Data for Samples 744474.1 – 4 (KLGen 4665 )*

| Sample Name | Lab No | Silica (g.m-3) |
|---|---|---|
| Procedural Blank | - | <0.1 |
| Procedural Blank | - | <0.1 |
| QC Standard | - | 5.20 |
| QC Standard Range | - | 4.25 – 5.75 |

### *Quality Control Data for Samples 744474.1 – 4,19 (AutotM 176)*

| Sample Name | Lab No | Alkalinity (g/m3 as CaCO3) |
|---|---|---|
| Procedural Blank | - | < 4 |
| QC Standard 1 | - | 153.9 |
| QC Standard 2 | - | 154.8 |
| QC Standard Range | - | 150.7 – 157.4 |
| Duplicate Sample 1 | 744474.19 | 9.7 |
| Duplicate Sample 2 | 744474.19 | 9.7 |

### *Quality Control Data for Samples 744474.1 – 4,19 (IC 3267)*

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | 1.57#### |
| QC Standard 1 | - | 10.27 |
| QC Standard Range | - | 8.5 – 11.5 |
| QC Standard 2 | - | 97.36 |
| QC Standard Range | - | 85 - 115 |

####This result is > detection limit, therefore all samples where this result is over 10% of the sample have been repeated on IC 3269

***Quality Control Data for Samples 744474.2 – 4,19 (IC 3269)***

| Sample Name | Lab No | Sulphate (g.m-3) |
|---|---|---|
| Procedural Blank | - | < 0.50 |
| QC Standard 1 | - | 10.31 |
| QC Standard Range | - | 8.5 – 11.5 |
| QC Standard 2 | - | 102.99 |
| QC Standard Range | - | 85 - 115 |

***Quality Control Data for Samples 744474.1 – 4,19 (L4C 2868 )***

| Sample Name | Lab No | Nitrite-N (g.m-3) | Nitrite-N+Nitrate-N (g.m-3) |
|---|---|---|---|
| Procedural Blank | - | <0.0020 | <0.0020 |
| QC Standard | - | N/A | 5.29 |
| QC Standard Range | - | N/A | 4.25 – 5.75 |

pdp solutions for your environment

PATTLE DELAMORE PARTNERS LTD

# Request for Analyses

**NOTE: Please acknowledge receipt of these samples by signing this form and emailing to submitter.**

**From: Pattle Delamore Partners Ltd** 021 248 2522

Address (Refer to base of sheet): ☑ PDP Auckland ☐ PDP Wellington ☐ PDP Christchurch

Submitted by: Remalia Sharplin Ph No.: (09) 523-6947

**To:** Hill Labs, Hamilton

Quote No.: 37478

PDP Job No.: A0227760

## Chain of Custody Record

**Sent:**

Name: Remalia Sharplin

Signature:

Date and time:

**Received:** ☐ Room temp. ☐ Chilled Temp.: 15.5°C

Name: Philip Horgan

Signature: Philip Horgan

Date and time: 17/11/09 4:25pm

**Notes:** Pls fax COC once received. Thanks.

**Results by:** ☑ Email submitter: Remalia.Sharplin @pdp.co.nz ☑ Mail (address below)

☑ Email other: Primary Contact: Andrew.Rumsby @pdp.co.nz ☐ Fax (number below)

Priority: ☐ Normal ☑ High ☐ Urgent

Results required by: ____ / ____ / ____

**Invoice to:** ☑ PDP ☐ Other:

| Sample ID | Sample type | No. bottles | Analyses requested | Notes |
|---|---|---|---|---|
| SW3, SW5, SW100, SW101 | FW | 3 each (12) | pH, EC, SS; Ion profile; Total metals. | |
| SW3B, SW5B, SW100B, SW101B | FW | 1 each (4) | Total metals. | |
| SW11, SW13, SW15 | FW | 3 each (9) | pH, EC, SS; Cyanide; Total metals. | |
| SW11B, SW13B, SW15B | FW | 1 each (3) | Total metals. | |
| SW7, SW9 | FW | 2 each (4) | pH, EC, SS; Total metals | |
| SW7B, SW8B | FW | 1 each (2) | Total metals | |
| SW201 | FW | 1 | Ion profile. | |
| SW21 | FW | 3 | & pH, EC, SS; Cyanide; Total metals | |
| SW21B | FW | 1 | Total metals. | |
| SW23B | FW | 1 | Total metals. | |

**Temperature On Arrival**

15.5 °C

Temperature was measured on one or more arbitrarily chosen samples in this batch.

Job No: 74474

Time Received: 17-Nov-2009 4:21:17 pm

No of Samples: 0 No of Fractions 0

**Sample type:** S Soil GW Groundwater SAL Seawater/saline FW Freshwater LEACH Leachate GEO Geothermal

SED Sediment BIO Biota TW Tradewaste WW Wastewater P Potable Other:

**Note: Samples may contain dangerous or hazardous substances**



PDP Auckland
PDP House, 235 Broadway, Newmarket, Auckland
PO Box 9528, Newmarket, Auckland 1149

PDP Wellington
iSOFT House, Level 1, 111 Customhouse Quay, Wellington
PO Box 6136, Wellington 6141

PDP Christchurch
Radio NZ House, 51 Chester St West, Christchurch
PO Box 389, Christchurch 8140

# Certificate of Analysis

PATTLE DELAMORE PARTNERS

PO BOX 9528
NEWMARKET
AUCKLAND
**Attention:** ANDREW RUMSBY

Copy to 1: Remalia Sharplin
2: Andrew Rumsby

**Job Description:** ON:AO2277600 Sampling/No
**Batch Number:** 09/32936

***Sample Descriptions***

| Sample No. | Date Sampled | Sample Description |
|---|---|---|
| 01 | 17/11/2009 | SW101 |
| 02 | 17/11/2009 | SW101B |

***Results***

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| | | 01 | 02 | | | | |
| Silver Trace by ICPMS | mg/L | 0.00007 | 0.00007 | | | | |
| Aluminium Trace by ICPMS | mg/L | 0.01 | 0.0072 | | | | |
| Arsenic Trace by ICP-MS | mg/L | 0.00012 | < 0.0001 | | | | |
| Boron Trace by ICPMS | mg/L | 0.013 | 0.013 | | | | |
| Barium Trace by ICPMS | mg/L | 0.017 | 0.017 | | | | |
| Beryllium Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Calcium: Soluble Trace by ICPMS | mg/L | 7.7 | | | | | |
| Calcium Trace by ICPMS | mg/L | 7. | 7.1 | | | | |
| Cadmium: Trace by ICPMS | mg/L | 0.015 | 0.015 | | | | |
| Chromium Trace by ICPMS | mg/L | < 0.0001 | < 0.0001 | | | | |
| Copper Trace by ICPMS | mg/L | 0.0058 | 0.0056 | | | | |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | | 1 | 1 | | | | |
| Iron: Soluble Trace by ICPMS | mg/L | < 0.002 | | | | | |
| Iron Trace by ICPMS | mg/L | 0.0051 | 0.0036 | | | | |
| Calcium Hardness Calc Trace ICPMS | mg/L | 17.48 | | | | | |
| Magnesium Hardness Calc Trace ICPMS | mg/L | 10.30 | | | | | |
| Total Hardness Calc Trace ICPMS | mg/L | 27.77 | | | | | |
| Mercury: Trace by ICPMS | mg/L | < 0.00005 | < 0.00005 | | | | |
| Potassium: Soluble Trace by ICPMS | mg/L | 0.61 | | | | | |
| Potassium Trace by ICPMS | mg/L | 0.67 | 0.66 | | | | |
| Lithium Trace by ICPMS | mg/L | 0.002 | 0.002 | | | | |
| Filtration for Soluble Metals | | Yes | | | | | |
| Magnesium: Soluble Trace by ICPMS | mg/L | 2.7 | | | | | |
| Magnesium Trace by ICPMS | mg/L | 2.5 | 2.6 | | | | |
| Manganese Trace by ICPMS | mg/L | 0.0012 | 0.0011 | | | | |
| Molybdenum Trace by ICPMS | mg/L | < 0.0003 | < 0.0003 | | | | |
| Sodium: Soluble Trace by ICPMS | mg/L | 7.9 | | | | | |
| Sodium Trace by ICPMS | mg/L | 7.8 | 7.9 | | | | |
| Nickel Trace by ICPMS | mg/L | 0.0011 | 0.001 | | | | |
| Lead Trace by ICPMS | mg/L | 0.21 | 0.2 | | | | |

| Test Description | Units | Sample Number/Result | | | | | |
|---|---|---|---|---|---|---|---|
| Antimony Trace by ICPMS | mg/L | < 0.001 | < 0.001 | | | | |
| Selenium Trace by ICP-MS | mg/L | < 0.0005 | < 0.0005 | | | | |
| Silica: Soluble Trace by ICPMS | mg/L | 13. | | | | | |
| Tin Trace by ICPMS | mg/L | < 0.0001 | < 0.0001 | | | | |
| Uranium Trace by ICPMS | mg/L | < 0.00001 | < 0.00001 | | | | |
| Zinc Trace by ICPMS | mg/L | 1.7 | 1.7 | | | | |
| Alkalinity total by Autotitrator | mg/L CaCO3 | 11 | | | | | |
| Alkalinity bicarbonate | mg/L HCO3 | 13 | | | | | |
| Chloride by Ion Chromatography | mg/L | 11.1 | | | | | |
| Carbon dioxide by Calculation (Nomograph) | mg/L | 2.4 | | | | | |
| Conductivity by Auto-titrator | mS/m 25oC | 11.8 | | | | | |
| GF/C Filtration | | Yes | | | | | |
| PROFILE ONLY Ion balance | | Attached | | | | | |
| Membrane Filtration | | Yes | | | | | |
| Ammonia Nitrogen low level Soluble | mg/L N | < 0.01 | | | | | |
| Nitrite Nitrogen by Ion Chromatography | mg/L N | < 0.002 | | | | | |
| Nitrate Nitrogen by Ion Chromatography | mg/L N | 0.1 | | | | | |
| Nitrate & Nitrite Nitrogen by Calculation | mg/L N | 0.102 | | | | | |
| pH(Autotitrator) at room temp(c.20°C) | pH Unit | 7.1 | | | | | |
| Sulphate by Ion Chromatography | mg/L SO4 | 23.1 | | | | | |
| Total dissolved solids | mg/L | 97 | | | | | |
| Temperature | oC | 20.0 | | | | | |

***Test Descriptions***

| Test Description | Method | Accredited |
|---|---|---|
| Alkalinity bicarbonate | APHA (2005) 2320 B | IANZ |
| Alkalinity total by Autotitrator | APHA (2005) 2320 B | IANZ |
| Aluminium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Ammonia Nitrogen low level Soluble | APHA (2005) 4500-NH3 G, Mod | IANZ |
| Antimony Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Arsenic Trace by ICP-MS | USEPA 200.8 (Modified) | IANZ |
| Barium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Beryllium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Boron Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Cadmium: Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Calcium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Calcium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Calcium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Carbon dioxide by Calculation (Nomograph) | APHA (2005) 4500-CO2 B | |
| Chloride by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Chromium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Conductivity by Auto-titrator | APHA (2005) 2510 B | IANZ |
| Copper Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Filtration for Soluble Metals | Cleanroom: nitric acid-leached 0.45um filter. | |
| GF/C Filtration | Glass Fiber Filtration 1.2 um | |
| Iron Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Iron: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lead Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Lithium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

| Test Description | Method | Accredited |
|---|---|---|
| Magnesium Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Magnesium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Magnesium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Manganese Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Membrane Filtration | Membrane Filter, 0.45um | |
| Mercury: Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Molybdenum Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nickel Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Nitrate & Nitrite Nitrogen by Calculation | Calculation | |
| Nitrate Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Nitric/Hydrochloric Acid Digest (5:1 Ratio) | APHA (2005) 3030E (Modified) | |
| Nitrite Nitrogen by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| pH(Autotitrator) at room temp(c.20°C) | APHA (2005) 4500-H B | IANZ |
| Potassium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Potassium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| PROFILE ONLY Ion balance | APHA (2005) 1030E | |
| Selenium Trace by ICP-MS | USEPA 200.8 (Modified) | IANZ |
| Silica: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | |
| Silver Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sodium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sodium: Soluble Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Sulphate by Ion Chromatography | APHA (2005) 4110 B | IANZ |
| Temperature | Thermometer | IANZ |
| Tin Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Total dissolved solids | APHA (2005) 2540 C (Modified) | |
| Total Hardness Calc Trace ICPMS | APHA 2340B (2005) | IANZ |
| Uranium Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |
| Zinc Trace by ICPMS | USEPA 200.8 (Modified) | IANZ |

**Comments:** This report replaces 09/32936-2.

Results are reported on an as received basis.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

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:

Dr You-Sing Yong
Operations Manager
07 December 2009
yyong@water.co.nz

## ION BALANCE :

| | | | |
|---|---|---|---|
| **Batch No. :** | **09/32936** | | |
| **Date :** | **12/07/09** | | |
| **Sample Description** | **PDP-MISC** | | |
| **Sample No . :** | | 01 | 02 |

| **Cation** | **meq/L Conversion** | **mg/L** | **meq/L** | **mg/L** | **meq/L** |
|---|---|---|---|---|---|
| Ammonia | 0.0714 | 0.01 | 0.000714 | | |
| Calcium (soluble) | 0.0499 | 7.7 | 0.38423 | | |
| Magnesium (soluble) | 0.0823 | 2.7 | 0.22221 | | |
| Sodium (soluble) | 0.0435 | 7.9 | 0.34365 | | |
| Potassium (soluble) | 0.0256 | 0.61 | 0.015616 | | |
| Lithium (soluble) | 0.1441 | | | | |
| Iron (soluble) | 0.0358 | 0.002 | 7.16E-05 | | |
| Aluminium (soluble) | 0.1112 | | | | |
| Manganese (soluble) | 0.0364 | | | | |
| Cation meq/L total | | | 0.966492 | | 0 |

| **Anion** | **meq/L Conversion** | | | | |
|---|---|---|---|---|---|
| Phosphorus (Soluble Reactive) | 0.0968 | | | | |
| Fluoride | 0.0526 | | | | |
| Chloride | 0.0282 | 11.1 | 0.31302 | | |
| Sulphate | 0.0208 | 23.1 | 0.48048 | | |
| Nitrite | 0.02174 | 0.002 | 4.35E-05 | | |
| Nitrate | 0.01613 | 0.1 | 0.001613 | | |
| Alkalinity | 0.0199 | 10.74 | 0.213726 | | |
| Anion meq/L total | | | 1.008882 | | 0 |
| Sum of Anions + Cations | | | 2 | | |
| meq/L difference | | | .04 | | . |
| **% Difference** | | | **2.15%** | | **#DIV/0!** |
| Conductivity | | | 11.79 | | |
| pH | | | 7.08 | | |

| | Anion Sum | Criteria |
|---|---|---|
| Acceptance Criteria : APHA 21st Edition, 2005 | 0-3.0 | ± 0.2 meq/L |
| | 3-10 | ± 2 % |
| | 10-800 | ± 2 -5% |

# Appendix D

Brian T. Coffey and Associates Limited

*Environmental Consultants*

Water Resource Management

# Environment Waikato Contract RCS 2009/10-0: Tui Mine Remedial Works - Instream Ecological Baseline Monitoring

September 2009

*Prepared for:*

Environment Waikato
P.O. Box 4010, Hamilton East

Attention: Ghassan Basheer

*Prepared on behalf of:*
Pattle Delamore Partners Limited
P.O. Box 9528, Auckland
Attention: Andrew Rumsby.

*Prepared by:*
Brian Coffey

Inquiries and reference: please quote:
Brian T. Coffey and Associates Limited
BM: EW / PDP Tui Mine Contract, Sept. 2009.

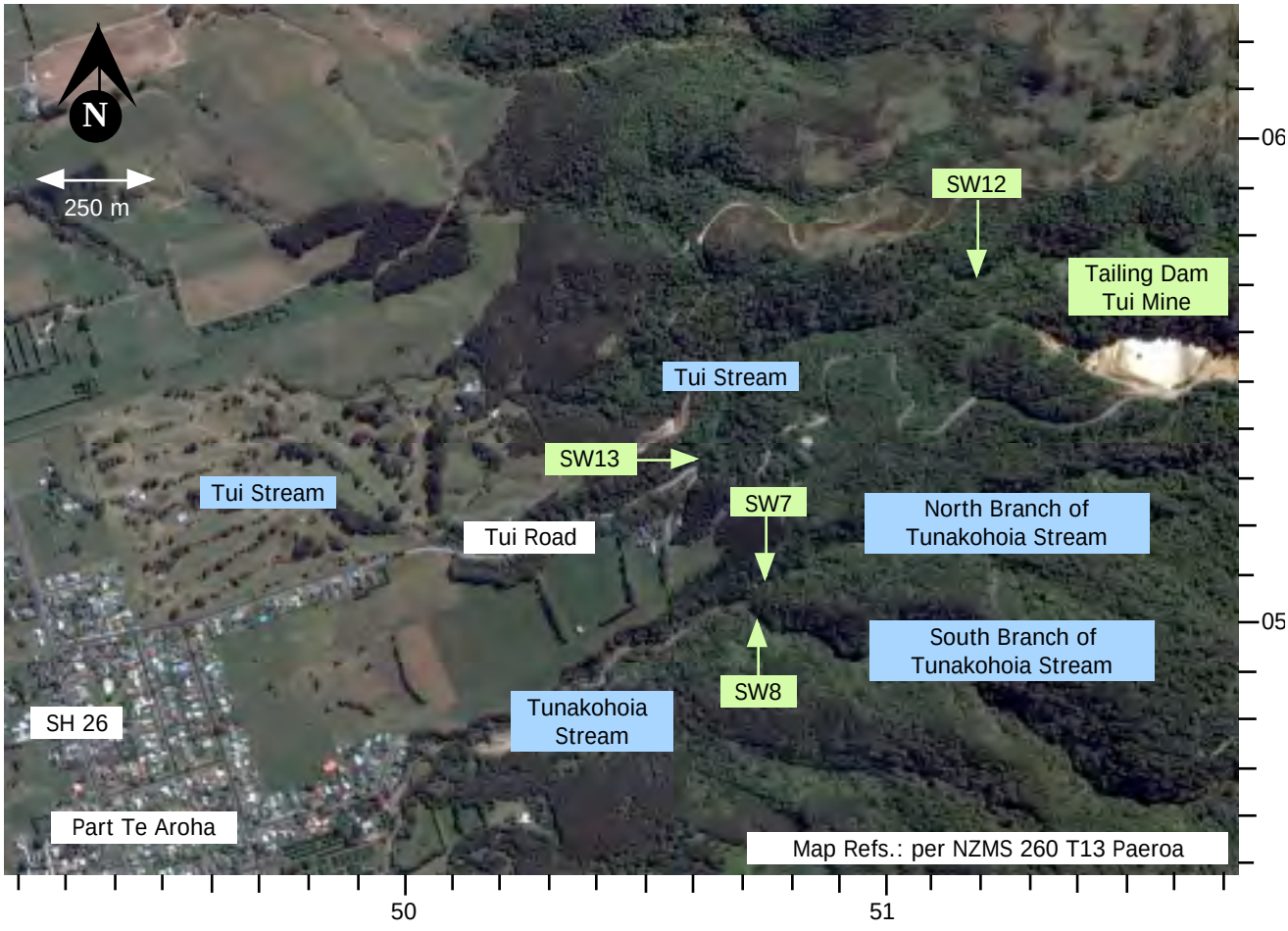
417 Given Avenue, P.O. Box 83, Whangamata, New Zealand
Telephones: 64 [07] 865 6671 / (0274) 937 865. Email: bricoff@xtra.co.nz

## 1.0 Introduction and Background

This report responds to the requirements of Environment Waikato Contract RCS 2009/10-0 for an instream ecological assessment of monitoring locations SW7, SW8 and SW13 within the Tunakohoia and Tui Streams in the vicinity of the former Tui Mine and a remnant tailings dam that is being maintained at the site (see Figure 1).

Given the obvious dearth of aquatic taxa recorded at monitoring location SW 13 downstream of a discharge from the remnant tailings dam at the former Tui Mine on 07 September 2009, an additional monitoring location (SW12) was sampled upstream of the discharge from the tailing dam to the Tui Stream on 09 September 2009. A period of dry weather stream flows preceded the 9th of September 2009.

*Figure 1: Locality of monitoring locations (SW7, SW8, SW12 and SW13) to the north east of Te Aroha at which instream ecological assessments were made for Environment Waikato Contract RCS 2009/10-0, September 2009.*




## 2.0 Methods and Approach

The instream ecological assessment was undertaken once during a water quality monitoring programme conducted by Pattle Delamore Partners Limited and included the following.

- A qualitative habitat assessment at water monitoring sites SW 7, SW 8, SW 12 and SW 13 in accordance with Environment Waikato's "Guidelines for Ecological Assessments in Freshwater Environments - Macroinvertebrate Sampling in Wadeable Streams" (Collier and Kelly, 2005).

- The collection of water quality data (temperature, dissolved oxygen, pH) using calibrated field meters[1] prior to each assessment.
- Macroinvertebrate sampling (kick net sampling) in accordance with methodology prescribed by Collier and Kelly (2005) that require the collection of at least four (4) replicates at each site for the detection of statistically significant differences in macroinvertebrate populations. The macroinvertebrate samples were preserved in the field for later processing and analysis.
- The analysis of aquatic macroinvertebrate data using the indices listed in Collier and Kelly (2005) and basic statistical tests to determine any difference in aquatic macroinvertebrate community structure between monitoring locations.

### 2.1 Habitat Assessment

Field assessment cover forms and hard-bottomed habitat forms (Collier and Kelly, 2005) were completed for each of four 50 m long stream sections shown in Figure 1 and Colour Plates 1 to 17.

### 2.2 Water Quality

Water temperature, dissolved oxygen, pH and conductivity were measured with a calibrated Hach HQ40d meter with twin probe connectors and standard IntelliCAL probes at the upstream end of each monitoring location.

### 2.3 Macroinvertebrate Communities

A long-handled D-net and sieve fitted with 0.5 mm mesh was used to collect macroinvertebrates samples within each monitoring location as specified by Ministry for the Environment Protocols (Stark et. al., 2001) with additions or variations as specified by Collier and Kelly (2005). In total, an area of approximately three $m^2$ was sampled and the proportion of habitat types sampled was recorded on field assessment cover forms.

A composite macroinvertebrate sample from each monitoring location was drained through a 0.5 mm sieve, transferred to a labelled container and preserved in isopropyl alcohol for transport to the laboratory.

Ministry for the Environment Protocols (Stark et. al., 2001) with additions or variations as specified by Collier and Kelly (2005) were used to obtain a 200 individual fixed count with scan for rare taxa for each macroinvertebrate sample in the laboratory. Four replicates were analysed for each monitoring location.

## 3.0 Results and Discussion

### 3.1 Habitat Assessment

Raw data sheets for habitat assessment are provided as attachments in Appendix A (for field assessment cover forms – Stream Survey Sheet 1) and Appendix B (for hard-bottomed habitat assessments sheets – Stream Survey Sheet 2A).

Figure 2 presents a summary of overall physical habitat assessment scores for monitoring locations SW12, SW13, WS7 and SW8.

Figure 3 summarises the nine individual inputs to the overall physical habitat scores for each monitoring location.

The highest scoring monitoring locality in terms of physical habitat quality was SW8. The slightly reduced physical habitat score at SW12 relative to SW8 was a function of reduced stream bank stability at the steep-sided monitoring location SW12.

[1] Hach HQ40d meter with twin probe connectors and standard IntelliCAL probes.

*Figure 2: Total Habitat Scores for each Monitoring Locality (see Appendix A).*

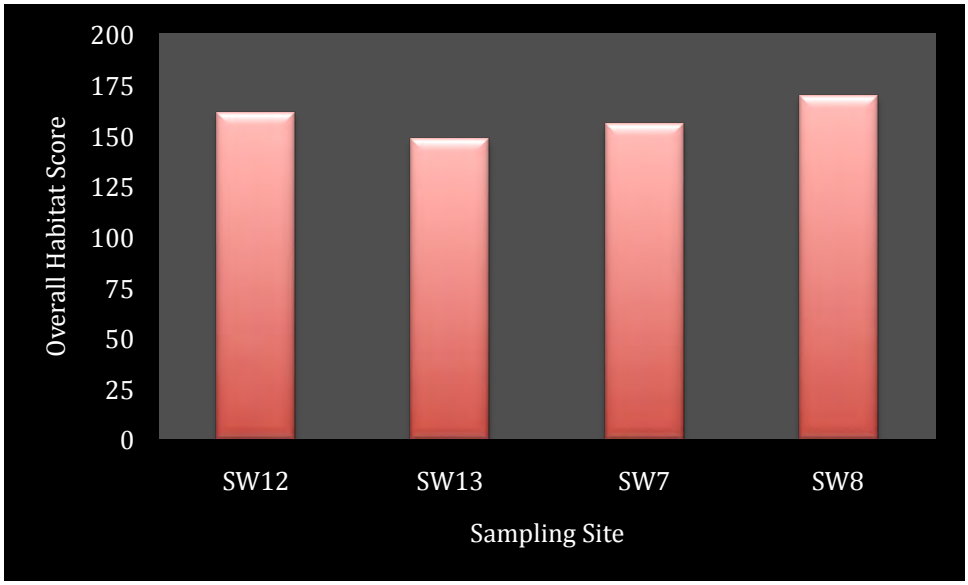
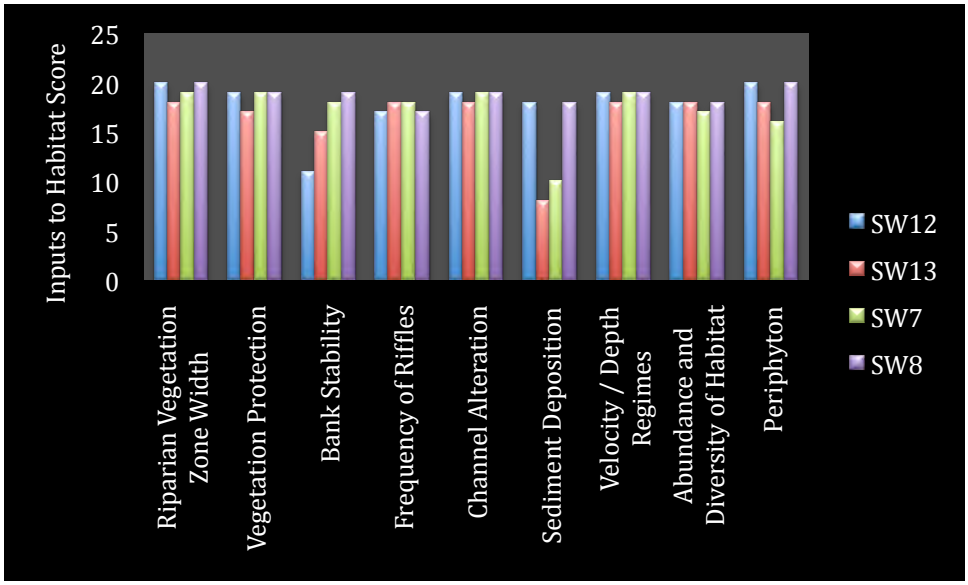



*Figure 3: Graphical Summary of Nine Qualitative Habitat Score Parameters for Monitoring Locations (see Appendix B).*




The reduced overall physical habitat score at monitoring localities SW7 and SW13 relative to SW12 was related to sediment deposition in the streambed. Monitoring locality SW13 had a marginally lower score than SW7 due to reduced bank stability.

Overall, physical habitat scores were considered to be sufficiently similar that valid comparisons could be made between instream community structure and ambient water quality at each of the four monitoring localities.

### 3.3 Macroinvertebrate Communities

The presence and relative abundance of macroinvertebrates, together with calculated metrics of macroinvertebrate community structure are provided in Appendix C (Stream Survey Sheet 5).

An area of approximately three square metres of riffle habitat at monitoring localities SW 12 and SW8 yielded well in excess of 200 individual aquatic macroinvertebrates per replicate sample.

However, an area of approximately three square metres of riffle habitat at monitoring localities SW13 and SW 7 yielded a total of only eight and six individual macroinvertebrates respectively in four replicate samples (see Appendix C).

It was clear that the very low number of aquatic invertebrates sampled at monitoring localities SW13 and SW7 were "drift" from either upstream sites or from tributaries / seeps to the stream channel rather than being "resident" in the monitoring localities. These "drift taxa" were included in Figure 4 for taxa richness but not for the other metrics of macroinvertebrate community structure graphed in Figures 5 to 9.

Taxa Richness for invertebrates (see Appendix A and Figure 7) reflects the "health" of instream communities and generally increases with increasing water quality, habitat diversity and / or habitat suitability.

Average taxa richness was significantly higher at monitoring locality SW 12 than at the other three monitoring localities (see Figure 4 and Table 1). There was no significant difference in the average taxa richness for drift communities within monitoring localities SW13 and SW 7 (see Figure 4 and Table 1). Average taxa richness was significantly different at monitoring locality SW 8 than at the other three monitoring localities (see Figure 4 and Table 1).

*Figure 4: Average Taxa Richness for Aquatic Macroinvertebrates at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C).*
*Error bars are ± S.E. (where n = 4).*

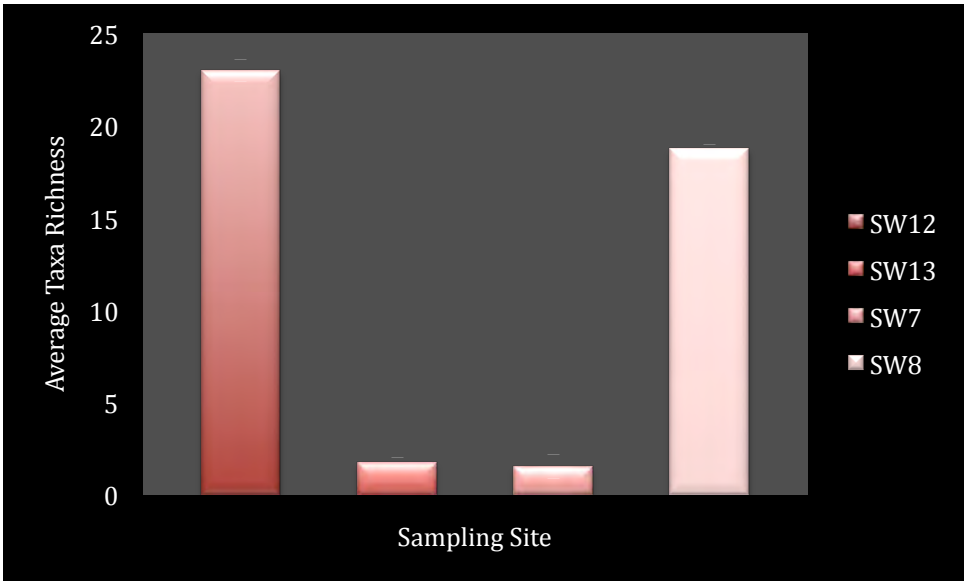



*Table 1: T-test on average taxa richness estimates summarised in Figure 4 and Appendix C.*

| Average Taxa Richness (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW 13 | 33.78 (>2.45) | ∴ Significant |
| SW 12 c.f. SW 7 | 24.83 (>2.45 | ∴ Significant |
| SW 12 c.f. SW 8 | 6.76 (>2.45) | ∴ Significant |
| SW 13 c.f. SW 7 | 0.36 (<2.45) | ∴ Not Significant |
| SW 13 c.f. SW 8 | 48.08 (>2.45) | ∴ Significant |
| SW 7 c.f. SW 8 | 24.90 (>2.45) | ∴ Significant |

The calculated Macroinvertebrate Community Index (MCI see Appendix C and Figure 5) and Quantitative Macroinvertebrate Community Index (QMCI see Appendix C and Figure 6) rely on prior allocation of scores (tolerance values range from 0 to 10) to freshwater macroinvertebrates based upon their pollution tolerances. Taxa that are characteristic of pristine conditions score more highly than taxa that may be found in "polluted" conditions.

*Figure 5: Average Macroinvertebrate Community Index (MCI) at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C). Error bars are ± S.E. (where n = 4).*

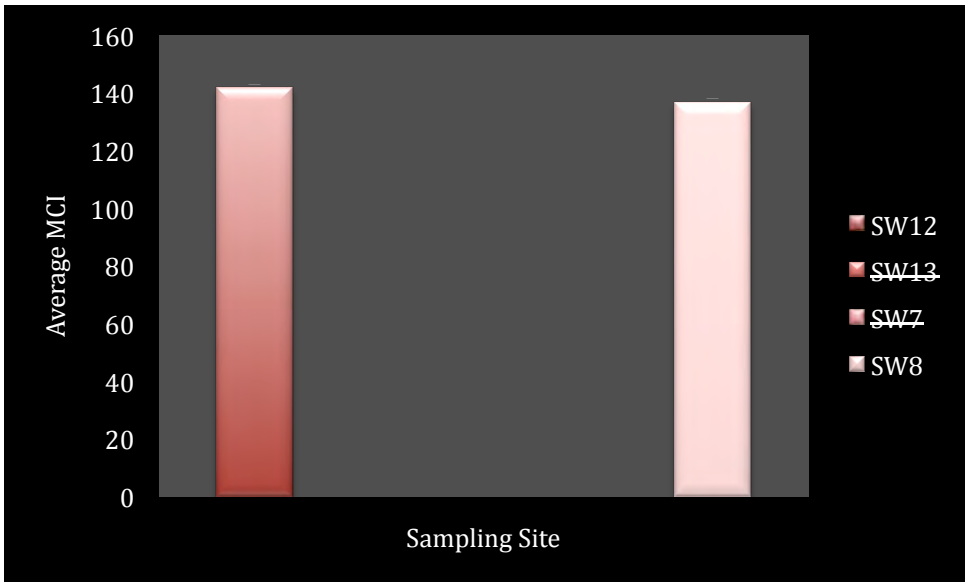



*Table 2: T-test on average MCI estimates summarised in Figure 5 and Appendix C.*

| Average MCI (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW 8 | 2.66 (>2.45) | ∴ Significant |

*Figure 6: Average Quantitative Macroinvertebrate Community Index (QMCI) at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C). Error bars are ± S.E. (where n = 4).*

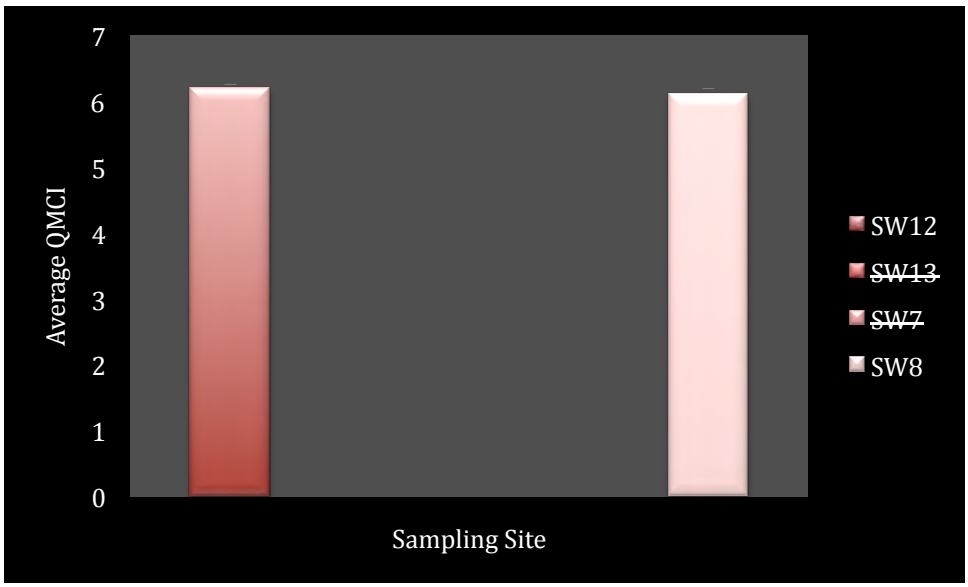



*Table 3: T-test on average QMCI estimates summarised in Figure 6 and Appendix C.*

| Average QMCI (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW 8 | 0.81 (<2.45) | ∴ Not Significant |

The MCI and QMCI have been developed as a means of detecting organic pollution in communities inhabiting rock or gravel riffles.

Whilst they have been modified to also include non-arthropod species and have been used to assess other forms of contamination, judgement is required when using these indices for specific contaminants / disturbance in other habitat types.

Macroinvertebrate Community Index values greater than 120 indicate very good instream habitat for aquatic macroinvertebrates. Poor instream habitat for aquatic macroinvertebrates is associated with MCI values of less than eighty. "Good" and "Fair" instream habitat for aquatic macroinvertebrates is associated with MCI values of 100 to 120 and 80 to 100 respectively (Stark 1985, 1993).

Quantitative Macroinvertebrate Community Index values greater than six indicate very good instream habitat for aquatic macroinvertebrates. Poor instream habitat for aquatic macroinvertebrates is associated with QMCI values of less than four. "Good" and "Fair" instream habitat for aquatic macroinvertebrates is associated with QMCI values of four to five and five to six respectively (Stark 1998).

Reference to Appendix C and to Figures 5 and 6 indicate that there was very low organic contamination at monitoring localities SW12 and SW8. There was a significant difference in average MCI values, but not QMCI values at monitoring localities SW12 and SW8 (see Tables 2 and 3).

The Ephemeroptera, Plecoptera, Trichoptera (EPT) Index is the total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera and generally increases with increasing water quality. This value summarises Taxa Richness within the insect orders that are generally considered pollution sensitive.

The average EPT Index (see Figure 7) was significantly higher at monitoring locality SW12 than at SW8 (see Table 4).

*Figure 7: Average Ephemeroptera, Plecoptera, Trichoptera Index (EPT Index) at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C). Error bars are ± S.E. (where n = 4).*

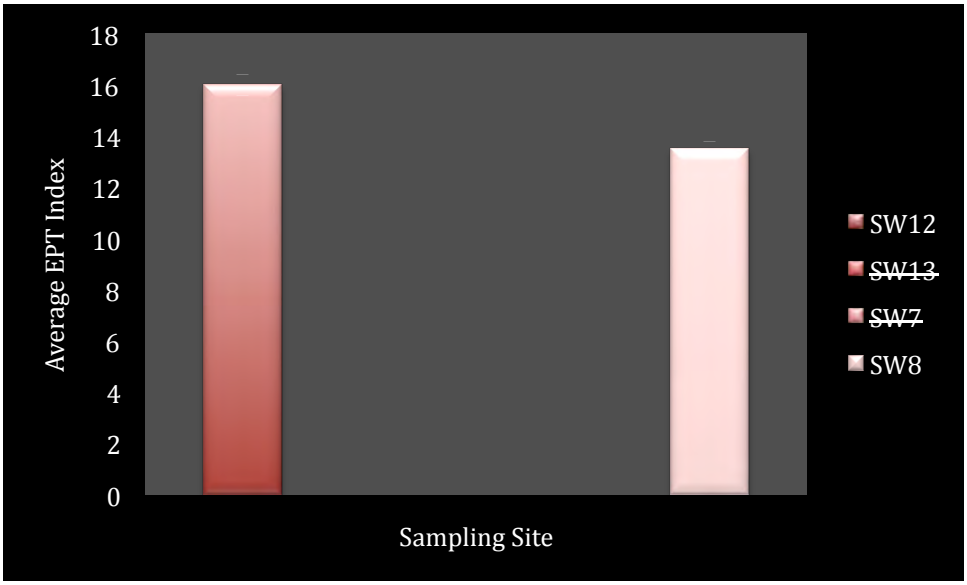



*Table 4: T-test on average EPT Index estimates summarised in Figure 7 and Appendix C.*

| Average EPT Index (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW 8 | 5.00 (>2.45) | ∴ Significant |

The percentage density of Ephemeroptera, Plecoptera and Trichoptera (% EPT Taxa) is a commonly used metric based on the percentage of the total number of pollution sensitive invertebrates in a

sample that are within these insect orders. This index should be highest in unimpaired, pristine sites little affected by eutrophication or nutrient enrichment.

"Very Good" instream habitat for aquatic macroinvertebrates is associated with greater than 60% EPT Taxa: "Poor" instream habitat is associated with less than 10% EPT Taxa and "Moderate" instream habitat is associated with 10 to 60% EPT Taxa (Milne and Perrie, 2006).

The % EPT Taxa was significantly higher at monitoring locality SW12 than at SW8 but instream habitat quality as indicated by this metric was very good at both localities (see Figure 11 and Table 5).

*Figure 8: Average Percent Ephemeroptera, Plecoptera, Trichoptera Taxa in Sample (% EPT Taxa) at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C). Error bars are ± S.E. (where n = 4).*

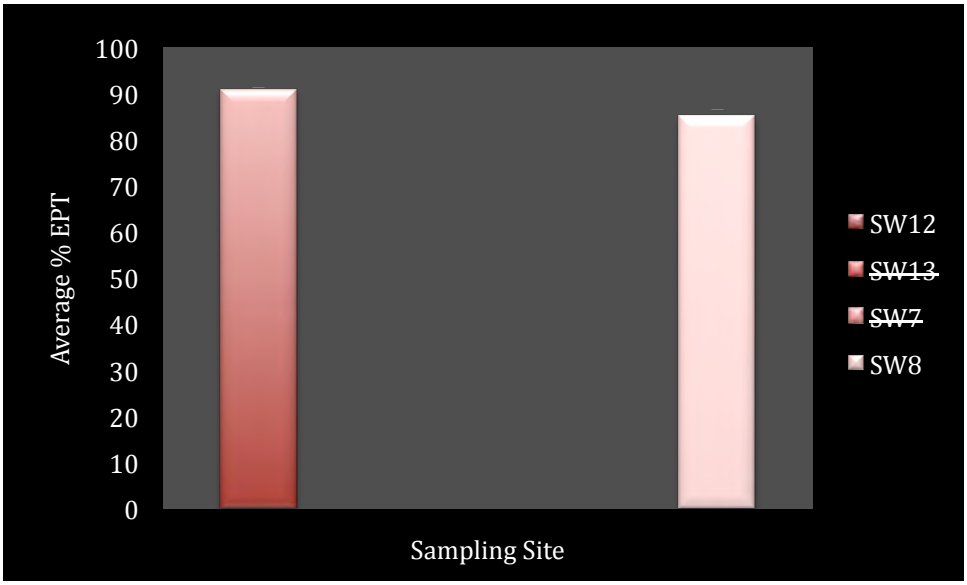



*Table 5: T-test on average % EPT Taxa estimates summarised in Figure 8 and Appendix C.*

| Average % EPT (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW.8 | 4.07 (>2.45) | ∴ Significant |

The percent contribution of the numerically dominant taxon to the total number of organisms is an indication of community balance at the lowest positive taxonomic level. A community dominated by relatively few species would normally indicate environmental stress.

In this instance (see Figure 13 and Table 6) the average contribution of the numerically dominant taxon (the larval mayfly *Coloburiscus humeralis* at both localities) was significantly higher at SW12 (35%) than at monitoring locality SW8 (28%).

In essence therefore, monitoring locality SW12 upstream of the discharge of the Tui Tailing Dam discharge to the Tui Stream, supported high quality habitat and instream community structure. Monitoring locality SW13 downstream of the discharge of the Tui Tailing Dam discharge to the Tui Stream, supported high quality habitat but did not support resident instream macroinvertebrate communities, not even pollution tolerant taxa.

The southern arm of the Tunakohoia Stream supported high quality habitat and instream community structure at monitoring locality SW8. The northern arm of the Tunakohoia Stream at monitoring locality SW7 supported high quality habitat but did not support resident instream macroinvertebrate communities, not even pollution tolerant taxa. This arm of the Tunakohoia Stream was also inspected upstream of the Tailing Dam (at GPS reference E2752100 N6405249 on 9/9/09) but was clearly contaminated with suspended solids and iron salts in its headwaters also.

*Figure 9: Average Percent Contribution of Dominant Taxon (% Contrib., Dom. Taxon) at Monitoring Localities SW12, SW13, SW7 and SW8 (see Appendix C). Error bars are ± S.E. (where n = 4).*

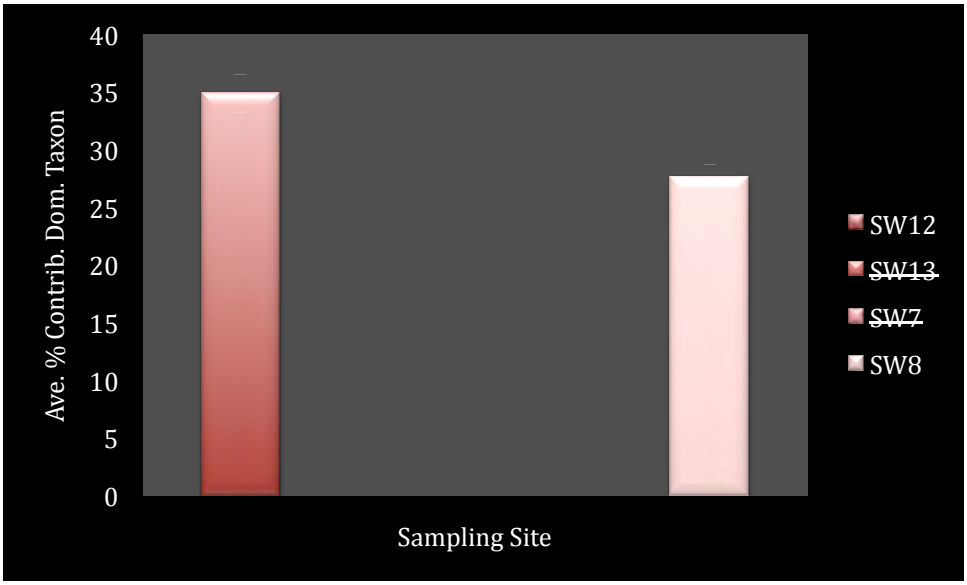



*Table 6: T-test on average % Contribution of Dominant Taxon (*Ave. % Contrib. Dom. Taxon) *estimates summarised in Figure 9 and Appendix C.*

| Ave. % Contrib. Dom. Taxon (t critical = 2.45 with 6 df) | t stat | Difference |
|---|---|---|
| SW 12 c.f. SW 8 | 3.70 (>2.45) | ∴ Significant |

### 3.5 Water Quality

The results of these analyses are summarised in Appendix A.

Dissolved oxygen was at or close to saturation at the relatively low water temperatures recorded at the four monitoring localities (9.0 to 11.1 $^{o}$C). The pH of stream water at the four monitoring localities ranged from 6.8 to 7.33.

Conductivity was 89.4 and 93.8 µS/cm at monitoring localities SW13 and SW7 respectively. Conductivity was 155 and 313 µS/cm at monitoring localities SW12 and SW8 respectively.

## 4.0 Findings and Conclusions

Given the similarity of physical habitat quality for aquatic macroinvertebrates that colonise hard-bottomed streams at the four monitoring localities sampled, the presence of healthy macroinvertebrate communities at monitoring localities SW12 and SW8 but not at monitoring localities SW13 and SW7 indicates water quality conditions are suitable for healthy instream communities at SW12 and SW 8 but not at SW13 and SW7.

Monitoring localities SW12 and SW8 appeared to be unaffected by past and / or present activities at the Tui Mine. Monitoring localities SW13 and SW7 appeared to be impacted by past and / or present activities at the Tui Mine.

The physico-chemical parameters of water temperature, dissolved oxygen and pH were suitable for healthy instream community at all four monitoring localities. However, the higher conductivity of stream water at monitoring localities SW13 and SW7 indicate there is a higher potential for dissolved contaminants in stream water at monitoring localities SW13 and SW7 relative to SW12 and SW8.

The findings in this report now need to be correlated with the results of the chemical sampling programme conducted by Pattle Delamore Partners Limited to meet the requirement of Environment Waikato Contract RCS 2009/10-0.

Colour Plates: (Cover Plate: Water supply pipeline from the weir at monitoring location SW 8 to Te Aroha as it crosses over the northern branch of the Tunakohoia Stream).

Plate 1: Remnant Tailings Dam at the former Mine on the North West side of Mount Te Aroha.

Plate 2: Stormwater / leachate pond for drainage from the Tui Mine Tailings Dam that drains into the Tui Stream.

Plate 3: Discharge from the Tailings Dam stormwater / leachate pond.

Plate 4: Deposited iron salts in the discharge channel from the from the Tailings Dam stormwater / leachate pond.


Plates 5 and 6: Channel and vegetation cover in upstream section of monitoring location SW 13.

Plate 7: Embedded rocks and boulders in the stream bed at monitoring location SW 13.

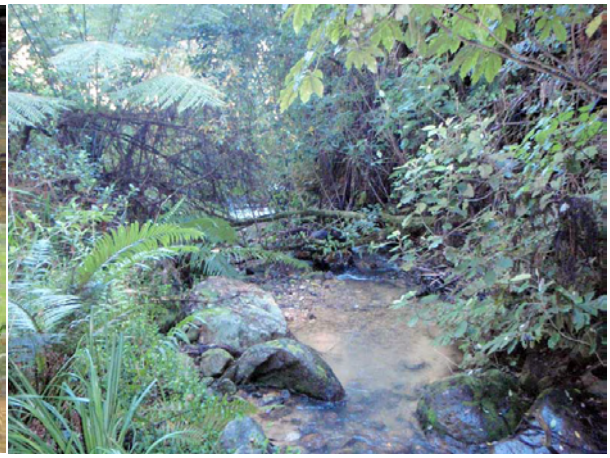


Plate 8: Vegetation cover in the downstream section of monitoring location SW 13.

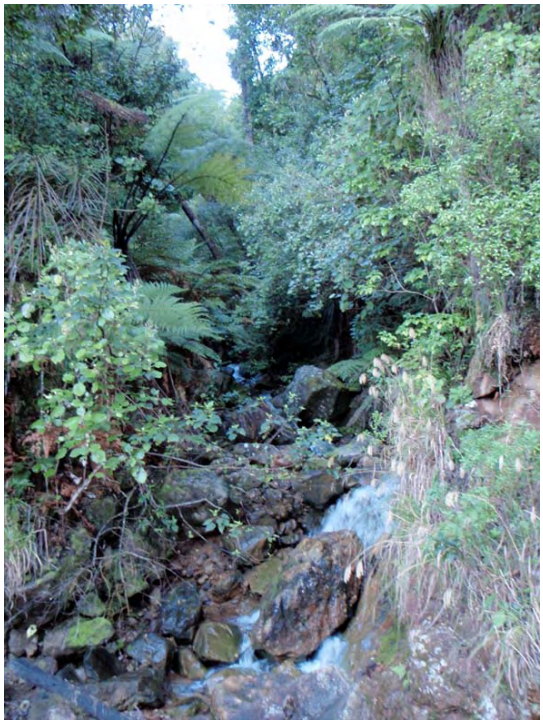


Plate 9: Stream bed and vegetation cover in the upstream section of monitoring location SW 7.

Plate 10: Downstream section of monitoring location SW7.

Plates 11 and 12: Sediment and iron salt deposits in the stream bed in the middle reach of monitoring location SW7.


Plates 13 and 14: Weir and water intake for the Te Aroha potable water supply at the downstream end of monitoring locality WS8.


Plates 15 and 16: Sampling sites in the middle and upstream sections of monitoring locality WS8.

Plate 17: Absence of flow from the southern to the northern arms of the Tunakohoia Stream as of 07 September 2009 due to abstraction of water for the Te Aroha potable water supply from the weir at the downstream reach of the southern arm of the Tunakohoia Stream.

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**Environment Waikato Field Assessment Cover Form (Collier and Kelly, 2005)**
**Wadeable Hard-Bottomed and Soft-Bottomed Streams**

| | | |
|---|---|---|
| Locality: Te Aroha | Date: 9 September 2009 | Stream / River Name: Tui Stream |
| Survey Objectives: | Baseline Description of Instream Community Structure for Tui Mine Remedial Works. | |
| Client: PDP Limited | | Assessor: BTC |
| Site Code: SW 12 | Sample Code: Tui SW12 | Photograph codes: Tui SW 12 |
| GPS COORDINATES: | Centre of reach | E. 2751200 N. 6405715 |
| Length of Reach: 50 (m): | | |

CHANNEL AND RIPARIAN FEATURES

| Canopy Cover: | Dom. Riparian Veg. |
|---|---|
| ~~Open~~ | ~~Crops etc~~ |
| ~~Partly shaded~~ | ~~Pasture~~ |
| Significantly shaded | ~~Exotic trees~~ |
| Fencing | ~~Retired~~ |
| ~~None or ineffective~~ | Native shrub |
| ~~One side or partial~~ | Native trees |
| Complete both sides | |

INSTREAM HYDRAULIC CONDITIONS

| | | |
|---|---|---|
| | | m |
| Ave. Stream width (active channel) | 2.10 | |
| Max. Stream width (active channel) | 3.10 | |
| Ave. Stream width (water) | 0.60 | |
| Max. Stream width (water) | 1.50 | |
| Ave. Stream depth | 0.15 | |
| Max Stream depth | 0.25 | |
| | | m/s |
| Ave. Surface velocity | 0.75 | |

WATER QUALITY Time (NZST): 1500 hrs pH: 7.02
Temperature: 11.0 °C Conductivity: 89.4 µS/cm Dissolved Oxygen: 95 % 10.14 mg/L
Turbldity: Clear ~~Slightly turbid~~ ~~Highly turbid~~ ~~Stained~~ ~~Other~~

STREAM-BOTTOM SUBSTRATA
Compaction (inorganic substrata):
~~assorted sizes tightly packed &/or overlapping~~
~~moderately packed with some overlap~~
mostly a loose assortment with little overlap
~~no packing / loose assortment easily moved~~
Embeddedness*:
(% gravel-boulder particles covered by fine sediment)
~~<5%~~ 5-25% ~~26-50% 51-75% >75%~~
ORGANIC MATERIAL (% cover*)
Large wood (>10 cm diameter)
~~<5%~~ 5-25% ~~26-50% 51-75% >75%~~
Coarse Detritus (small wood, sticks, leaves etc)
<5% ~~5-25% 26-50% 51-75% >75%~~
Fine (<1 mm ) Organic Deposits (edges & backwaters)
<5% 5-25% 26-50% 51-75% >75%

% surficial inorganic substratum size composition (should sum to 100%)

| Percentage | Substratum type Dimension mm (middle axis [mm]) |
|---|---|
| 10 | bedrock |
| 20 | boulder (>256) |
| 40 | cobble (>64 - 256) |
| 25 | gravel (>2 - 64) |
| 5 | sand (>0.06 - 2) |
| 0 | silt (004 - 0.06) |
| 0 | clay (<0.004 |

HABITAT TYPES SAMPLED (for macroinvertebrates)
(% of effort; each column should sum to 100%)

| | % | | % |
|---|---|---|---|
| Stones: | 100 | | |
| Wood: | 0 | Riffles: | 100 |
| Macrophytes: | 0 | Runs: | 0 |
| Edges: | 0 | | |

see Stream Survey Sheet 3 for periphyton
see Stream Survey Sheet 4 for macrophytes
see Stream Survey Sheet 5 for invertebrates

COMMENTS

Difficult access

Clear visual degradation of stream at and downstream of discharge from Tailings Dam with iron deposits and fine clays and silts.

**Environment Waikato Field Assessment Cover Form (Collier and Kelly, 2005)**
**Wadeable Hard-Bottomed and Soft-Bottomed Streams**

| | | |
|---|---|---|
| Locality: Te Aroha | Date: 07 September 2009 | Stream / River Name: Tui Stream |
| Survey Objectives: | Baseline Description of Instream Community Structure for Tui Mine Remedial Works. | |
| Client: PDP Limited | | Assessor: BTC |
| Site Code: SW 13 | Sample Code: SW 13 | Photograph codes: SW 13 |
| GPS COORDINATES: | Centre of reach | E. 2750615 N. 6405338 |
| Length of Reach (m): 50 | | |

CHANNEL AND RIPARIAN FEATURES

| Canopy Cover: | Dom. Riparian Veg. |
|---|---|
| ~~Open~~ | ~~Crops etc~~ |
| ~~Partly shaded~~ | ~~Pasture~~ |
| Significantly shaded | ~~Exotic trees~~ |
| Fencing | ~~Retired~~ |
| ~~None or ineffective~~ | Native shrub |
| ~~One side or partial~~ | Native trees |
| Complete both sides | |

INSTREAM HYDRAULIC CONDITIONS

| | | |
|---|---|---|
| | | m |
| Ave. Stream width (active channel) | 4.10 | |
| Max. Stream width (active channel) | 5.20 | |
| Ave. Stream width (water) | 1.00 | |
| Max. Stream width (water) | 2.10 | |
| Ave. Stream depth | 0.40 | |
| Max Stream depth | 0.25 | |
| | | m/s |
| Ave. Surface velocity | 1.00 | |

WATER QUALITY Time (NZST): 1430 hrs pH: 7.07
Temperature: 11.1 °C Conductivity: 155 µS/cm Dissolved Oxygen: 98 % 10.44 mg/L
Turbldity: O Clear O Slightly turbid O Highly turbid O Stained O Other

STREAM-BOTTOM SUBSTRATA
Compaction (inorganic substrata):
assorted sizes tightly packed &/or overlapping
moderately packed with some overlap
~~mostly a loose assortment with little overlap~~
~~no packing / loose assortment easily moved~~
Embeddedness*:
(% gravel-boulder particles covered by fine sediment)
~~<5% 5-25% 26-50% 51-75%~~ >75%
ORGANIC MATERIAL (% cover*)
Large wood (>10 cm diameter)
O <5% ~~O 5-25% O 26-50% O 51-75% O >75%~~
Coarse Detritus (small wood, sticks, leaves etc)
~~<5%~~ 5-25% ~~26-50% 51-75% >75%~~
Fine (<1 mm ) Organic Deposits (edges & backwaters)
~~<5% 5-25% 26-50%~~ 51-75% ~~>75%~~

% surficial inorganic substratum size composition (should sum to 100%)

| Percentage | Substratum type Dimension mm (middle axis [mm]) |
|---|---|
| | bedrock |
| 30 | boulder (>256) |
| 20 | cobble (>64 - 256) |
| 20 | gravel (>2 - 64) |
| 10 | sand (>0.06 - 2) |
| 10 | silt (004 - 0.06) |
| 10 | clay (<0.004 |

HABITAT TYPES SAMPLED (for macroinvertebrates)
(% of effort; each column should sum to 100%)

| | % | | % |
|---|---|---|---|
| Stones: | 100 | | |
| Wood: | | Riffles: | 100 |
| Macrophytes: | | Runs: | |
| Edges: | | | |

see Stream Survey Sheet 3 for periphyton
see Stream Survey Sheet 4 for macrophytes
see Stream Survey Sheet 5 for invertebrates

COMMENTS

Combination of deposited iron salts and silts clays had effectively "welded" cobbles into substrate.

See Colour Plates.

**Environment Waikato Field Assessment Cover Form (Collier and Kelly, 2005)**
**Wadeable Hard-Bottomed and Soft-Bottomed Streams**

| | | |
|---|---|---|
| Locality: Te Aroha | Date: 07 September 2009 | Stream / River Name: Northern Branch of Tunakohoia Stream |
| Survey Objectives: | Baseline Description of Instream Community Structure for Tui Mine Remedial Works. | |
| Client: PDP Limited | | Assessor: BTC |
| Site Code: SW 7 | Sample Code: SW 7 | Photograph codes: SW 7 |
| GPS COORDINATES: | Centre of reach | E. 275014 N. 6405094 |
| Length of Reach (m): | | |

**CHANNEL AND RIPARIAN FEATURES**

| Canopy Cover: | Dom. Riparian Veg. |
|---|---|
| ~~Open~~ | ~~Crops etc~~ |
| ~~Partly shaded~~ | ~~Pasture~~ |
| Significantly shaded | ~~Exotic trees~~ |
| Fencing | ~~Retired~~ |
| ~~None or ineffective~~ | Native shrub |
| ~~One side or partial~~ | Native trees |
| Complete both sides | |

**INSTREAM HYDRAULIC CONDITIONS**

| | | |
|---|---|---|
| | | m |
| Ave. Stream width (active channel) | 5.05 | |
| Max. Stream width (active channel) | 15.00 | |
| Ave. Stream width (water) | 1.02 | |
| Max. Stream width (water) | 3.10 | |
| Ave. Stream depth | 0.30 | |
| Max Stream depth | 0.75 | |
| | | m/s |
| Ave. Surface velocity | 0.75 | |

WATER QUALITY Time (NZST): 1630 hrs pH: 7.33
Temperature: 10.1 °C Conductivity: 313 µS/cm Dissolved Oxygen: 98 % 10.68 mg/L
Turbldity: ~~Clear~~ Slightly turbid ~~Highly turbid~~ ~~Stained~~ ~~Other~~

STREAM-BOTTOM SUBSTRATA
Compaction (inorganic substrata):
assorted sizes tightly packed &/or overlapping
~~moderately packed with some overlap~~
~~mostly a loose assortment with little overlap~~
~~no packing / loose assortment easily moved~~
Embeddedness*:
(% gravel-boulder particles covered by fine sediment)
~~<5%~~ ~~5-25%~~ ~~26-50%~~ ~~51-75%~~ >75%
ORGANIC MATERIAL (% cover*)
Large wood (>10 cm diameter)
~~<5%~~ 5-25% ~~26-50%~~ ~~51-75%~~ ~~>75%~~
Coarse Detritus (small wood, sticks, leaves etc)
~~<5%~~ 5-25% ~~26-50%~~ ~~51-75%~~ ~~>75%~~
Fine (<1 mm ) Organic Deposits (edges & backwaters)
~~<5%~~ ~~5-25%~~ 26-50% ~~51-75%~~ ~~>75%~~

% surficial inorganic substratum size composition (should sum to 100%)

| Percentage | Substratum type Dimension mm (middle axis [mm]) |
|---|---|
| 40 | bedrock |
| 20 | boulder (>256) |
| 10 | cobble (>64 - 256) |
| 10 | gravel (>2 - 64) |
| 5 | sand (>0.06 - 2) |
| 10 | silt (004 - 0.06) |
| 5 | clay (<0.004 |

HABITAT TYPES SAMPLED (for macroinvertebrates)
(% of effort; each column should sum to 100%)

| | % | | % |
|---|---|---|---|
| Stones: | 100 | | |
| Wood: | | Riffles: | 100 |
| Macrophytes: | | Runs: | |
| Edges: | | | |

see Stream Survey Sheet 3 for periphyton

see Stream Survey Sheet 4 for macrophytes

see Stream Survey Sheet 5 for invertebrates

COMMENTS

**Environment Waikato Field Assessment Cover Form (Collier and Kelly, 2005)**
**Wadeable Hard-Bottomed and Soft-Bottomed Streams**

| | | |
|---|---|---|
| Locality: Te Aroha | Date: 7 September 2009 | Stream / River Name: Southern Branch of Tunakohoia Stream |
| Survey Objectives: | Baseline Description of Instream Community Structure for Tui Mine Remedial Works. | |
| Client: PDP Limited | | Assessor: BTC |
| Site Code: SW 8 | Sample Code: SW 8 | Photograph codes: SW 8 |
| GPS COORDINATES: | Centre of reach | E. 2750722 N. 6405004 |
| Length of Reach (m): 50 | | |

CHANNEL AND RIPARIAN FEATURES

| Canopy Cover: | Dom. Riparian Veg. |
|---|---|
| ~~Open~~ | ~~Crops etc~~ |
| ~~Partly shaded~~ | ~~Pasture~~ |
| Significantly shaded | ~~Exotic trees~~ |
| Fencing | ~~Retired~~ |
| ~~None or ineffective~~ | Native shrub |
| ~~One side or partial~~ | Native trees |
| Complete both sides | |

INSTREAM HYDRAULIC CONDITIONS

| | | |
|---|---|---|
| | | m |
| Ave. Stream width (active channel) | 7.00 | |
| Max. Stream width (active channel) | 10.00 | |
| Ave. Stream width (water) | 2.00 | |
| Max. Stream width (water) | 3.50 | |
| Ave. Stream depth | 0.30 | |
| Max Stream depth | 0.50 | |
| | | m/s |
| Ave. Surface velocity | 0.30 | |

WATER QUALITY Time (NZST): 1630 hrs. pH: 6.80
Temperature: 9.0 °C Conductivity: 93.8 µS/cm Dissolved Oxygen: 97.4 % 10.90 mg/L
Turbldity: O Clear ~~O Slightly turbid O Highly turbid O Stained O Other~~

STREAM-BOTTOM SUBSTRATA
Compaction (inorganic substrata):
~~assorted sizes tightly packed &/or overlapping~~
~~moderately packed with some overlap~~
mostly a loose assortment with little overlap
~~no packing / loose assortment easily moved~~
Embeddedness*:
(% gravel-boulder particles covered by fine sediment)
<5% ~~5-25% 26-50% 51-75% >75%~~
ORGANIC MATERIAL (% cover*)
Large wood (>10 cm diameter)
<5% 5-25% 26-50% 51-75% >75%
Coarse Detritus (small wood, sticks, leaves etc)
~~<5%~~ 5-25% ~~26-50% 51-75% >75%~~
Fine (<1 mm ) Organic Deposits (edges & backwaters)
<5% ~~5-25% 26-50% 51-75% >75%~~

% surficial inorganic substratum size composition (should sum to 100%)

| Percentage | Substratum type Dimension mm (middle axis [mm]) |
|---|---|
| 10 | bedrock |
| 50 | boulder (>256) |
| 20 | cobble (>64 - 256) |
| 10 | gravel (>2 - 64) |
| 10 | sand (>0.06 - 2) |
| 0 | silt (004 - 0.06) |
| 0 | clay (<0.004 |

HABITAT TYPES SAMPLED (for macroinvertebrates)
(% of effort; each column should sum to 100%)

| | % | | % |
|---|---|---|---|
| Stones: | 100 | | |
| Wood: | | Riffles: | 100 |
| Macrophytes: | | Runs: | |
| Edges: | | | |

see Stream Survey Sheet 3 for periphyton
see Stream Survey Sheet 4 for macrophytes
see Stream Survey Sheet 5 for invertebrates

COMMENTS

Upstream of water supply weir and intake for the Te Aroha potable water supply.

**Wadeable Hard-Bottomed Streams (Environment Waikato, 2005)**
**Qualitative Habitat Assessment Field Data Sheet**

| Client: PDP Limited | Date: 7 - 9 September 2009 | Assessed by: BTC |
|---|---|---|

| Habitat Parameter | Category | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor | | | | |
| 1. Riparian Vegetative Zone Width | Bankside vegetation buffer is > 10 m. | Bankside vegetation buffer is < 10m | Pathways present + / or stock access to stream | Breaks frequent | SAMPLING SITE | | | |
| | Continuous and dense | Mostly continuous | Mostly healed over | Human activity clear | SW12 | SW13 | SW7 | SW8 |
| *Left bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 20 | 18 | 19 | 20 |
| *Right bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 20 | 18 | 19 | 20 |
| *Mean LB & RB* | | | | | 20 | 18 | 19 | 20 |
| | | | | | | | | |
| 2. Vegetative Protection | Bank surfaces and immediate riparian zones covered by native vegetation | Bank surfaces covered mainly by native vegetation | Bank surfaces covered by a mixture of grasses / shrubs, blackberry, willow and exotic trees | Bank surfaces covered by grasses and shrubs | | | | |
| | Trees, understorey shrubs, or non-woody plants present | Disruption evident | Vegetation disruption obvious | DisruptIon of streambank vegetation very high | | | | |
| | Vegetative disruption minimal | Banks may be covered by exotic forestry | Bare soil / closely cropped veg common | Grass heavily grazed | SAMPLING SITE | | | |
| | | | | Significant stock damage to bank | SW12 | SW13 | SW7 | SW8 |
| *Left bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 19 | 17 | 19 | 19 |
| *Right bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 19 | 17 | 19 | 19 |
| *Mean LB & RB* | | | | | 19 | 17 | 19 | 19 |
| | | | | | | | | |
| 3. Bank Stability | Banks stable | Moderately stable | Moderately unstable | Unstable | | | | |
| | Erosion / bank failure absent or minimal | Infrequent small areas of erosion mostly healed over | 30-60% of bank in reach has areas of erosion | Many eroded areas | SAMPLING SITE | | | |
| | <5% of bank affected | 5-30% of bank eroded | High erosion potential during floods | 60 - 100% of bank has erosional scars | SW12 | SW13 | SW7 | SW8 |
| *Left bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 11 | 15 | 18 | 19 |
| *Right bank* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 11 | 15 | 18 | 19 |
| *Mean LB & RB* | | | | | 11 | 15 | 18 | 19 |

**Continued:** Qualitative Habitat Assessment for Wadeable Hard-Bottomed Streams

| Habitat Parameter | Category | | | | SAMPLING SITE | | | |
|---|---|---|---|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor | | | | |
| 4. Frequency of Riffles | Riffles relatively frequent | Occurrence of riffles infrequent | Occassional riffle or run | Generally flat water, shallow riffles | | | | |
| | Distance between riffles divided by width of stream = 5 – 7 | Distance between riffles divided by width of stream = 7 - 15 | Bottom contours provide some habitat | Poor habitat | | | | |
| | Variety of habitat is key | | Distance between riffles divided by width of stream = 15 - 25 | Distance between riffles divided by width of stream > 25 | SW12 | SW13 | SW7 | SW8 |
| *Site Score* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 17 | 18 | 18 | 17 |
| 5. Channel Alteration | Changes to channel / dredging absent or minimal | Some changes to channel / dredging | Channel changes / dredging extensive | Banks shored with gabion or cement | | | | |
| | Stream with normal pattern | Evidence of past channel / dredging | Embankments or shoring structures present on both banks | >80% of the stream reach channelised and disrupted | SAMPLING SITE | | | |
| | | Recent channel / dredging not present | 40 to 80% of reach channelised and disrupted | Instream habitat altered or absent | SW12 | SW13 | SW7 | SW8 |
| *Site Score* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 19 | 18 | 19 | 19 |
| 6. Sediment Deposition (out of channel and in channel) | Little / no islands or point bars present | New increase in bar formation. mostly from gravel. sand or fine sediment | Some deposition of new gravel. sand or fine sediment on old and new bars | Heavy deposits of fine material | | | | |
| | <20% of the bottom affected by sediment deposition | 20-50% of the bottom affected | 50-80% of the bottom affected | Increased bar development | | | | |
| | | Slight deposition in pools | Sediment deposits at obstructions, constrictions and bends | >80% of the bottom changing frequently | SAMPLING SITE | | | |
| | | | | Pools almost absent due to sediment deposition | SW12 | SW13 | SW7 | SW8 |
| *Site Score* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 18 | 8 | 10 | 18 |
| 7. Velocity / Depth regimes | 4 velocity / depth regimes present | 3 of 4 velocity / depth present | 2 of 4 velocity / depth present | Dominated by 1 velocity / depth regime | SAMPLING SITE | | | |
| | Slow / deep. Slow / shallow Fast / shallow Fast / deep | If fast / shallow is missing then score lower | If fast / shallow or slow shallow is missing then score lower | Usually slow / deep. | SW12 | SW13 | SW7 | SW8 |
| Site Score | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 19 | 18 | 19 | 19 |

**Continued:** Qualitative Habitat Assessment for Wadeable Hard-Bottomed Streams

| Habitat Parameter | Category | | | | SAMPLING SITE | | | |
|---|---|---|---|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor | SW12 | SW13 | SW7 | SW8 |
| 8. Abundance and Diversity of Habitat | >50% substrate favourable for invertebrate colonisation and wide variety of woody debris, riffles, root mats | 30-50% substrate favourable for invertebrate colonisatlon | 10-30% substrate favourable for invertebrate colonisatlon | <10% substrate favourable for invertebrate colonisatlon | | | | |
| | Snags / submerged logs / undercut banks / cobbles provide abundant fish cover | Snags / submerged logs / undercut banks / cobbles | Fish cover patchy | Fish cover rare or absent | | | | |
| | Must not be new or transient | Fish cover common | 60-90% substrate easily moved by foot | Substrate unstable or lacking | | | | |
| | | Moderate variety of habitat. Can consist of some new material | Woody debris rare or may be smothered by sediment | Stable habitats lacking or limited to macrophytes | | | | |
| *Site Score* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 18 | 18 | 17 | 18 |
| 9. Periphyton | Periphyton not visible on hand held stones<br>Stable substrate<br>Surfaces rough to touch | Periphyton not visible on stones<br>Stable substrate<br>Periphyton obvious to touch | Periphyton visible<br><20% cover of available substrate | Periphyton obvious and prolific<br>>20% cover of available substrate | SAMPLING SITE | | | |
| | | | | | SW12 | SW13 | SW7 | SW8 |
| *Site Score* | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 | 20 | 18 | 16 | 20 |

| | | SAMPLING SITE | | | |
|---|---|---|---|---|---|
| | | SW12 | SW13 | SW7 | SW8 |
| *Total Score* | N.B.: Use only means of LB and RB values. | 161 | 148 | 155 | 169 |

Appendix C: Stream Survey Sheet 5: Laboratory Analysis of Macroinvertebrate Samples.

| Client: PDP Limited | Date: 7 - 9 September 2009 | Lab. Sorting and I.D. by: BTC |
|---|---|---|

| | HB* | SB** | SW 12 | | | | | | SW 13 | | | | | | SW 7 | | | | | | SW 8 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAXA | *MCI* | *MCI* | #1 | #2 | #3 | #4 | | | #1 | #2 | #3 | #4 | | | #1 | #2 | #3 | #4 | Ave. | S.D. | #1 | #2 | #3 | #4 | | |
| ANNELIDA (laboratory counts) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hirudinea | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Glossiphonia sp.* | *3* | *1.2* | | 1 | | 2 | | | | | | | | | | | | | | | | 1 | | | | |
| MOLLUSCA (laboratory counts) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Potamopyrgus antipodarum* | *4* | *2.1* | 2 | 3 | 2 | 1 | | | | | | | | | | | | | | | 8 | 7 | 5 | 5 | | |
| CRUSTACEA (laboratory counts) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Paranephrops planifrons* | *5* | *8.4* | | | 1 | 1 | | | | | | | | | | | | | | | | 1 | | | | |
| INSECT LARVAE (counts) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EPHEMEROPTERA (mayflies) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acanthophlebia* | *7* | *9.6* | 12 | 15 | 8 | 16 | | | | | | | | | | | | | | | 3 | 2 | 4 | 2 | | |
| *Coloburiscus humeralis* | *9* | *8.1* | 75 | 66 | 78 | 63 | | | 1 | | 1 | 2 | | | | 1 | | 1 | | | 51 | 54 | 56 | 61 | | |
| *Deleatidium sp.* | *8* | *5.6* | 11 | 17 | 9 | 11 | | | | | | | | | | | | | | | 35 | 34 | 41 | 32 | | |
| *Nesameletus sp.* | *9* | *8.6* | 7 | 4 | 11 | 9 | | | | | 1 | | | | | | | | | | 3 | 4 | 4 | 2 | | |
| *Rallidens mcfarlanei* | *9* | *3.9* | | | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Zephlebia sp.* | *7* | *8.8* | 12 | 8 | 5 | 8 | | | | | | | | | 1 | | | | | | 6 | 4 | 5 | 4 | | |
| PLECOPTERA (stone flies) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acroperla trivacuata* | *5* | *5.1* | 7 | 12 | 8 | 11 | | | | | | | | | | | | 1 | | | 18 | 15 | 13 | 16 | | |
| *Austroperla cyrene* | *9* | *8.4* | 4 | 3 | 3 | 4 | | | | 1 | | | | | | | | | | | 5 | 2 | 3 | 5 | | |
| *Spaniocera sp.* | *8* | *8.8* | 1 | | 2 | 1 | | | | | | | | | | | | | | | | | | | | |
| *Sternoperla prusina* | *10* | *9.1* | 6 | 7 | 4 | 9 | | | 1 | | | | | | | | | 1 | | | 4 | 3 | 4 | 5 | | |
| *Zelandobius furcillatus* | *5* | *7.4* | 9 | 8 | 12 | 9 | | | | | | | | | | | | | | | 4 | 2 | 2 | 4 | | |
| *Zelandoperla fenestrata* | *10* | *8.9* | 3 | 1 | 2 | 2 | | | | | | | | | | | | | | | 2 | | 2 | | | |
| TRICHOPTERA (caddisflies) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Aoteapsyche colonica* | *4* | *6* | 17 | 26 | 22 | 18 | | | | | | | | | | | | | | | 28 | 32 | 27 | 33 | | |
| *Hydrobiosella mixta* | *9* | *7.6* | 5 | 6 | 4 | 5 | | | | | | | | | | | | | | | 6 | 5 | 6 | 3 | | |
| *Hydrochorema sp.* | *9* | | 7 | 5 | 7 | 4 | | | | | | | | | | | | | | | 2 | 4 | 5 | 3 | | |
| *Orthopsyche fimbriata* | *9* | *7.5* | 5 | 3 | 7 | 5 | | | | | | | | | | | | | | | | | | | | |
| *Polyplectropus sp* | *8* | *8.1* | 2 | 4 | 3 | 4 | | | | | | | | | | | | | | | 3 | 4 | 3 | 5 | | |
| COLEOPTERA (beetles) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Elmidae* | *6* | *7.2* | 3 | 2 | 5 | 6 | | | | | | 1 | | | | 1 | | | | | 17 | 19 | 11 | 13 | | |
| DIPTERA (two winged flies) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Aphrophila neozelandica* | *5* | *5.6* | 3 | 2 | 1 | 1 | | | | | | | | | | | | | | | 1 | | 2 | 1 | | |
| *Chironomus sp.* | *1* | *3.4* | 3 | 4 | 2 | 2 | | | | | | | | | | | | | | | 4 | 5 | 3 | 4 | | |
| *Eriopterini sp.* | *9* | *7.5* | 2 | 1 | 3 | 2 | | | | | | | | | | | | | | | | | | | | |
| *MEGALOPTERA (dobsonflies)* | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Archichauloides diversus* | *7* | *7.3* | 6 | 4 | 4 | 6 | | | | | | | | | | | | | | | 2 | 3 | 4 | 3 | | |

* Stark et. al. (2001) ** Stark and Maxted (2007)

Appendix C: Stream Survey Sheet 5: Laboratory Analysis of Macroinvertebrate Samples.

SUMMARY STATS: MACROINVERTEBRATES

| | SW 12 | | | | | | SW 13 | | | | | | SW 7 | | | | | | SW 8 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | ave. | S.D. | #1 | #2 | #3 | #4 | ave. | S.D. | #1 | #2 | #3 | #4 | ave. | S.D. | #1 | #2 | #3 | #4 | ave. | S.D. |
| Taxa Richness | 22 | 22 | 24 | 24 | 23 | 1.15 | 2 | 1 | 2 | 2 | 1.75 | 0.5 | 1 | 2 | 0 | 3 | 1.5 | 1.29 | 19 | 19 | 19 | 18 | 18.8 | 0.5 |
| # inverts | 202 | 202 | 204 | 200 | 202 | 1.63 | 2 | 1 | 2 | 3 | 2 | 0.82 | 1 | 2 | 0 | 3 | 1.5 | 1.29 | 202 | 201 | 200 | 201 | 201 | 0.82 |
| MCI | 144 | 139 | 143 | 141 | 142 | 2.15 | | | | | | | | | | | | | 139 | 132 | 139 | 136 | 136 | 3.5 |
| QMCI | 6.24 | 6.07 | 6.14 | 6.33 | 6.19 | 0.11 | | | | | | | | | | | | | 6.14 | 5.99 | 6.34 | 5.98 | 6.11 | 0.17 |
| EPT Index* | 16 | 15 | 17 | 16 | 16 | 0.82 | | | | | | | | | | | | | 14 | 13 | 14 | 13 | 13.5 | 0.58 |
| %EPT* | 91 | 92 | 91 | 90 | 91 | 1 | | | | | | | | | | | | | 84 | 82 | 88 | 87 | 85 | 3 |
| % contrib. dom. taxon | 37.1 | 32.7 | 38.2 | 31.5 | 34.9 | 3.3 | | | | | | | | | | | | | 25.2 | 26.9 | 28 | 30.3 | 27.6 | 2.14 |

* excluding *Oxythira* and *Paroxythira*

**Appendix E**

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 17.09.09.

Sample ID: SW3

Sampler Initials: REPS, GJS.

Job Number: A02277600

Weather: fine, cloudy.

Sampling Equipment: Troll 9500 & YSI 000.

Flow Method: V-notch weir.

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 5.04pm | 10.36 | 7.84 | 92.09 | 176 | 10.64 | < 5 | |
| | | | | 000 = | 9.99 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

V-notch weir water level = 27 mm

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 17.09.09

Sample ID: SW5

Sampler Initials: REPS, GJS

Job Number: AO2277606

Weather: Low clouds

Sampling Equipment: Troll 9500, YSI ODO

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (μS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 5.18 pm | 14.35 | 7.63 | 562.9 | 194 | 9.94 | <5 | slightly CO |
| | | | | ODO = | 9.66 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 17.09.09

Sample ID: SW7

Sampler Initials: REPS, GJS

Job Number: AD02277600

Weather: Fine

Sampling Equipment: Troll 9500, YSI 600

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 11:58am | 11.90 | 6.95 | 301.6 | 234 | 11.24 | < 5 | |
| | | | | ODO = | 10.77 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Total CN collected, to be placed on Cold Hold @ Lab.

# PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17.09.09

Sample ID: SW8

Sampler Initials: REPS, GJS

Job Number: A022277600

Weather: Fine

Sampling Equipment: Troll 9500, YSI ODO

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 10:20am | 11.31 | 7.30 | 83.99 | 243 | 11.46 | < 5 | CL |
| | | | | ODO = 10.7 | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

# PDP SURFACE WATER SAMPLING FORM

Site: Tui mine

Date/s: 18.09.09

Sample ID: SW11

Sampler Initials: REPS, AJS

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Troll9500, YSI ODO

Flow Method: Flowtracker, v notch weir.

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 9.40am | 12.37 | 3.29 | 528.8 | 496 | 11.70 | <5 | CL |
| | | | | 000 = | 10.31 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Total Cyanide BLIND REPLICATE | SW21 |
| Total Cyanide SPLIT SAMPLE | SW11 |
| | |
| | |

| Blank | Label |
|---|---|
| Dissolved metals Filter (Rinsate) blank | SW50B |
| | |

Field Calibration ☑

Comments

V-notch weir water level = 60 mm

# PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17.09.09

Sample ID: SW13

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Fine

Sampling Equipment: Troll9500, YSI ODO

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 1.22pm | 12.15 | 6.94 | 134.1 | 209 | 11.31 | <5 | CL |
| | | | | ODO = | 10.28 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Total metals BLIND REPLICATE | SW23 |
| Dissolved metals BLIND REPLICATE | SW23B |
| Total metals SPLIT SAMPLE | SW13 |
| Dissolved metals SPLIT SAMPLE | SW13B |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 18.09.09

Sample ID: SW15

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Troll9500, YSI ODO

Flow Method: Volumetric

| Time | Water Temp. (°C) | pH (pH units) | EC ~~m~~S/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 8.00 am | 12.52 | 5.67 | 79.07 | 190 | 10.4 | < 5 | CL |
| | | | | ODO = | 9.93 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

SW15 Volumetric flow:

| Time (S) | Vol (L) |
|---|---|
| 1.94 | 3.9 |
| 1.96 | 3.9 |
| 1.72 | 4.0 |
| 1.62 | 3.8 |
| 1.97 | 3.9 |
| 1.80 | 3.9 |

# PDP SURFACE WATER SAMPLING FORM

Site: Tui mine

Date/s: 17.09.09

Sample ID: SW100

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Fine

Sampling Equipment: Troll 9500, YSI 000

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 3:57pm | 14.11 | 7.51 | 445.8 | 189 | 10.08 | <5 | |
| | | | | 000 = | 9.91 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Cation/Anion Profile + Diss. silica, pH, TSS, EC BLIND REPLICATE | SW 120 |
| Cation/Anion Profile + diss. silica, pH, TSS, EC SPLIT SAMPLE | SW100 |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 17.09.09

Sample ID: SW101

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Troll 9504 YSI 000

Flow Method: Gradient Calculations (Level surveying).

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 2:56 pm | 11.57 | 7.23 | 105.1 | 207 | 11.71 | <5 | CL |
| | | | | 000 = 10.49 | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Depth measurements for gradient calcs:

| Culvert | Upgradient | Down gradient |
|---|---|---|
| Culvert 1 (True left) | 0.015 cm | 0.005 cm |
| Culvert 2 (True Right) | 0.025 cm | 0.010 cm |

Culvert base levels using Level surveying Equipment:

| | | |
|---|---|---|
| Culvert 1 | 2.495 m | 2.845 m |
| Culvert 2 | 2.425 m | 2.975 m |

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 8.10.09

Sample ID: SW3

Sampler Initials: REPS, LJC

Job Number: AD2277600

Weather: Overcast

Sampling Equipment: Troll 9500, YSI ODO

Flow Method: V-notch weir

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 4:56 pm | 10.17 | 6.76 | 65.08 | 301 | 9.87 | < 5 | |
| | | | | ODO = 10.15 | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

V-notch weir water level = 75mm

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 9.10.09

Sample ID: SW5

Sampler Initials: REPS, LJC

Job Number: A02277600

Weather: Rain

Sampling Equipment: Troll9500, YSI ODO

Flow Method: Flow tracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 8.44 am | 12.92 | 6.31 | 465.5 | 225 | 11.02 | < 5 | CL |
| | | | | ODO = | 9.47 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Total metals BLIND REPLICATE | SW25 |
| Dissolved metals BLIND REPLICATE | SW25B |
| Ion profile, silica, pH, EC, TSS BLIND REPLICATE | SW25 |
| SPLITS: Total metals & ion profile + pH, EC, TSS | SW5 |
| Dissolved metals Ion profile, silica, TSS, pH, EC | SW5B SW5 |

| Blank | Label |
|---|---|
| Trip Blank | SW250 |
| Dissolved metals filter (rinsate) Blank | SW250B |

Field Calibration ☑

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 8.10.09

Sample ID: SW7

Sampler Initials: REPS, LJC

Job Number: AD22776OO

Weather: Fine / Overcast

Sampling Equipment: Troll 9500, YSI 000

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 10:50 am | 10.27 | 6.57 | 156.8 | 589 | 11.58 | <5 | CL / CO |
| | | | | 000 = | 11.08 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

PATTLE DELAMORE PARTNERS LTD

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 8.10.09

Sample ID: SW8

Sampler Initials: REPS, LJC

Job Number: AO2277600

Weather: Fine / Overcast

Sampling Equipment: Troll 9500, YSI ODO

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 9:30 am | 8.62 | 7.93 | 60.04 | 796 | 12.72 | <5 | CL |
| | | | | ODO = | 11.42 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

PATTLE DELAMORE PARTNERS LTD

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 8.10.09

Sample ID: SW 11

Sampler Initials: REPS, LJC

Job Number: AO2279600

Weather: Overcast / Fine

Sampling Equipment: Troll 9500, YSI 000

Flow Method: V-Notch weir & Flowtracker.

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 6.00 pm | 11.70 | 3.04 | 618.3 | 516 | 8.75 | < 5 | CL |
| | | | | COD = | 9.33 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Cyanide BLIND REPLICATE | SW21 |
| Cyanide SPLIT SAMPLE | SW11 |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

# PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 8.10.09

Sample ID: SW13

Sampler Initials: REDS, LTC

Job Number: AD22777600

Weather: Fine / Overcast

Sampling Equipment: TVal 9500, YSI 600

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 12:41 pm | 10.53 | 7.05 | 89.55 | 548 | 12.27 | < 5 | CL |
| | | | | DUP = | 10.96 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 8.10.09

Sample ID: SW15

Sampler Initials: REPS, LJC

Job Number: A02277600

Weather: Overcast

Sampling Equipment: TROLL9500, YSI ODO

Flow Method: Volumetric

| Time | Water Temp. (°C) | pH (pH units) | EC (µS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 6:42 pm | 12.39 | 5.19 | 181.0 | 217 | 8.64 | <5 | CL |
| | | | | ODO: | 9.42 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

Difficult to volumetrically measure flow. High flow caused water to bounce back out of bucket.

Range of 3-5 L between 0.27 & 0.5 s

(→ 4L / 0.39 s)

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 8.10.09

Sample ID: SW100

Sampler Initials: REPS, LJC

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Troll 9500, YSI 600

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 3:25 pm | 10.66 | 6.73 | 199.2 | 342 | 9.93 | < 5 | CL |
| | | | | ODO = | 10.39 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Waste Rockpile has been removed since Round 1.

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 8-10-09

Sample ID: SW101

Sampler Initials: REPS, LJC

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Troll 9500, YSI ODO

Flow Method: Gradient calculations

| Time | Water Temp. (°C) | pH (pH units) | EC ~~mS~~/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 2:46 pm | 9.55 | 6.57 | 70.54 | 379 | 11.13 | < 5 | CL |
| | | | | ODO = | 10.64 | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Depth measurements for Gradient calcs:

| Culvert | Upgradient | Downgradient |
|---|---|---|
| Culvert 1 (True Left) | 5.0 cm | 2.0 cm |
| Culvert 2 (True Right) | 5.5 cm | 5.0 cm |

# PDP SURFACE WATER SAMPLING FORM

Site: Tui mine

Date/s: 17.11.09

Sample ID: SW3

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: V-notch weir

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 1:35pm | 10.97 | 7.42 | 0.108 | 258 | 9.10 | 0.9 | CL |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

weir water level = 37 mm
v-notch

PATTLE DELAMORE PARTNERS LTD

# PDP SURFACE WATER SAMPLING FORM

Site: Tui mine

Date/s: 17.11.09

Sample ID: SW5

Sampler Initials: REPS, GJS

Job Number: AD2277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 12:39 pm | 13.98 | 7.29 | 0.614 | 297 | 9.91 | 19.0 | CO |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

PATTLE DELAMORE PARTNERS LTD

## PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17.11.09

Sample ID: SW7

Sampler Initials: REPS, GJS

Job Number: A02277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 9:01 am | 11.36 | 6.39 | 0.346 | 330 | 10.45 | 5.4 | CO |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

PATTLE DELAMORE PARTNERS LTD

## PDP SURFACE WATER SAMPLING FORM

Site: Tui mine

Date/s: 17.11.09

Sample ID: SW 8

Sampler Initials: REPS GJS

Job Number: AO2277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 8:24 am | 11.42 | 6.06 | 0.09 | 350 | 12.41 | 1.6 | CL |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

# PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17.11.09

Sample ID: SW 11

Sampler Initials: REPS, GJS

Job Number: A022776000

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: V-notch weir

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 2.37 pm | 13.95 | 3.36 | 0.693 | 477 | 10.84 | 5.0 | |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Total CN Blind Replicate | SW21 |
| Total metals Blind Replicate | SW21 |
| Dissolved metals Blind replicate | SW21B |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☑

Comments

weir water level on v-notch = 58mm

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui Mine

Date/s: 17.11.09

Sample ID: ~~SW13~~ SW13

Sampler Initials: REPS, GJS

Job Number: AD2277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Flow tracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 9:53am | 11.76 | 6.99 | 0.153 | 312 | 10.98 | 3.7 | |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| ~~Dissolved~~ metals, Filtered Rinsate Blank | SW23B |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

## PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17.11.09

Sample ID: SW15

Sampler Initials: REDS, GJS

Job Number: AD2277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Volumetric

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 2.54 pm | 12.87 | 5.86 | 0.210 | 270 | 11.31 | 0.3 | CL |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Volumetric measurements:

| Time (S) | Vol (L) |
|---|---|
| 1.81 | 2.65 |
| 1.46 | 2.3 |
| 1.98 | 2.7 |
| 1.50 | 2.7 |
| 1.53 | 2.7 |
| 1.42 | 2.9 |
| 1.60 | 2.9 |
| 1.32 | 2.7 |

## PDP SURFACE WATER SAMPLING FORM

Site: Tui Mine

Date/s: 17-11-09

Sample ID: SW100

Sampler Initials: REDS, GJS

Job Number: A02277600

Weather: Cloudy

Sampling Equipment: Horiba

Flow Method: Flowtracker

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 11:43 am | 12.37 | 6.97 | 0.470 | 317 | 10.82 | 12.8 | CO |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| | |
| | |
| | |
| | |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

**PDP SURFACE WATER SAMPLING FORM**

Site: Tui mine

Date/s: 17.11.09

Sample ID: SW101

Sampler Initials: REPS, GJS

Job Number: AD2277600

Weather: Overcast

Sampling Equipment: Horiba

Flow Method: Gradient + Calculations

| Time | Water Temp. (°C) | pH (pH units) | EC (mS/cm) | ORP (mV) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | Water Appearance * |
|---|---|---|---|---|---|---|---|
| 11:15 pm | 10.73 | 6.57 | 0.113 | 306 | 11.29 | 0.5 | CL |
| | | | | | | | |

* CL = clear; CO = cloudy; TU = turbid; SA = sandy

| Duplicate | Label |
|---|---|
| Ion profile, silica, TSS, pH, EC BLIND REPLICATE | SW201 |
| Ion profile, silica, TSS, pH, EC SPLIT SAMPLE | SW101 |
| Total metals SPLIT SAMPLE | SW101 |
| Dissolved metals SPLIT SAMPLE | SW101B |

| Blank | Label |
|---|---|
| | |
| | |

Field Calibration ☐

Comments

Depth measurements for grad. calcs:

| Culvert | Upgradient | Downgradient |
|---|---|---|
| Culvert 1 (TL) | 1.4 cm | 0.6 cm |
| Culvert 2 (TR) | 1.5 cm | 1.3 cm |

# Appendix F

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/09/17 17:38:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.9% | 4.1% |
| Velocity | 3.7% | 4.3% |
| Width | 0.3% | 0.3% |
| Method | 4.4% | - |
| # Stations | 7.8% | - |
| Overall | 9.8% | 6.0% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 7 |
| Start Edge | REW | Total Width | 0.350 |
| Mean SNR | 38.6 dB | Total Area | 0.023 |
| Mean Temp | 14.32 °C | Mean Depth | 0.064 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2526 |
| | | Total Discharge | 0.0057 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 17:38 | 0.75 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 17:39 | 0.85 | 0.6 | 0.100 | 0.6 | 0.040 | 0.3925 | 1.00 | 0.3925 | 0.008 | 0.0029 | 51.8 |
| 2 | 17:42 | 0.90 | 0.6 | 0.080 | 0.6 | 0.032 | 0.3042 | 1.00 | 0.3042 | 0.004 | 0.0012 | 21.4 |
| 3 | 17:44 | 0.95 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1862 | 1.00 | 0.1862 | 0.004 | 0.0007 | 13.1 |
| 4 | 17:45 | 1.00 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1475 | 1.00 | 0.1475 | 0.004 | 0.0006 | 10.4 |
| 5 | 17:49 | 1.05 | 0.6 | 0.060 | 0.6 | 0.024 | 0.0625 | 1.00 | 0.0625 | 0.003 | 0.0002 | 3.3 |
| 6 | 17:49 | 1.10 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

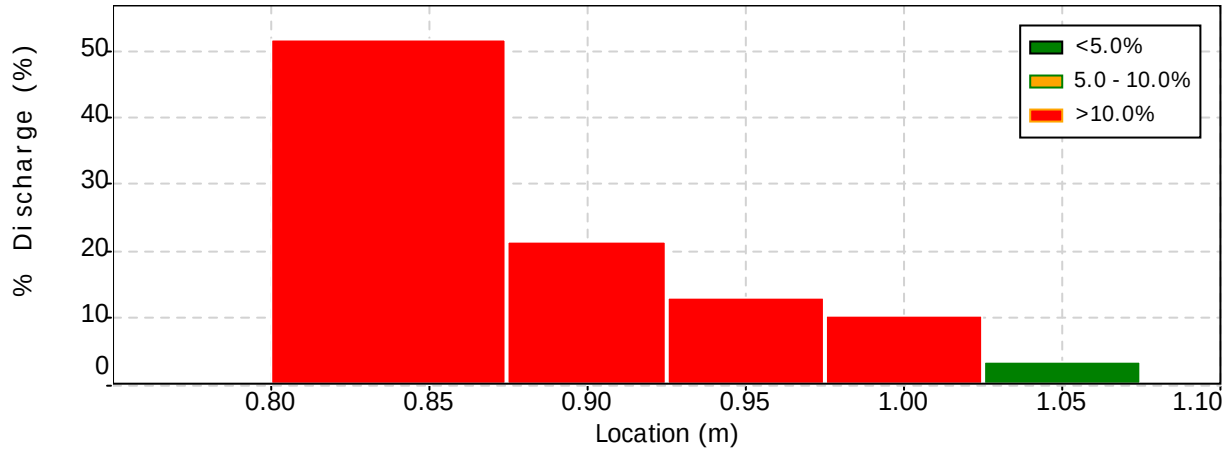
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

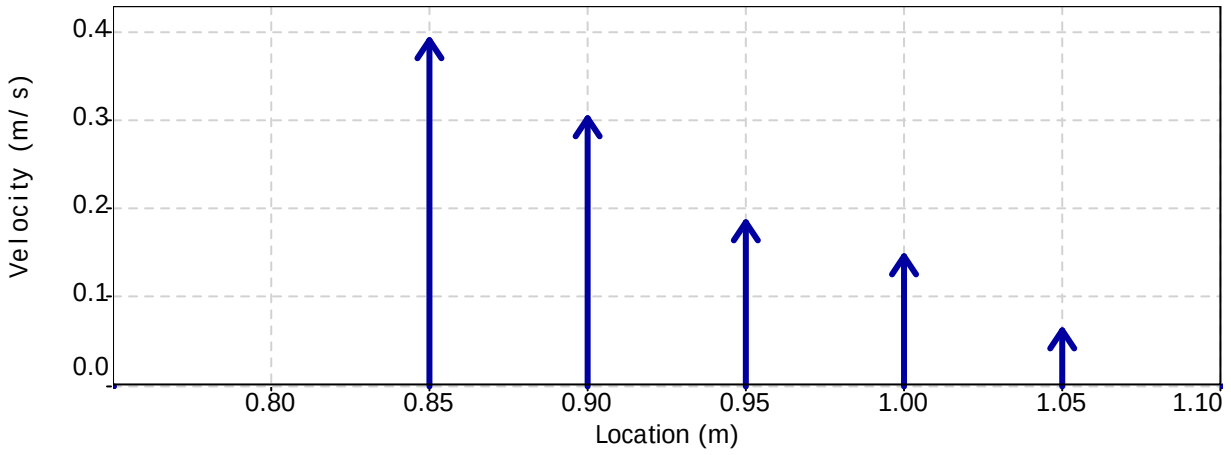
# Discharge Measurement Summary

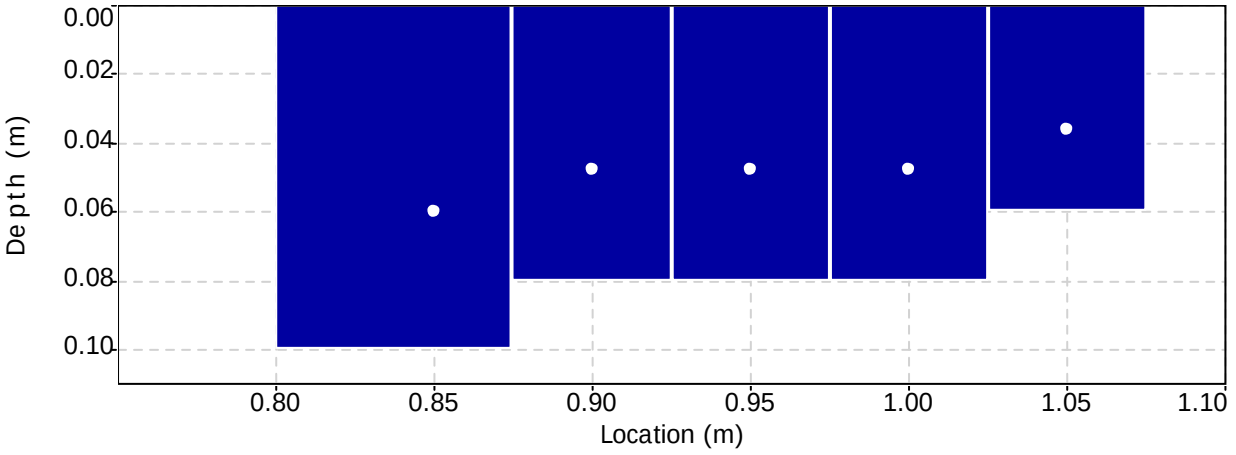
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/09/17 17:38:48 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/09/17 17:38:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 5 | 1.05 | 0.6 | Boundary QC is Good; possible boundary interference |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

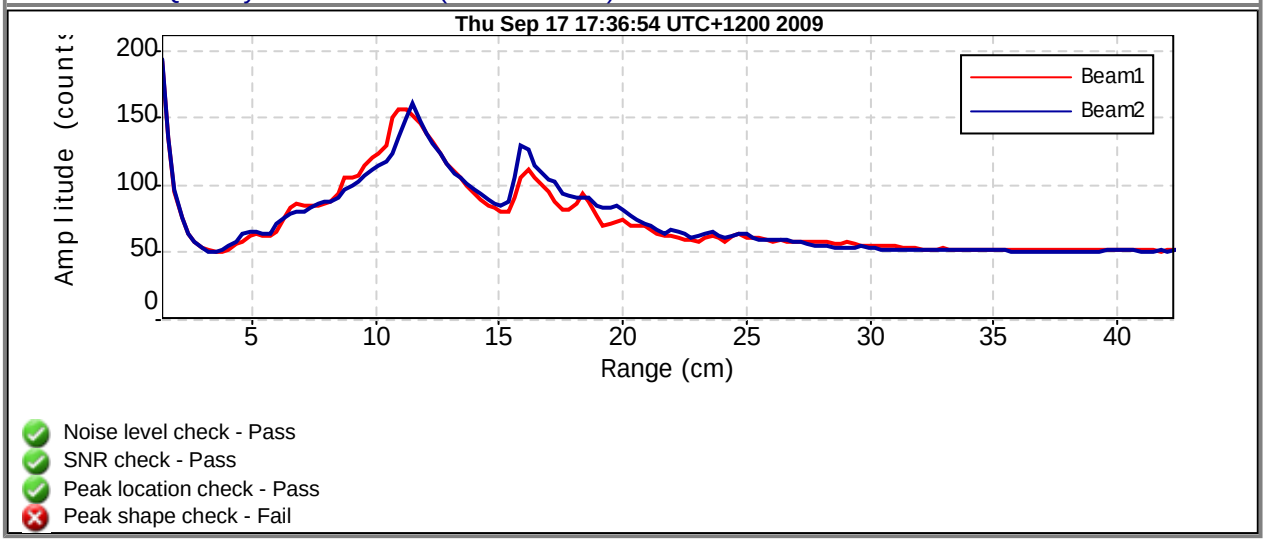
## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/09/17 17:38:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Fail

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/09/17 12:08:42 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.8% | 2.9% |
| Velocity | 4.1% | 15.8% |
| Width | 0.3% | 0.3% |
| Method | 3.9% | - |
| # Stations | 9.4% | - |
| Overall | 11.1% | 16.1% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 6 |
| Start Edge | LEW | Total Width | 0.650 |
| Mean SNR | 37.5 dB | Total Area | 0.091 |
| Mean Temp | 11.95 °C | Mean Depth | 0.140 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1962 |
| | | Total Discharge | 0.0179 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 12:08 | 1.50 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 12:08 | 1.55 | 0.6 | 0.160 | 0.6 | 0.064 | 0.3274 | 1.00 | 0.3274 | 0.016 | 0.0052 | 29.3 |
| 2 | 12:12 | 1.70 | 0.6 | 0.150 | 0.6 | 0.060 | 0.1798 | 1.00 | 0.1798 | 0.023 | 0.0040 | 22.7 |
| 3 | 12:14 | 1.85 | 0.6 | 0.170 | 0.6 | 0.068 | 0.1009 | 1.00 | 0.1009 | 0.026 | 0.0026 | 14.4 |
| 4 | 12:18 | 2.00 | 0.6 | 0.180 | 0.6 | 0.072 | 0.2221 | 1.00 | 0.2221 | 0.027 | 0.0060 | 33.6 |
| 5 | 12:18 | 2.15 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

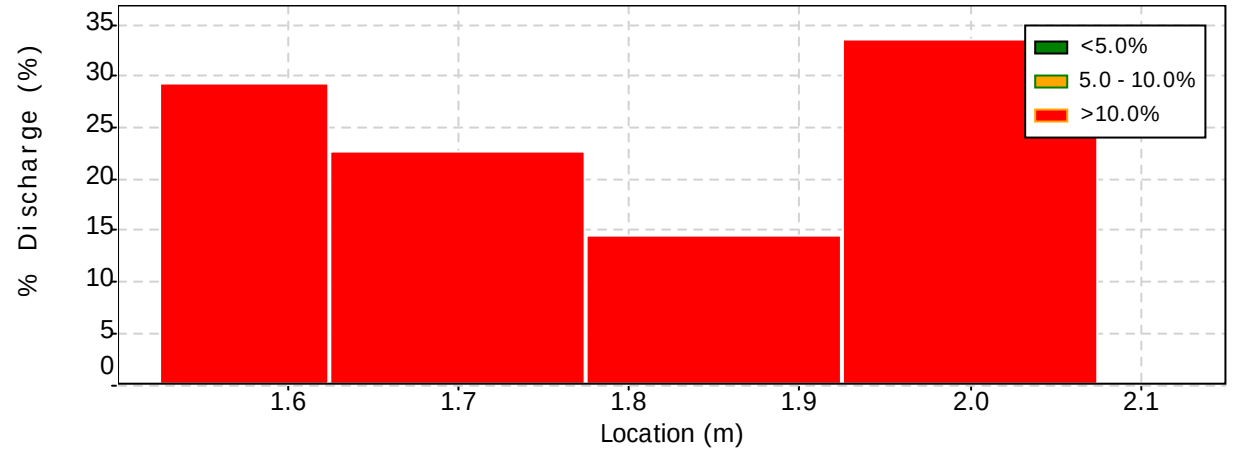
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

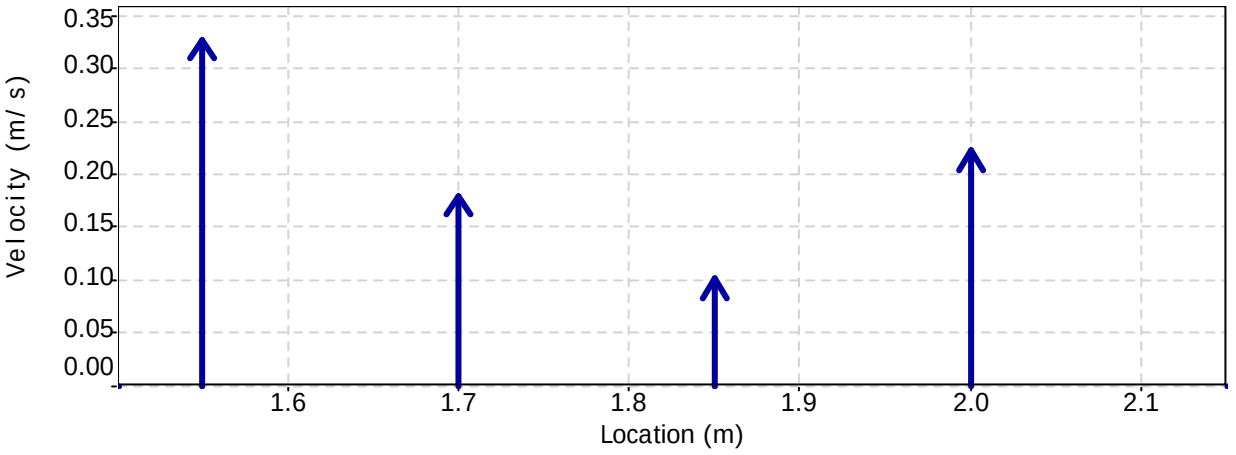
# Discharge Measurement Summary

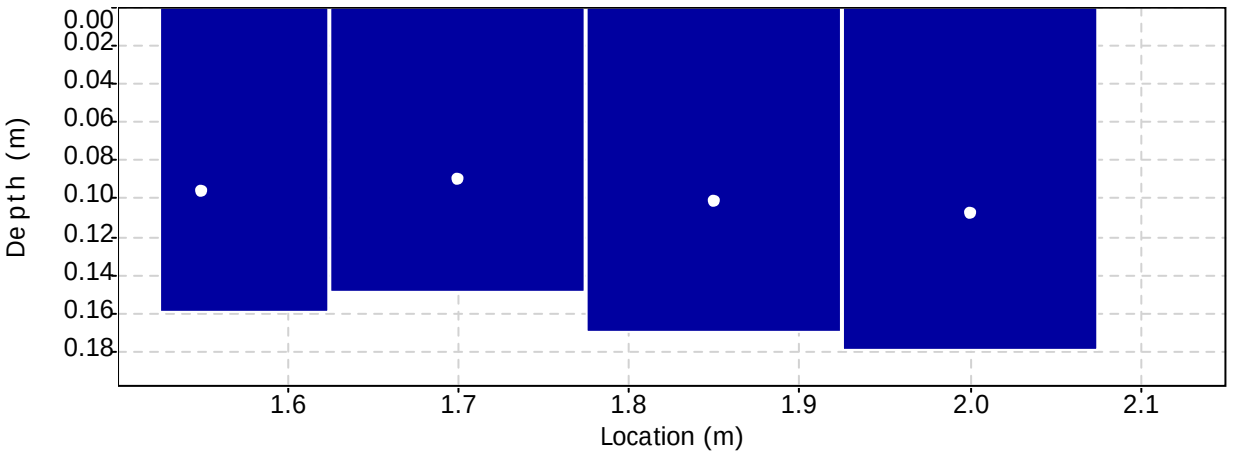
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/09/17 12:08:42 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/09/17 12:08:42 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| No Quality Control warnings | | | |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

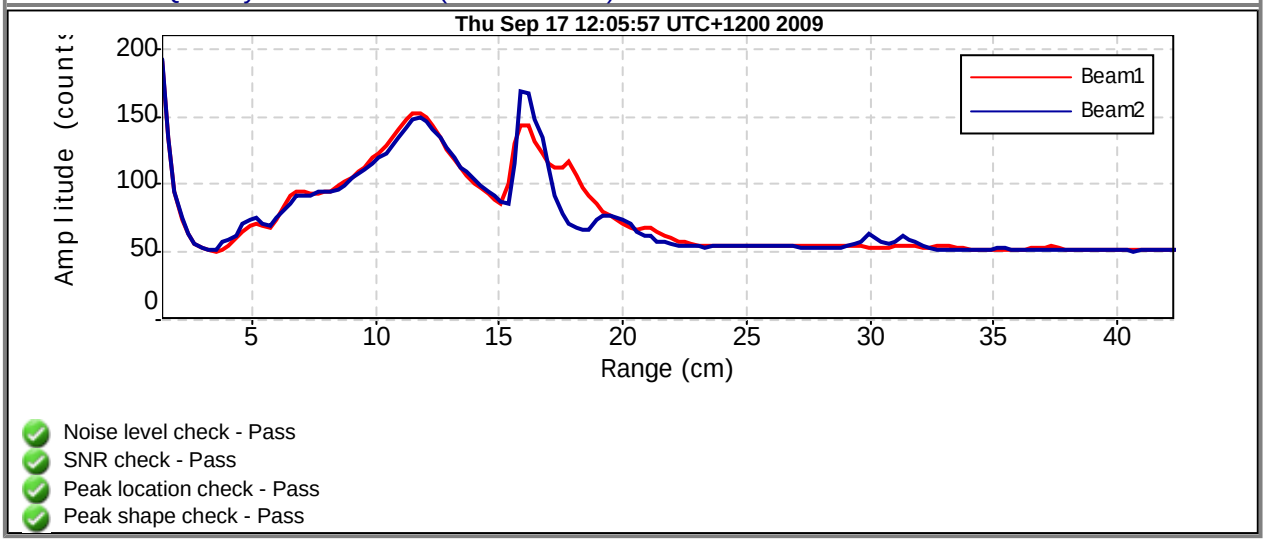
## File Information

| | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/09/17 12:08:42 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW8.8.WAD |
| Start Date and Time | 2009/09/17 10:37:43 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.7% | 7.2% |
| Velocity | 1.6% | 19.8% |
| Width | 0.2% | 0.2% |
| Method | 3.5% | - |
| # Stations | 3.9% | - |
| Overall | 5.6% | 21.1% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 13 |
| Start Edge | LEW | Total Width | 5.600 |
| Mean SNR | 19.7 dB | Total Area | 0.530 |
| Mean Temp | 11.29 °C | Mean Depth | 0.095 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.0472 |
| | | Total Discharge | 0.0250 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10:37 | 0.45 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 10:40 | 0.70 | 0.6 | 0.200 | 0.6 | 0.080 | 0.0017 | 1.00 | 0.0017 | 0.075 | 0.0001 | 0.5 |
| 2 | 10:43 | 1.20 | 0.6 | 0.200 | 0.6 | 0.080 | 0.0228 | 1.00 | 0.0228 | 0.130 | 0.0030 | 11.8 |
| 3 | 10:50 | 2.00 | 0.6 | 0.110 | 0.6 | 0.044 | 0.1295 | 1.00 | 0.1295 | 0.077 | 0.0100 | 39.8 |
| 4 | 10:56 | 2.60 | 0.6 | 0.120 | 0.6 | 0.048 | 0.0734 | 1.00 | 0.0734 | 0.060 | 0.0044 | 17.6 |
| 5 | 10:59 | 3.00 | 0.6 | 0.100 | 0.6 | 0.040 | 0.0580 | 1.00 | 0.0580 | 0.033 | 0.0019 | 7.5 |
| 6 | 11:01 | 3.25 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0507 | 1.00 | 0.0507 | 0.020 | 0.0010 | 4.1 |
| 7 | 11:02 | 3.50 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0794 | 1.00 | 0.0794 | 0.020 | 0.0016 | 6.3 |
| 8 | 11:06 | 3.75 | 0.6 | 0.060 | 0.6 | 0.024 | 0.0645 | 1.00 | 0.0645 | 0.015 | 0.0010 | 3.9 |
| 9 | 11:08 | 4.00 | 0.6 | 0.050 | 0.6 | 0.020 | 0.0299 | 1.00 | 0.0299 | 0.018 | 0.0005 | 2.1 |
| 10 | 11:12 | 4.45 | 0.6 | 0.050 | 0.6 | 0.020 | 0.0369 | 1.00 | 0.0369 | 0.031 | 0.0012 | 4.6 |
| 11 | 11:15 | 5.25 | 0.6 | 0.065 | 0.6 | 0.026 | 0.0084 | 1.00 | 0.0084 | 0.052 | 0.0004 | 1.7 |
| 12 | 11:15 | 6.05 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

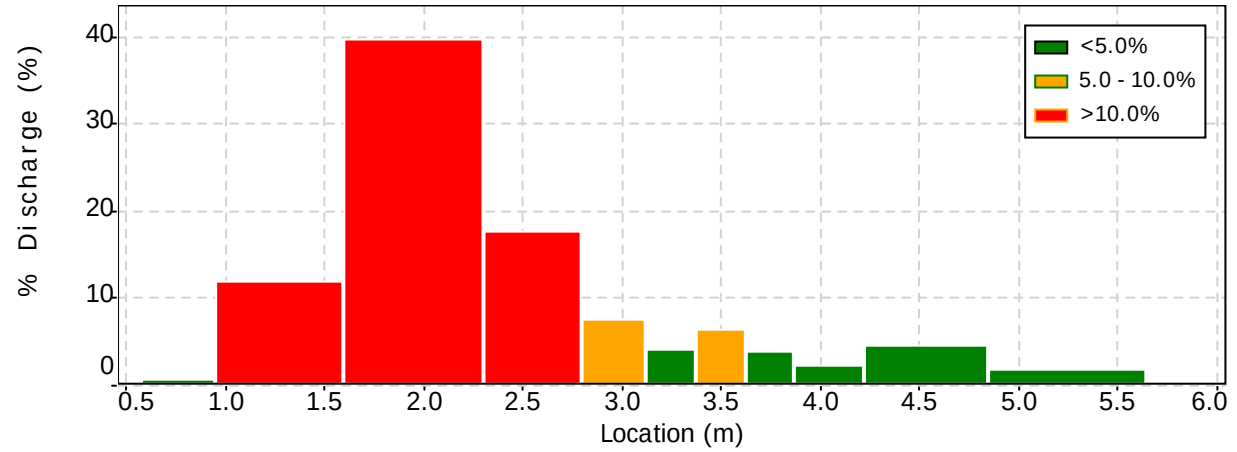
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

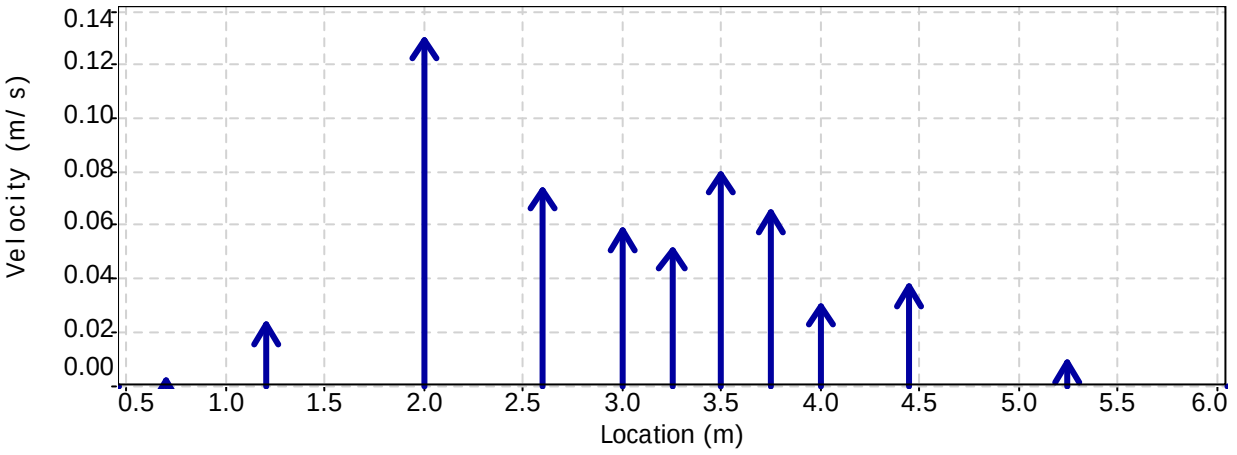
# Discharge Measurement Summary

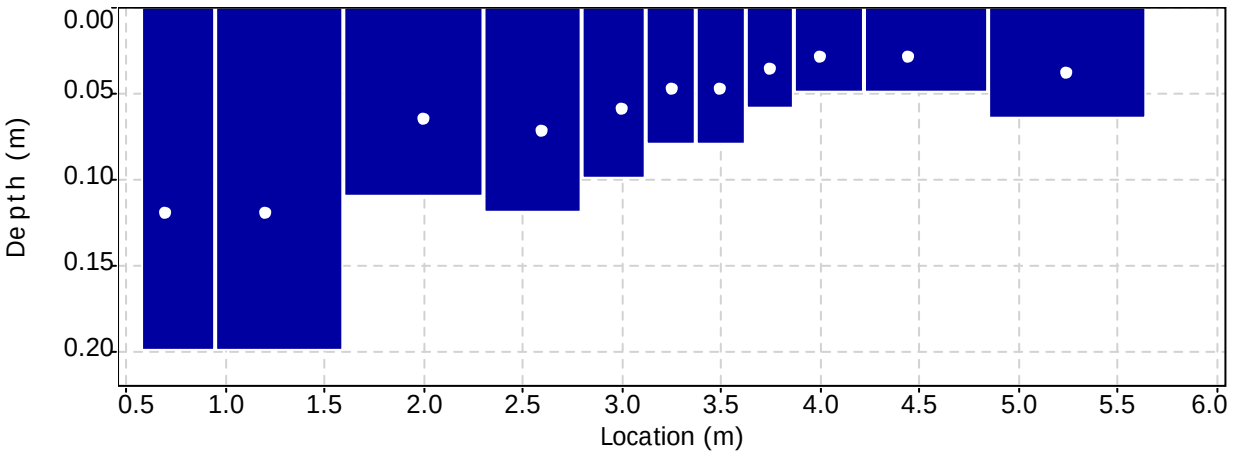
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW8.8.WAD |
| Start Date and Time | 2009/09/17 10:37:43 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW8.8.WAD |
| Start Date and Time | 2009/09/17 10:37:43 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 2 | 1.20 | 0.6 | High angle: -25 |
| 3 | 2.00 | 0.6 | High angle: -25 |
| 4 | 2.60 | 0.6 | High angle: -22 |
| 11 | 5.25 | 0.6 | SNR (29.9) is different from typical SNR (19.7) |
| | | 0.6 | High SNR variation during measurement: 12.0,11.2 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

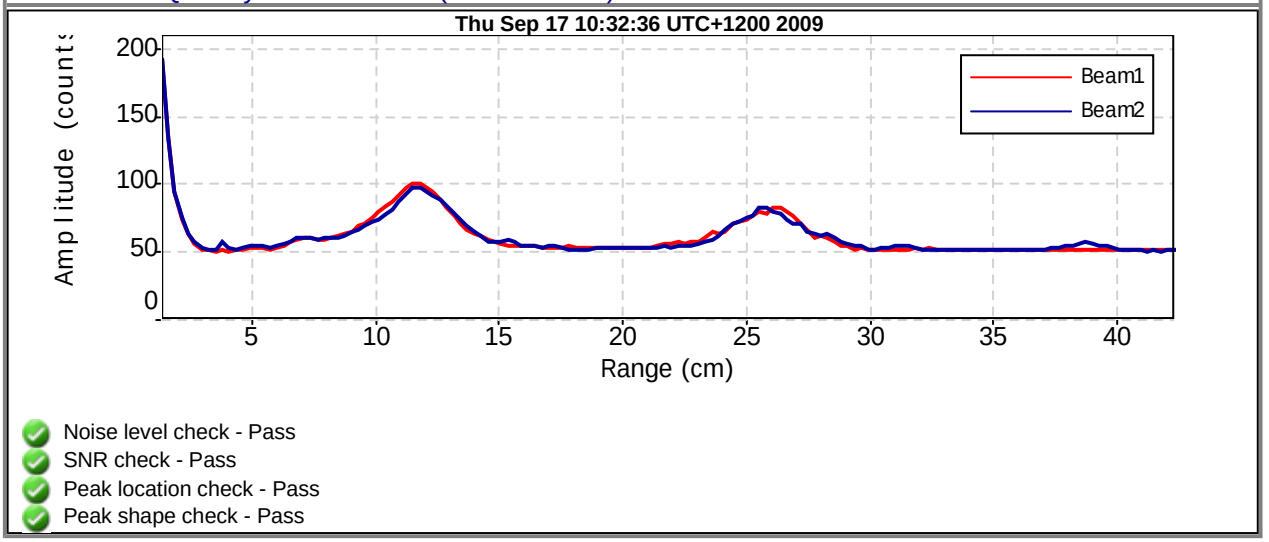
## File Information

| | |
|---|---|
| File Name | TUISW8.8.WAD |
| Start Date and Time | 2009/09/17 10:37:43 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW11.2.WAD |
| Start Date and Time | 2009/09/18 08:47:07 |

## Site Details

| | |
|---|---|
| Site Name | |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 1.2% | 0.0% |
| Velocity | 5.0% | 0.0% |
| Width | 0.4% | 0.4% |
| Method | 6.2% | - |
| # Stations | 12.2% | - |
| Overall | 14.6 % | 1.0 % |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 5 |
| Start Edge | LEW | Total Width | 0.400 |
| Mean SNR | 38.2 dB | Total Area | 0.016 |
| Mean Temp | 12.39 °C | Mean Depth | 0.040 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.0777 |
| | | Total Discharge | 0.0012 |

## Measurement Results

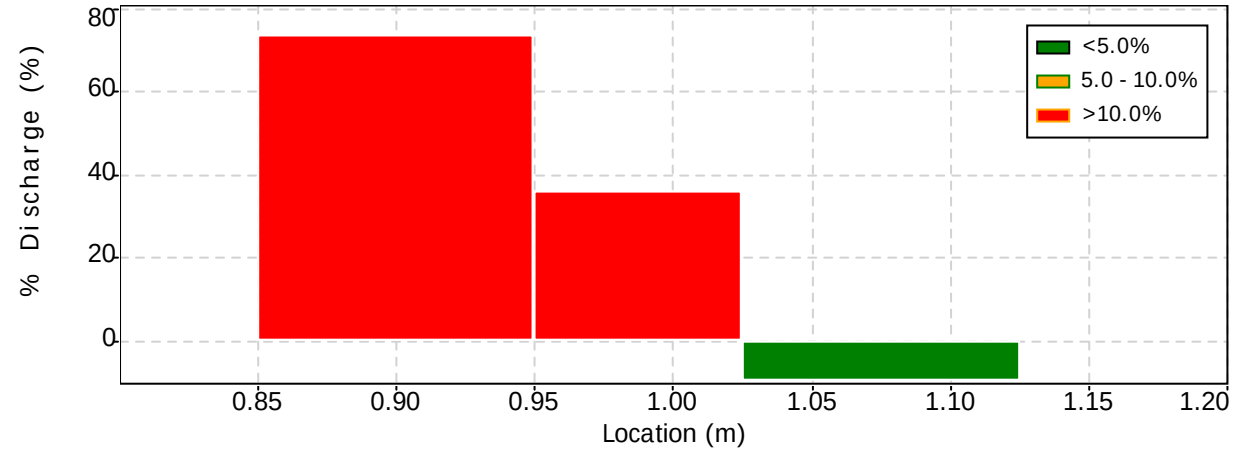
| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 08:47 | 1.20 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 08:48 | 1.05 | 0.6 | 0.050 | 0.6 | 0.020 | -0.0239 | 1.00 | -0.0239 | 0.005 | -0.0001 | -9.6 |
| 2 | 08:52 | 1.00 | 0.6 | 0.060 | 0.6 | 0.024 | 0.0994 | 1.00 | 0.0994 | 0.005 | 0.0004 | 36.0 |
| 3 | 08:55 | 0.90 | 0.6 | 0.065 | 0.6 | 0.026 | 0.1408 | 1.00 | 0.1408 | 0.007 | 0.0009 | 73.6 |
| 4 | 08:55 | 0.80 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

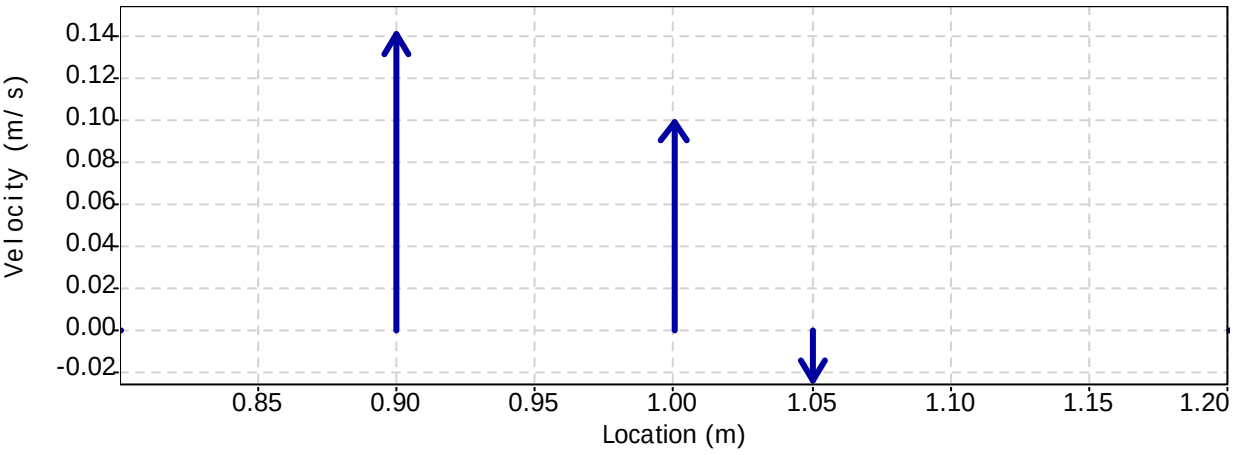
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

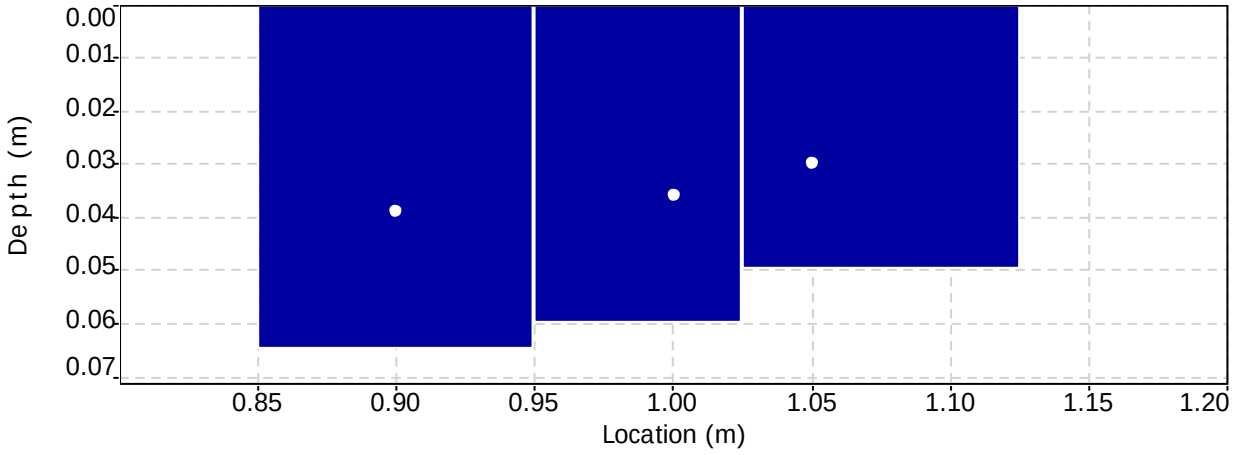
# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

| File Information | | Site Details | |
|---|---|---|---|
| File Name | TUISW11.2.WAD | Site Name | |
| Start Date and Time | 2009/09/18 08:47:07 | Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW11.2.WAD |
| Start Date and Time | 2009/09/18 08:47:07 |

## Site Details

| | |
|---|---|
| Site Name | |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 1 | 1.05 | 0.6 | High angle: 132 |
| 3 | 0.90 | 0.6 | High angle: 29 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

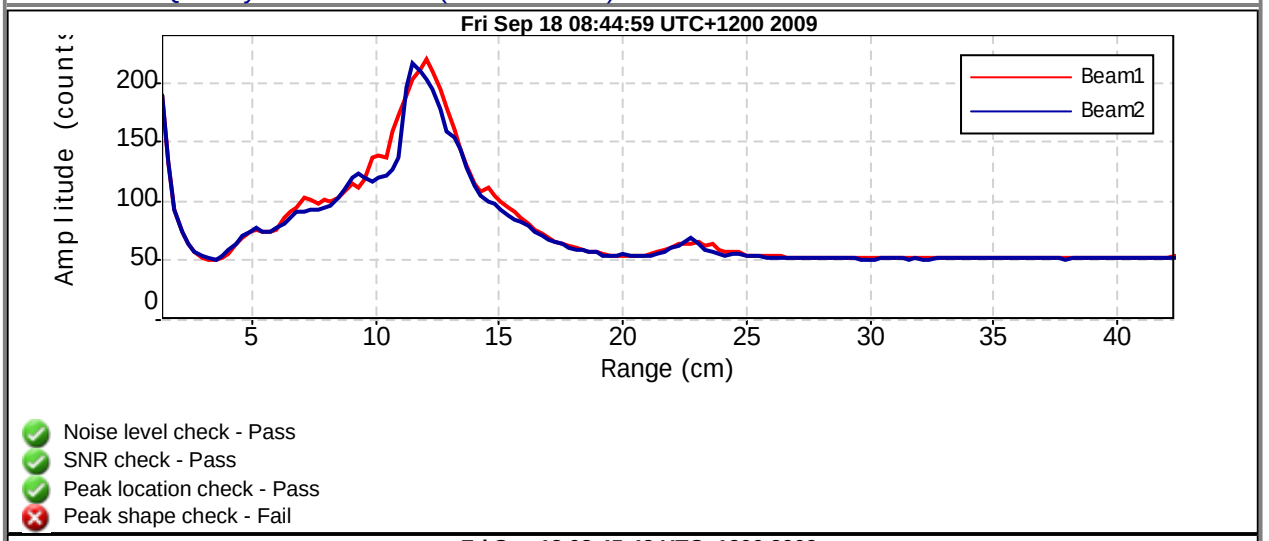
## File Information

| | |
|---|---|
| File Name | TUISW11.2.WAD |
| Start Date and Time | 2009/09/18 08:47:07 |

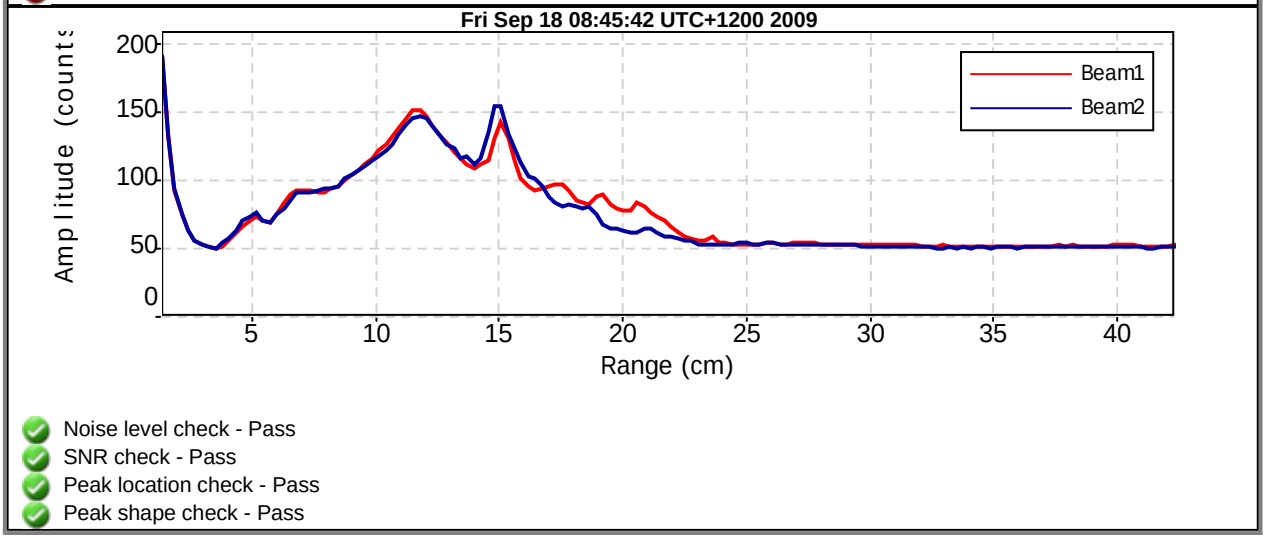
## Site Details

| | |
|---|---|
| Site Name | |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Fail




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/09/17 13:52:03 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.8% | 10.9% |
| Velocity | 2.4% | 12.7% |
| Width | 0.3% | 0.3% |
| Method | 3.8% | - |
| # Stations | 5.1% | - |
| Overall | 6.9% | 16.7% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 10 |
| Start Edge | LEW | Total Width | 0.900 |
| Mean SNR | 35.6 dB | Total Area | 0.079 |
| Mean Temp | 12.15 °C | Mean Depth | 0.088 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2256 |
| | | Total Discharge | 0.0178 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 13:52 | 1.15 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 13:52 | 1.25 | 0.6 | 0.140 | 0.6 | 0.056 | 0.4856 | 1.00 | 0.4856 | 0.014 | 0.0068 | 38.1 |
| 2 | 13:53 | 1.35 | 0.6 | 0.160 | 0.6 | 0.064 | 0.1421 | 1.00 | 0.1421 | 0.016 | 0.0023 | 12.8 |
| 3 | 13:55 | 1.45 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0679 | 1.00 | 0.0679 | 0.008 | 0.0005 | 3.0 |
| 4 | 13:57 | 1.55 | 0.6 | 0.070 | 0.6 | 0.028 | 0.0089 | 1.00 | 0.0089 | 0.007 | 0.0001 | 0.3 |
| 5 | 13:59 | 1.65 | 0.6 | 0.100 | 0.6 | 0.040 | -0.0063 | 1.00 | -0.0063 | 0.010 | -0.0001 | -0.4 |
| 6 | 14:00 | 1.75 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1057 | 1.00 | 0.1057 | 0.008 | 0.0008 | 4.7 |
| 7 | 14:03 | 1.85 | 0.6 | 0.080 | 0.6 | 0.032 | 0.4340 | 1.00 | 0.4340 | 0.008 | 0.0035 | 19.5 |
| 8 | 14:05 | 1.95 | 0.6 | 0.080 | 0.6 | 0.032 | 0.4866 | 1.00 | 0.4866 | 0.008 | 0.0039 | 21.8 |
| 9 | 14:05 | 2.05 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

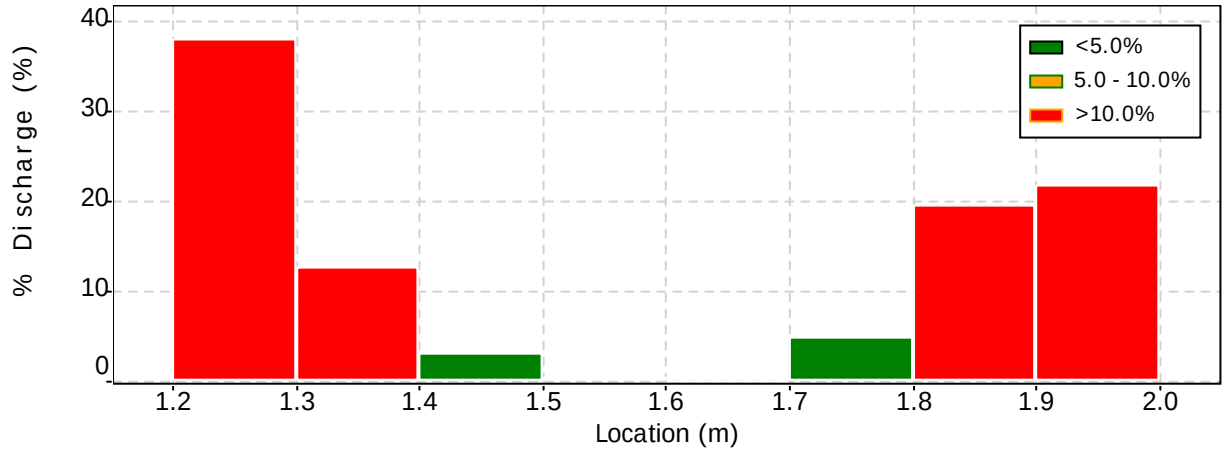
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

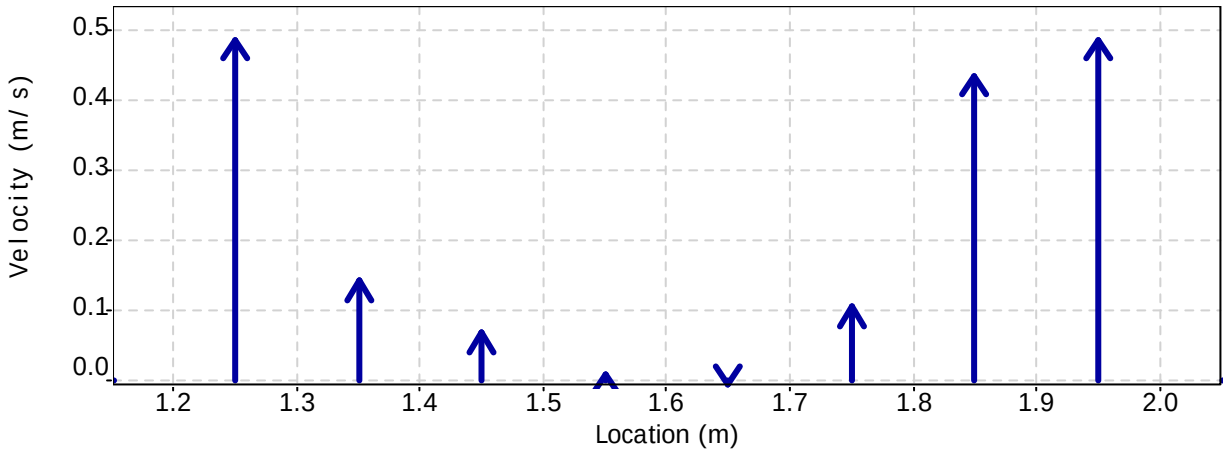
# Discharge Measurement Summary

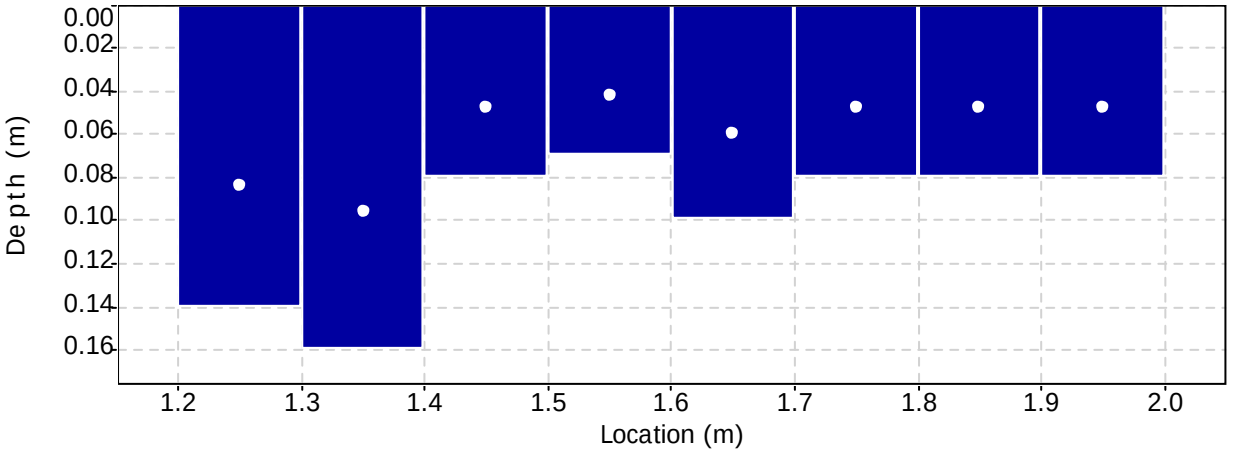
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/09/17 13:52:03 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/09/17 13:52:03 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 3 | 1.45 | 0.6 | High angle: 21 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

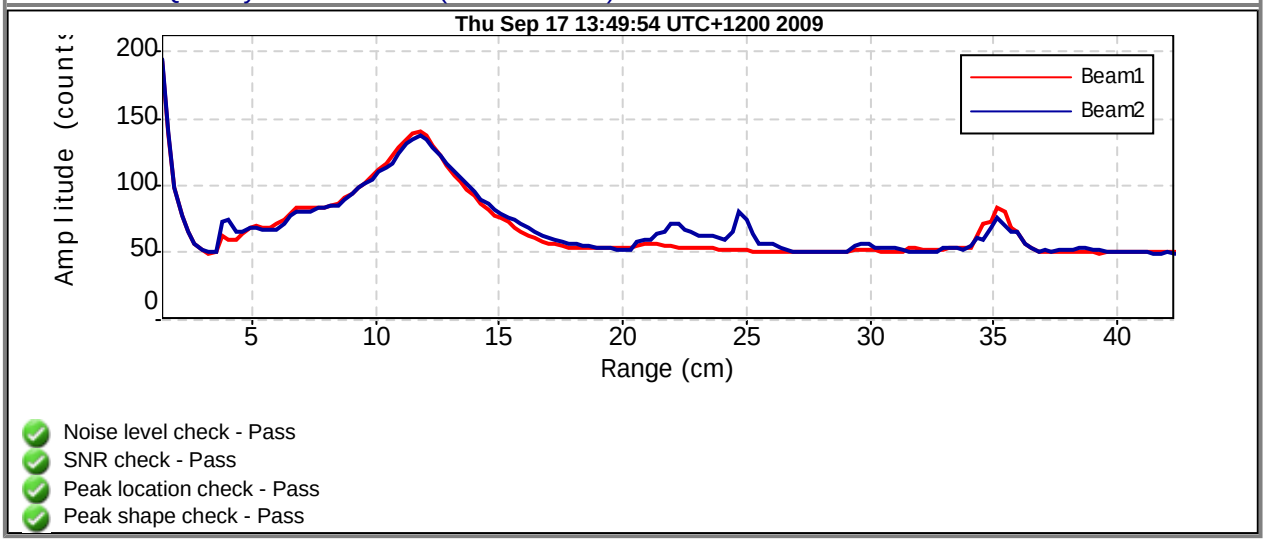
## File Information

| | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/09/17 13:52:03 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/09/17 16:05:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.7% | 11.8% |
| Velocity | 0.8% | 7.1% |
| Width | 0.2% | 0.2% |
| Method | 3.4% | - |
| # Stations | 6.6% | - |
| Overall | 7.6% | 13.8% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 8 |
| Start Edge | REW | Total Width | 0.700 |
| Mean SNR | 36.9 dB | Total Area | 0.038 |
| Mean Temp | 13.99 °C | Mean Depth | 0.054 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1501 |
| | | Total Discharge | 0.0057 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 16:05 | 1.80 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 16:05 | 1.70 | 0.6 | 0.060 | 0.6 | 0.024 | 0.1882 | 1.00 | 0.1882 | 0.006 | 0.0011 | 19.8 |
| 2 | 16:07 | 1.60 | 0.6 | 0.060 | 0.6 | 0.024 | 0.2247 | 1.00 | 0.2247 | 0.006 | 0.0013 | 23.6 |
| 3 | 16:08 | 1.50 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1957 | 1.00 | 0.1957 | 0.008 | 0.0016 | 27.5 |
| 4 | 16:10 | 1.40 | 0.6 | 0.060 | 0.6 | 0.024 | 0.1195 | 1.00 | 0.1195 | 0.006 | 0.0007 | 12.6 |
| 5 | 16:12 | 1.30 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1069 | 1.00 | 0.1069 | 0.008 | 0.0009 | 15.0 |
| 6 | 16:14 | 1.20 | 0.6 | 0.040 | 0.6 | 0.016 | 0.0218 | 1.00 | 0.0218 | 0.004 | 0.0001 | 1.5 |
| 7 | 16:14 | 1.10 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

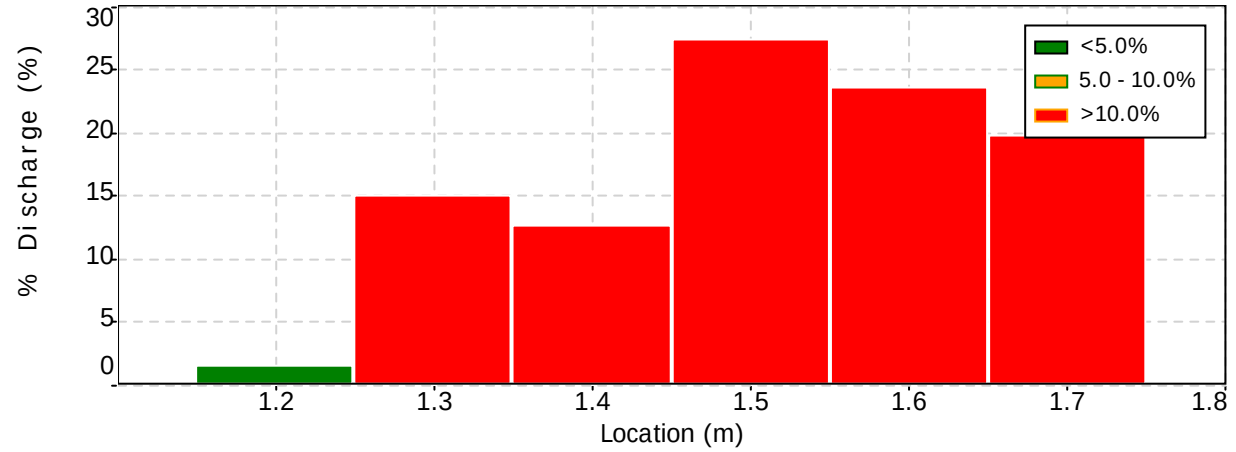
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

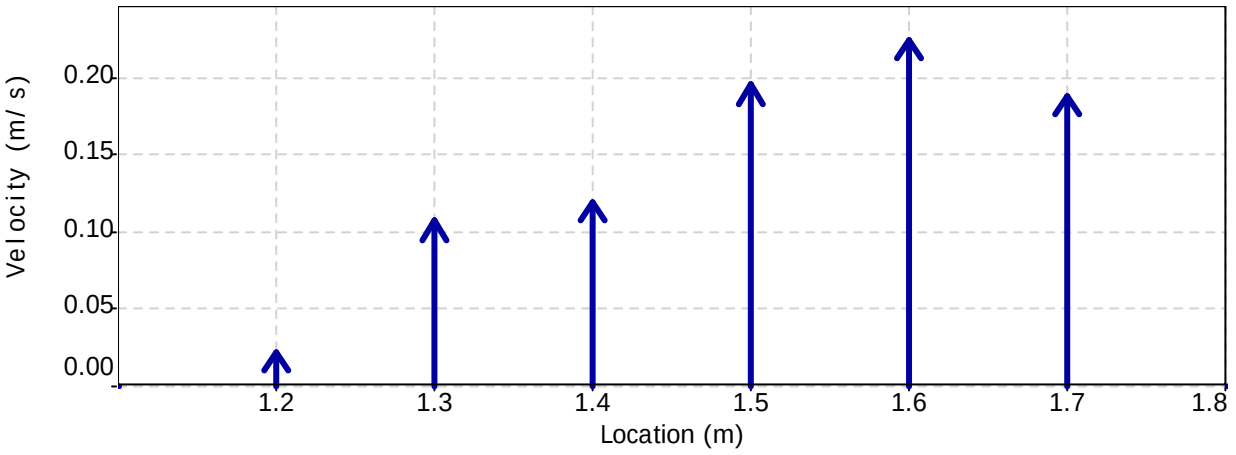
# Discharge Measurement Summary

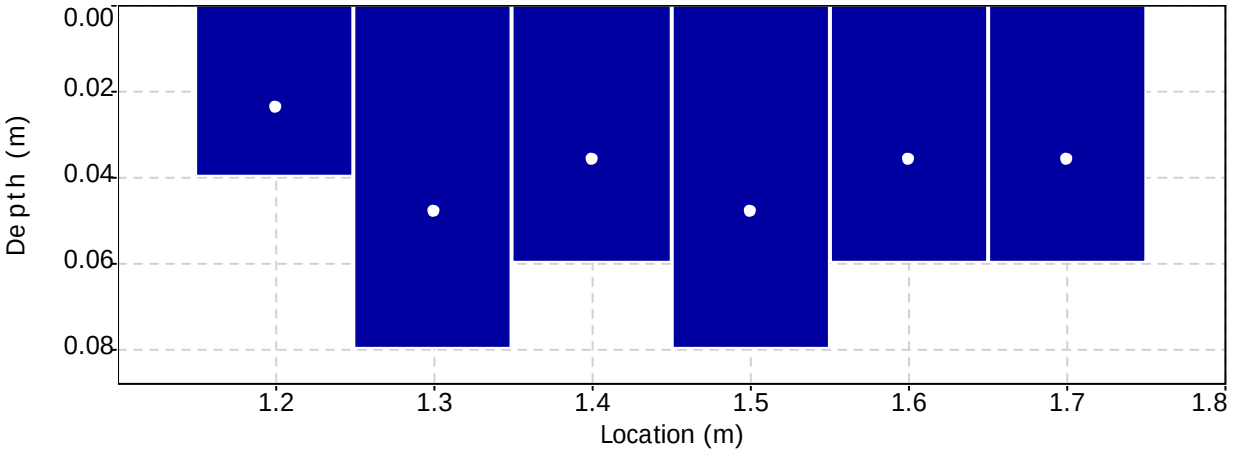
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/09/17 16:05:48 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/09/17 16:05:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 5 | 1.30 | 0.6 | Boundary QC is Good; possible boundary interference |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

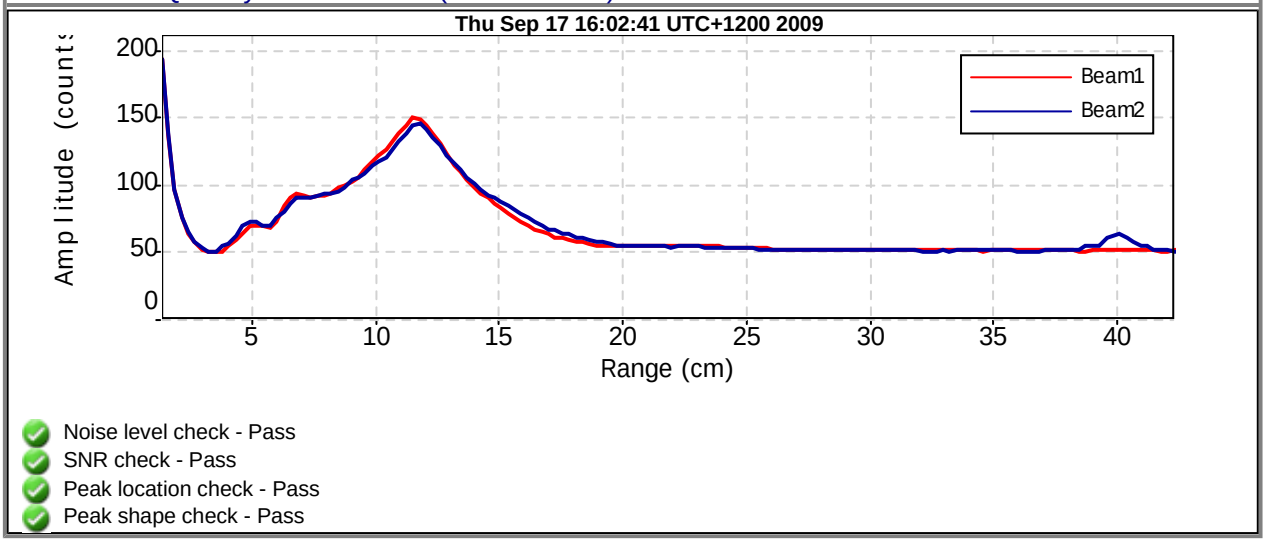
## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/09/17 16:05:48 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/10/09 09:59:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.6% | 2.9% |
| Velocity | 2.0% | 14.6% |
| Width | 0.2% | 0.2% |
| Method | 3.2% | - |
| # Stations | 5.8% | - |
| Overall | 7.0% | 14.9% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 9 |
| Start Edge | REW | Total Width | 0.450 |
| Mean SNR | 39.9 dB | Total Area | 0.035 |
| Mean Temp | 13.06 °C | Mean Depth | 0.078 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2902 |
| | | Total Discharge | 0.0102 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 09:59 | 0.30 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 09:59 | 0.35 | 0.6 | 0.080 | 0.6 | 0.032 | 0.4922 | 1.00 | 0.4922 | 0.004 | 0.0020 | 19.4 |
| 2 | 10:00 | 0.40 | 0.6 | 0.080 | 0.6 | 0.032 | 0.4846 | 1.00 | 0.4846 | 0.004 | 0.0019 | 19.1 |
| 3 | 10:02 | 0.45 | 0.6 | 0.080 | 0.6 | 0.032 | 0.5873 | 1.00 | 0.5873 | 0.004 | 0.0023 | 23.1 |
| 4 | 10:03 | 0.50 | 0.6 | 0.100 | 0.6 | 0.040 | 0.3008 | 1.00 | 0.3008 | 0.005 | 0.0015 | 14.8 |
| 5 | 10:05 | 0.55 | 0.6 | 0.110 | 0.6 | 0.044 | 0.2408 | 1.00 | 0.2408 | 0.006 | 0.0013 | 13.0 |
| 6 | 10:07 | 0.60 | 0.6 | 0.100 | 0.6 | 0.040 | 0.2801 | 1.00 | 0.2801 | 0.005 | 0.0014 | 13.8 |
| 7 | 10:08 | 0.65 | 0.6 | 0.100 | 0.6 | 0.040 | -0.0436 | 1.00 | -0.0436 | 0.008 | -0.0003 | -3.2 |
| 8 | 10:08 | 0.75 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

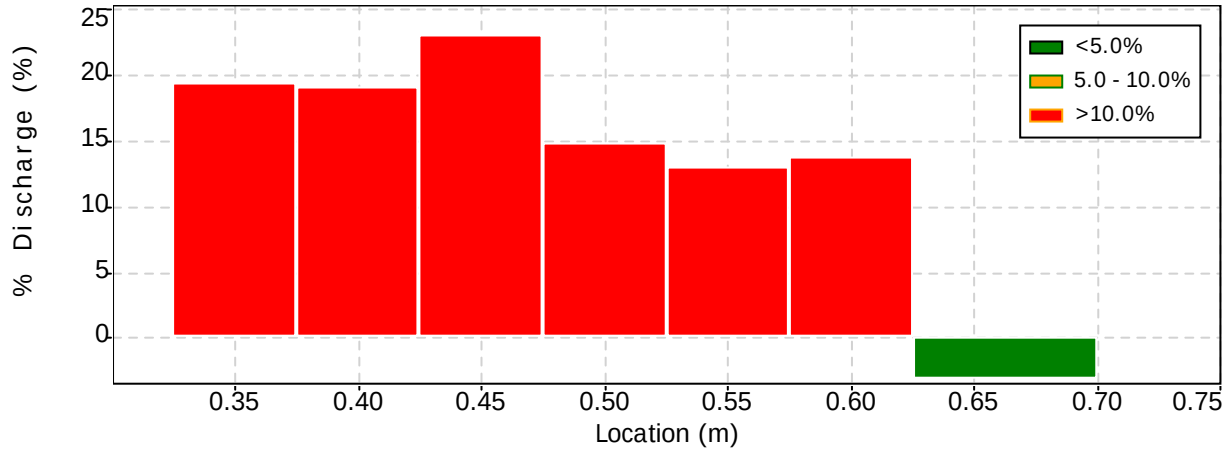
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

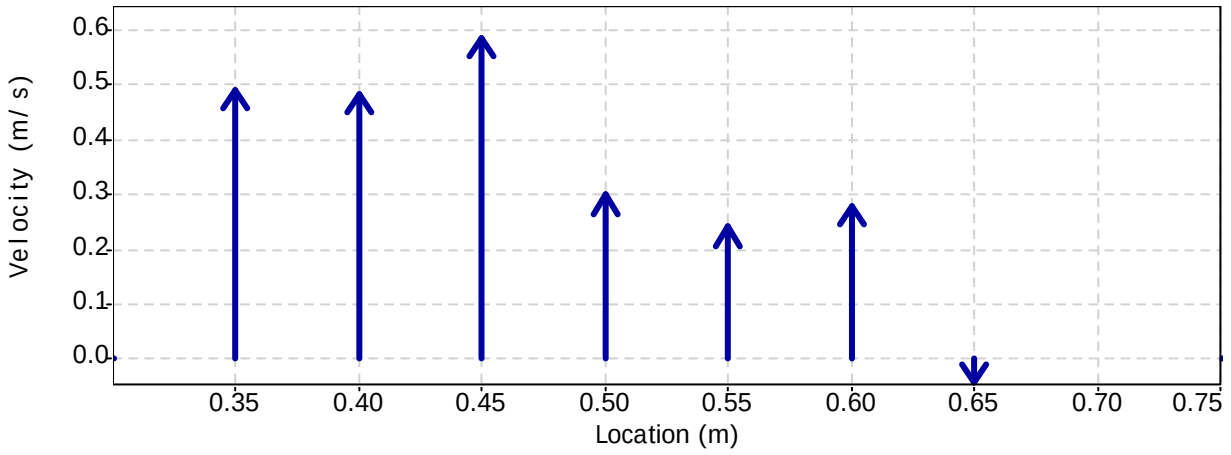
# Discharge Measurement Summary

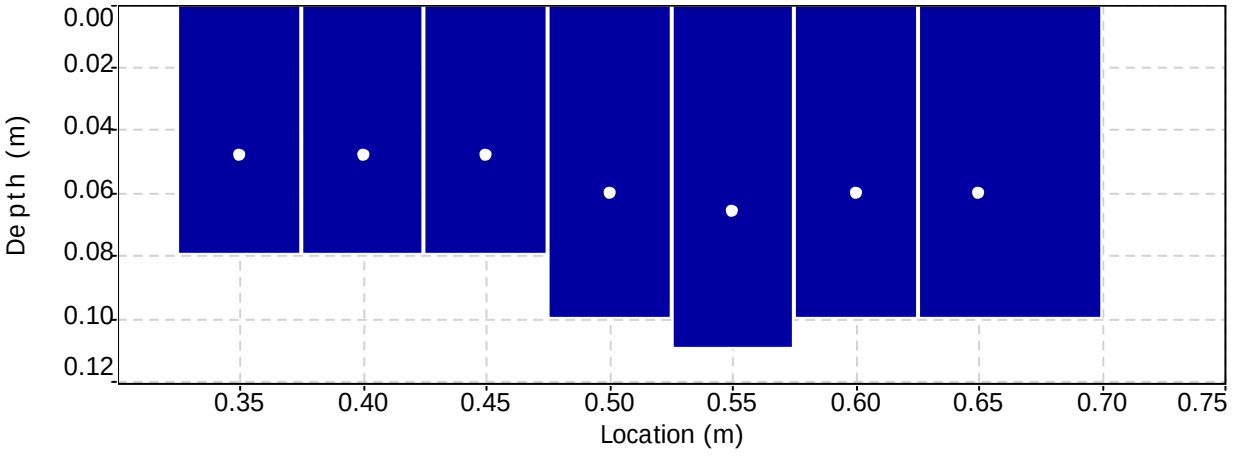
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/10/09 09:59:24 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/10/09 09:59:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 7 | 0.65 | 0.6 | High angle: -150 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

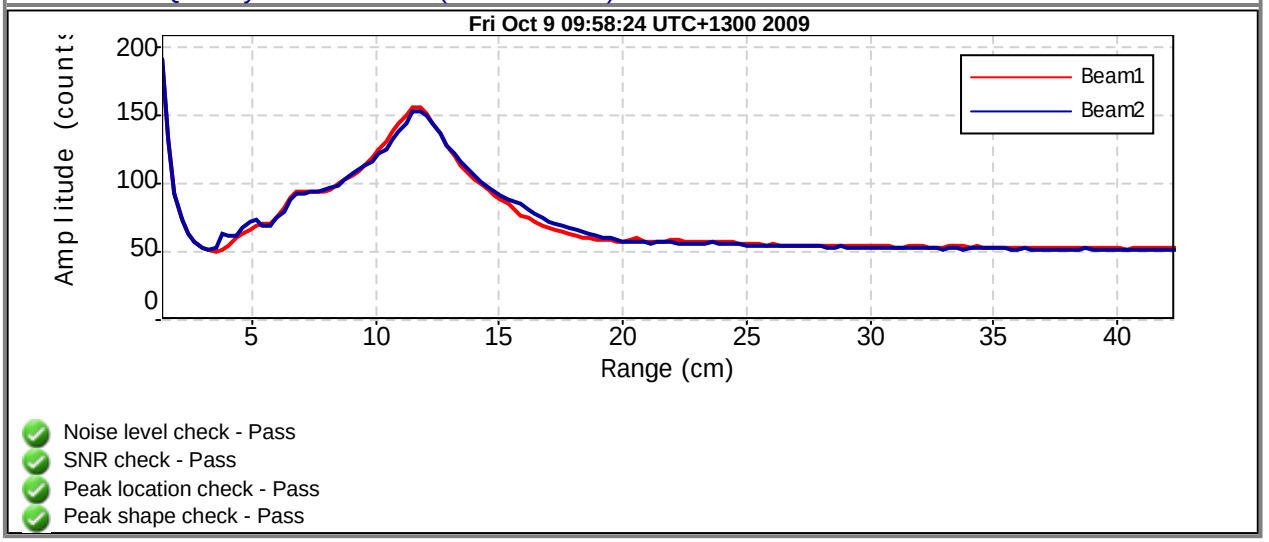
## File Information

| | |
|---|---|
| File Name | TUISW5.WAD |
| Start Date and Time | 2009/10/09 09:59:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/10/08 09:53:58 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.5% | 7.4% |
| Velocity | 1.7% | 9.5% |
| Width | 0.2% | 0.2% |
| Method | 2.1% | - |
| # Stations | 3.6% | - |
| Overall | 4.6% | 12.0% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 14 |
| Start Edge | LEW | Total Width | 1.550 |
| Mean SNR | 41.5 dB | Total Area | 0.366 |
| Mean Temp | 10.35 °C | Mean Depth | 0.236 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2975 |
| | | Total Discharge | 0.1089 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 09:53 | 1.50 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 09:53 | 1.60 | 0.6 | 0.100 | 0.6 | 0.040 | 0.4496 | 1.00 | 0.4496 | 0.010 | 0.0045 | 4.1 |
| 2 | 09:58 | 1.70 | 0.6 | 0.120 | 0.6 | 0.048 | 0.4681 | 1.00 | 0.4681 | 0.012 | 0.0056 | 5.2 |
| 3 | 10:03 | 1.80 | 0.8/0.2 | 0.280 | 0.2 | 0.224 | 0.4127 | 1.00 | 0.3172 | 0.035 | 0.0111 | 10.2 |
| *3* | *10:01* | *1.80* | *0.8/0.2* | *0.280* | *0.8* | *0.056* | *0.2218* | | | | | |
| 4 | 10:09 | 1.95 | 0.2/0.8 | 0.280 | 0.2 | 0.224 | 0.3350 | 1.00 | 0.3017 | 0.035 | 0.0106 | 9.7 |
| *4* | *10:10* | *1.95* | *0.2/0.8* | *0.280* | *0.8* | *0.056* | *0.2685* | | | | | |
| 5 | 10:18 | 2.05 | 0.8/0.2 | 0.360 | 0.2 | 0.288 | 0.3052 | 1.00 | 0.2750 | 0.036 | 0.0099 | 9.1 |
| *5* | *10:15* | *2.05* | *0.8/0.2* | *0.360* | *0.8* | *0.072* | *0.2449* | | | | | |
| 6 | 10:23 | 2.15 | 0.2/0.6/0.8 | 0.380 | 0.2 | 0.304 | 0.2724 | 1.00 | 0.1731 | 0.038 | 0.0066 | 6.0 |
| *6* | *10:26* | *2.15* | *0.2/0.6/0.8* | *0.380* | *0.6* | *0.152* | *0.1430* | | | | | |
| *6* | *10:24* | *2.15* | *0.2/0.6/0.8* | *0.380* | *0.8* | *0.076* | *0.1339* | | | | | |
| 7 | 10:32 | 2.25 | 0.2/0.8 | 0.360 | 0.2 | 0.288 | 0.2417 | 1.00 | 0.2112 | 0.036 | 0.0076 | 7.0 |
| *7* | *10:34* | *2.25* | *0.2/0.8* | *0.360* | *0.8* | *0.072* | *0.1807* | | | | | |
| 8 | 10:40 | 2.35 | 0.2/0.6/0.8 | 0.400 | 0.2 | 0.160 | 0.1126 | 1.00 | 0.1813 | 0.040 | 0.0073 | 6.7 |
| *8* | *10:41* | *2.35* | *0.2/0.6/0.8* | *0.400* | *0.6* | *0.160* | *0.1688* | | | | | |
| *8* | *10:39* | *2.35* | *0.2/0.6/0.8* | *0.400* | *0.8* | *0.320* | *0.2751* | | | | | |
| 9 | 10:45 | 2.45 | 0.6 | 0.250 | 0.6 | 0.100 | 0.4809 | 1.00 | 0.4809 | 0.031 | 0.0150 | 13.8 |
| 10 | 10:48 | 2.60 | 0.6 | 0.240 | 0.6 | 0.096 | 0.5901 | 1.00 | 0.5901 | 0.036 | 0.0212 | 19.5 |
| 11 | 10:50 | 2.75 | 0.6 | 0.270 | 0.6 | 0.108 | 0.2306 | 1.00 | 0.2306 | 0.041 | 0.0093 | 8.6 |
| 12 | 10:52 | 2.90 | 0.6 | 0.110 | 0.6 | 0.044 | 0.0135 | 1.00 | 0.0135 | 0.017 | 0.0002 | 0.2 |
| 13 | 10:52 | 3.05 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

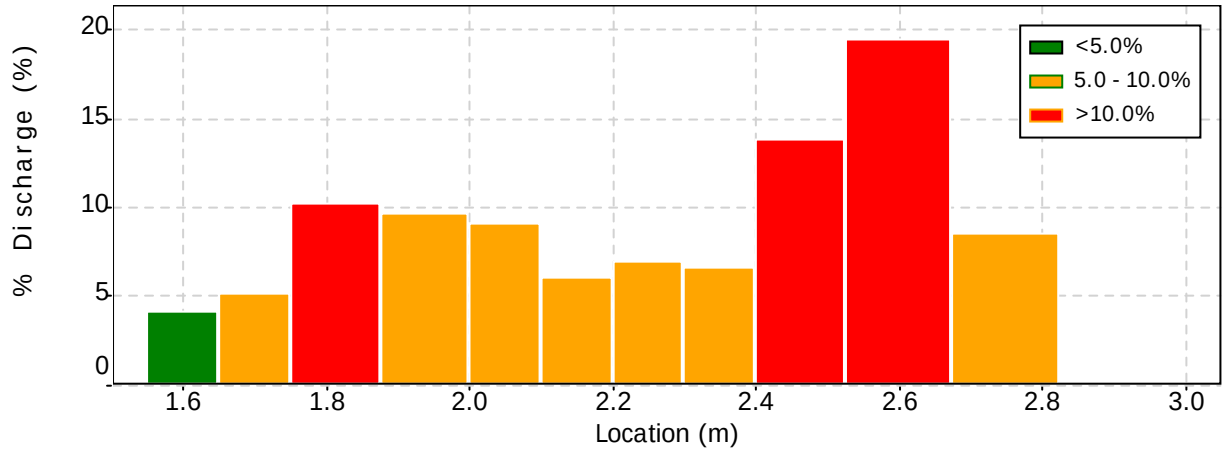
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

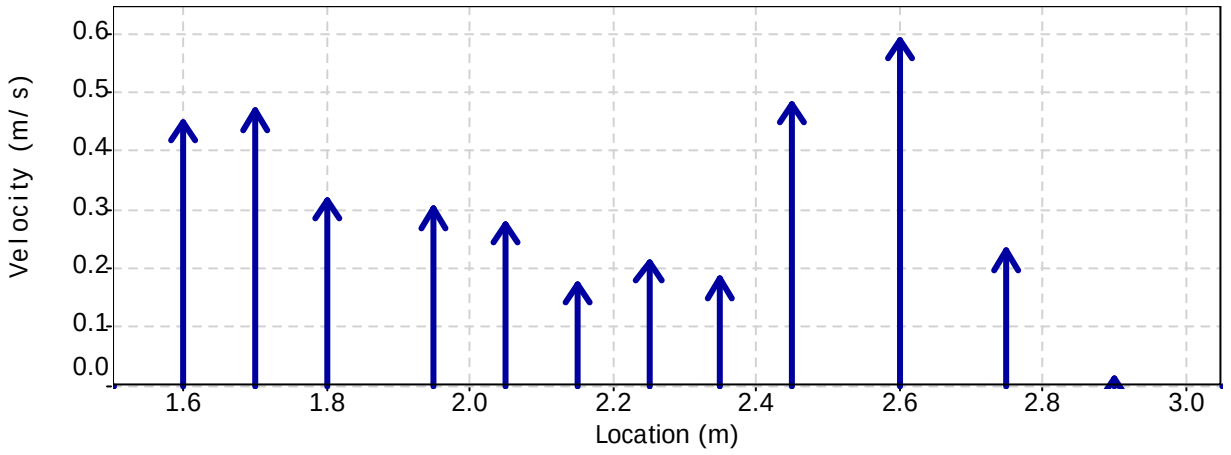
# Discharge Measurement Summary

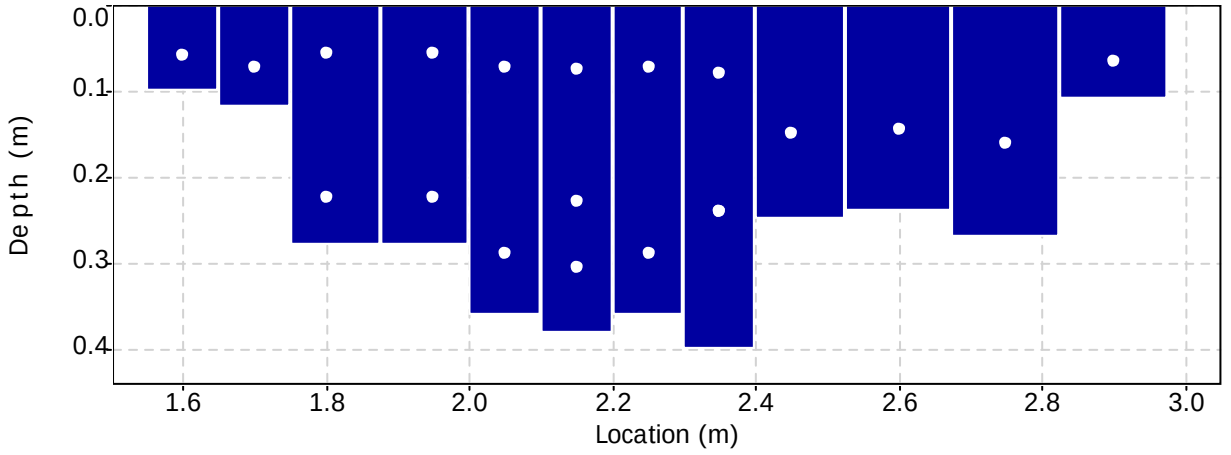
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/10/08 09:53:58 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW7.WAD |
| Start Date and Time | 2009/10/08 09:53:58 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 1 | 1.60 | 0.6 | High standard error: 0.031 |
| 6 | 2.15 | 0.8 | High angle: 21 |
| 7 | 2.25 | 0.2 | High angle: -25 |
| | | 0.8 | High angle: 25 |
| 8 | 2.35 | 0.2 | High angle: 50 |
| | | 0.6 | High angle: 31 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW8.WAD |
| Start Date and Time | 2009/10/08 08:54:27 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.6% | 6.2% |
| Velocity | 1.6% | 9.3% |
| Width | 0.2% | 0.2% |
| Method | 3.0% | - |
| # Stations | 4.2% | - |
| Overall | 5.5% | 11.3% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 12 |
| Start Edge | LEW | Total Width | 5.600 |
| Mean SNR | 34.8 dB | Total Area | 0.633 |
| Mean Temp | 8.73 °C | Mean Depth | 0.113 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1956 |
| | | Total Discharge | 0.1237 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 08:54 | 0.60 | None | 0.090 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0070 | 0.009 | 0.0001 | 0.1 |
| 1 | 08:54 | 0.80 | 0.6 | 0.160 | 0.6 | 0.064 | 0.0070 | 1.00 | 0.0070 | 0.032 | 0.0002 | 0.2 |
| 2 | 08:59 | 1.00 | 0.6 | 0.160 | 0.6 | 0.064 | 0.0591 | 1.00 | 0.0591 | 0.044 | 0.0026 | 2.1 |
| 3 | 09:02 | 1.35 | 0.6 | 0.230 | 0.6 | 0.092 | 0.2137 | 1.00 | 0.2137 | 0.115 | 0.0246 | 19.9 |
| 4 | 09:05 | 2.00 | 0.6 | 0.170 | 0.6 | 0.068 | 0.3217 | 1.00 | 0.3217 | 0.098 | 0.0314 | 25.4 |
| 5 | 09:08 | 2.50 | 0.6 | 0.140 | 0.6 | 0.056 | 0.2007 | 1.00 | 0.2007 | 0.081 | 0.0162 | 13.1 |
| 6 | 09:12 | 3.15 | 0.6 | 0.110 | 0.6 | 0.044 | 0.1848 | 1.00 | 0.1848 | 0.074 | 0.0137 | 11.1 |
| 7 | 09:16 | 3.85 | 0.6 | 0.080 | 0.6 | 0.032 | 0.2429 | 1.00 | 0.2429 | 0.038 | 0.0092 | 7.5 |
| 8 | 09:18 | 4.10 | 0.6 | 0.060 | 0.6 | 0.024 | 0.1554 | 1.00 | 0.1554 | 0.020 | 0.0030 | 2.4 |
| 9 | 09:20 | 4.50 | 0.6 | 0.060 | 0.6 | 0.024 | 0.1785 | 1.00 | 0.1785 | 0.038 | 0.0067 | 5.4 |
| 10 | 09:25 | 5.35 | 0.6 | 0.100 | 0.6 | 0.040 | 0.1881 | 1.00 | 0.1881 | 0.085 | 0.0160 | 12.9 |
| 11 | 09:25 | 6.20 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

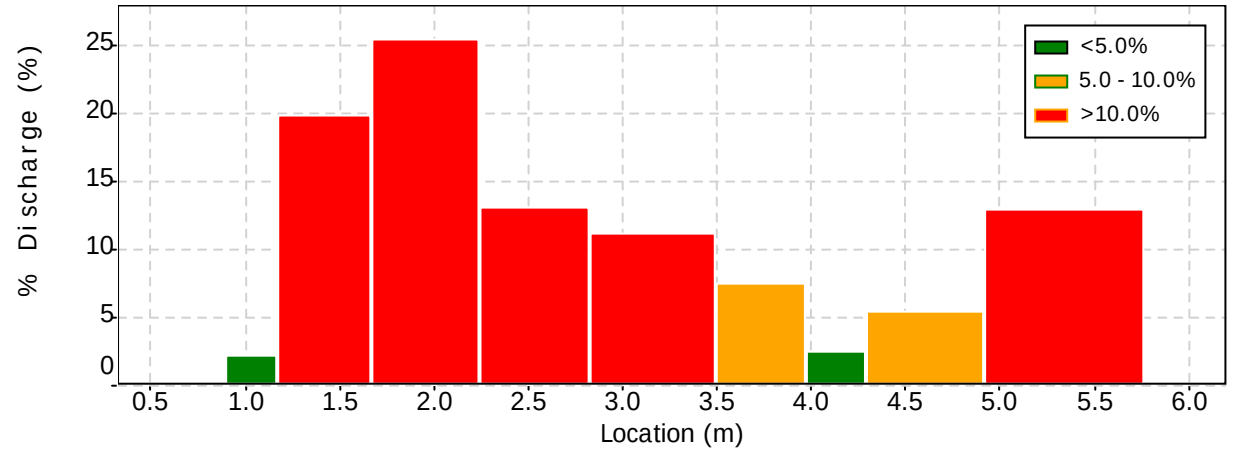
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

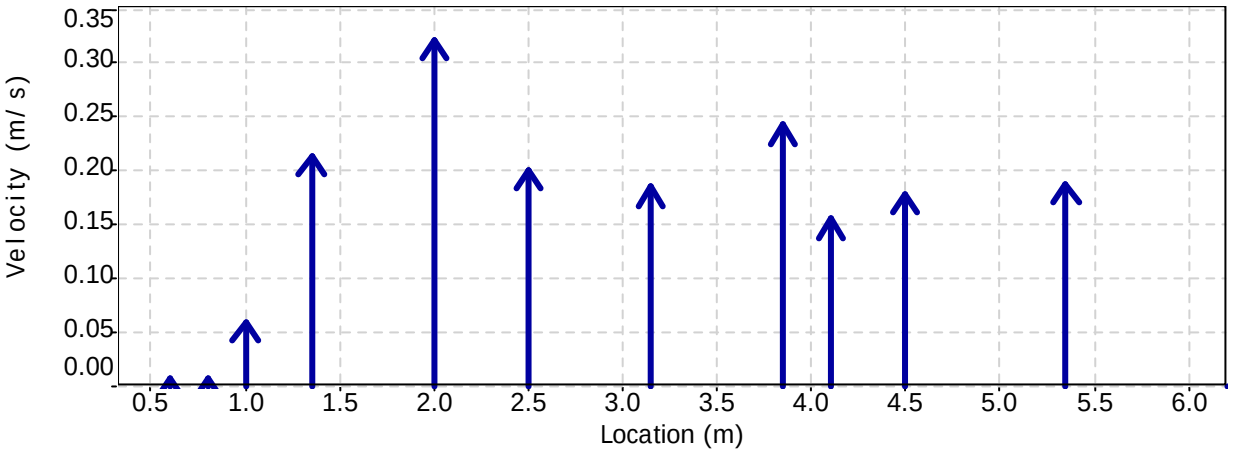
# Discharge Measurement Summary

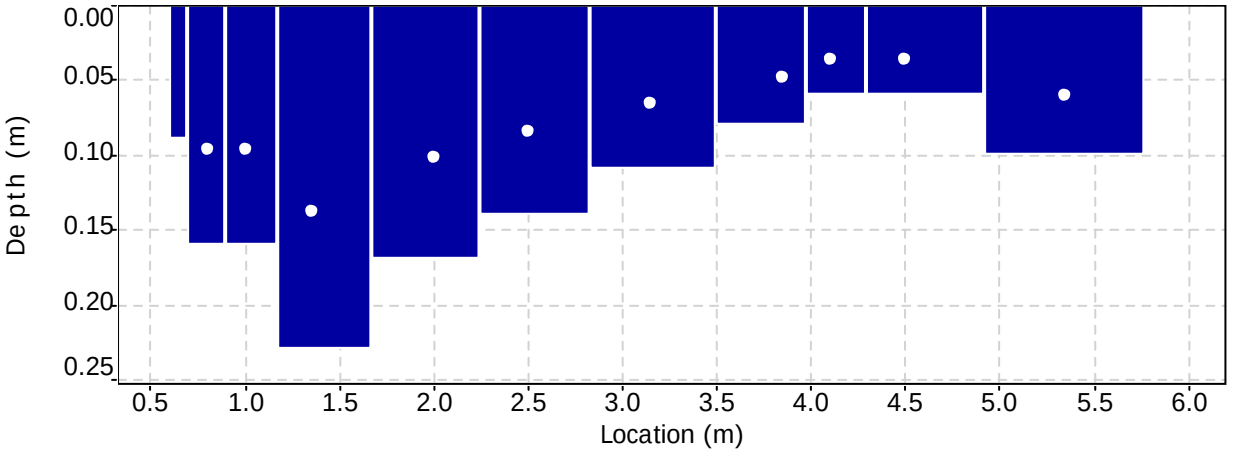
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW8.WAD |
| Start Date and Time | 2009/10/08 08:54:27 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW8.WAD |
| Start Date and Time | 2009/10/08 08:54:27 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 2 | 1.00 | 0.6 | High angle: 31 |
| 4 | 2.00 | 0.6 | High angle: -32 |
| 5 | 2.50 | 0.6 | High angle: -24 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

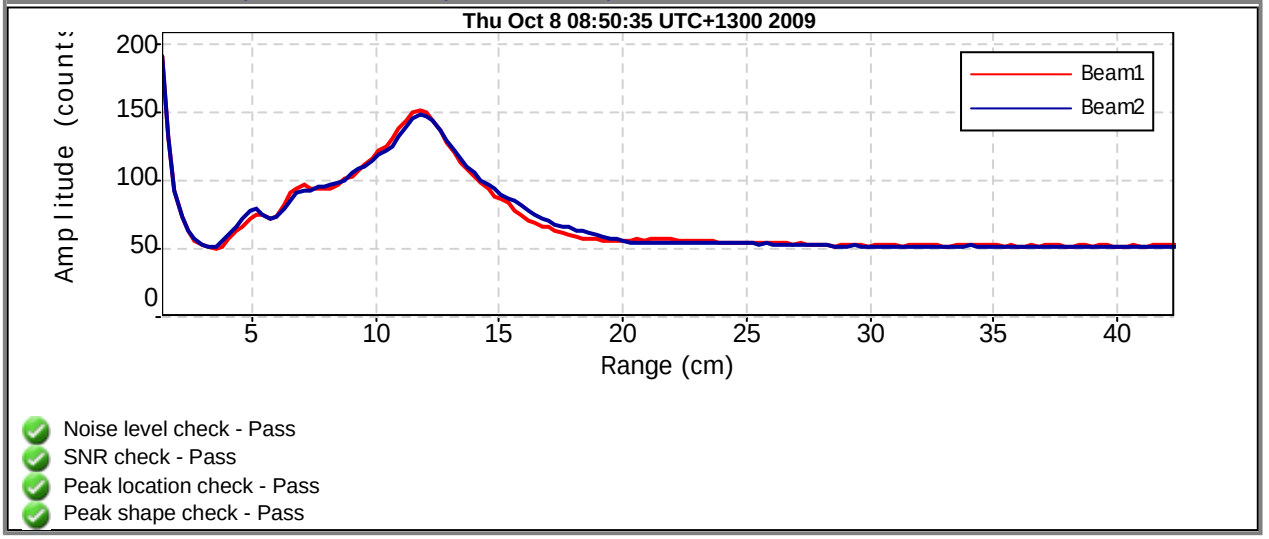
## File Information

| | |
|---|---|
| File Name | TUISW8.WAD |
| Start Date and Time | 2009/10/08 08:54:27 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW11.WAD |
| Start Date and Time | 2009/10/08 18:06:37 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 1.3% | 3.0% |
| Velocity | 2.9% | 17.7% |
| Width | 0.4% | 0.4% |
| Method | 6.3% | - |
| # Stations | 9.4% | - |
| Overall | 11.8% | 18.0% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 6 |
| Start Edge | LEW | Total Width | 0.350 |
| Mean SNR | 40.8 dB | Total Area | 0.018 |
| Mean Temp | 11.66 °C | Mean Depth | 0.051 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1091 |
| | | Total Discharge | 0.0020 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 18:06 | 0.75 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 18:09 | 0.65 | 0.6 | 0.060 | 0.6 | 0.024 | -0.0020 | 1.00 | -0.0020 | 0.005 | 0.0000 | -0.5 |
| 2 | 18:11 | 0.60 | 0.6 | 0.070 | 0.6 | 0.028 | -0.0099 | 1.00 | -0.0099 | 0.004 | 0.0000 | -1.8 |
| 3 | 18:12 | 0.55 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1009 | 1.00 | 0.1009 | 0.004 | 0.0004 | 20.6 |
| 4 | 18:14 | 0.50 | 0.6 | 0.080 | 0.6 | 0.032 | 0.2673 | 1.00 | 0.2673 | 0.006 | 0.0016 | 81.7 |
| 5 | 18:14 | 0.40 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

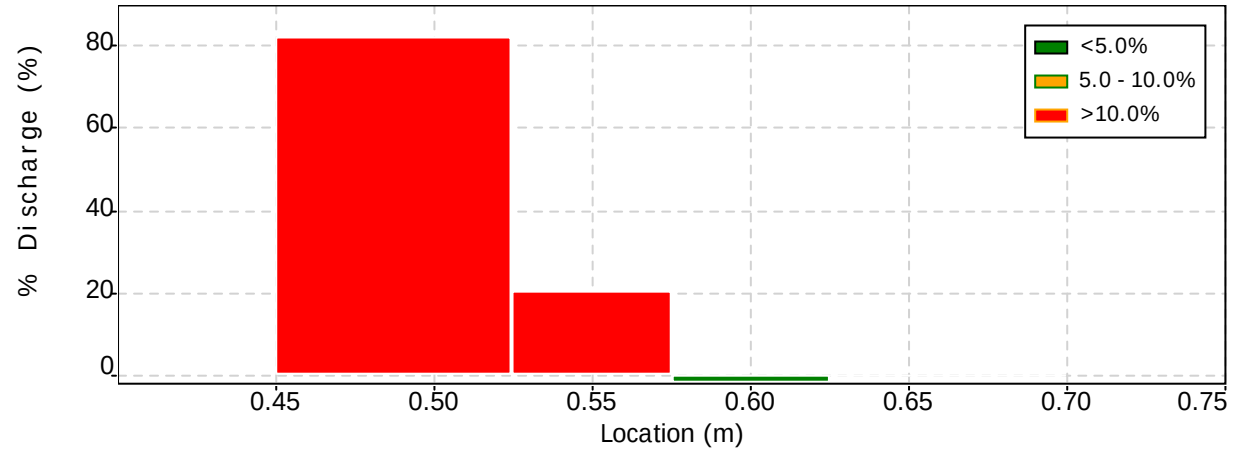
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

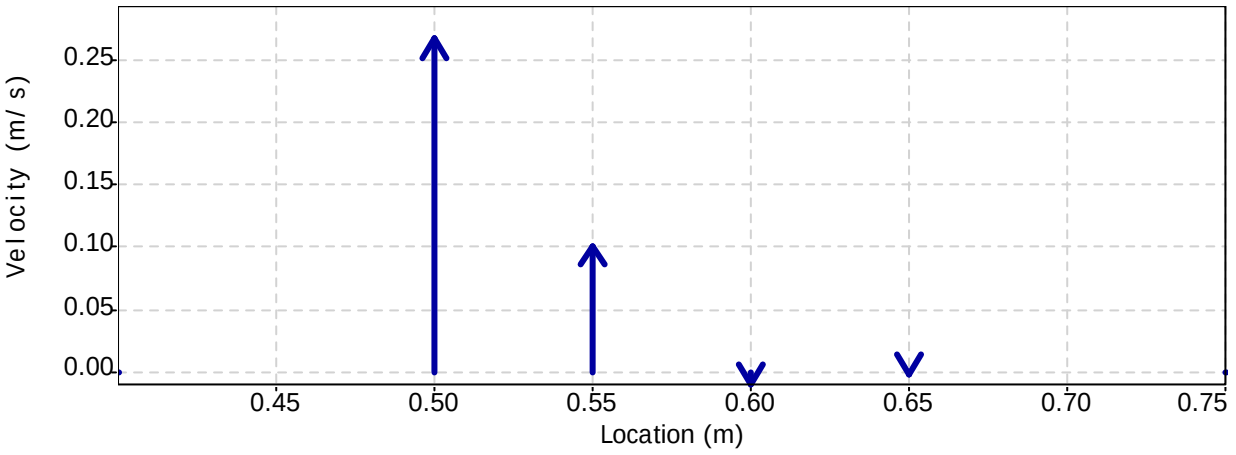
# Discharge Measurement Summary

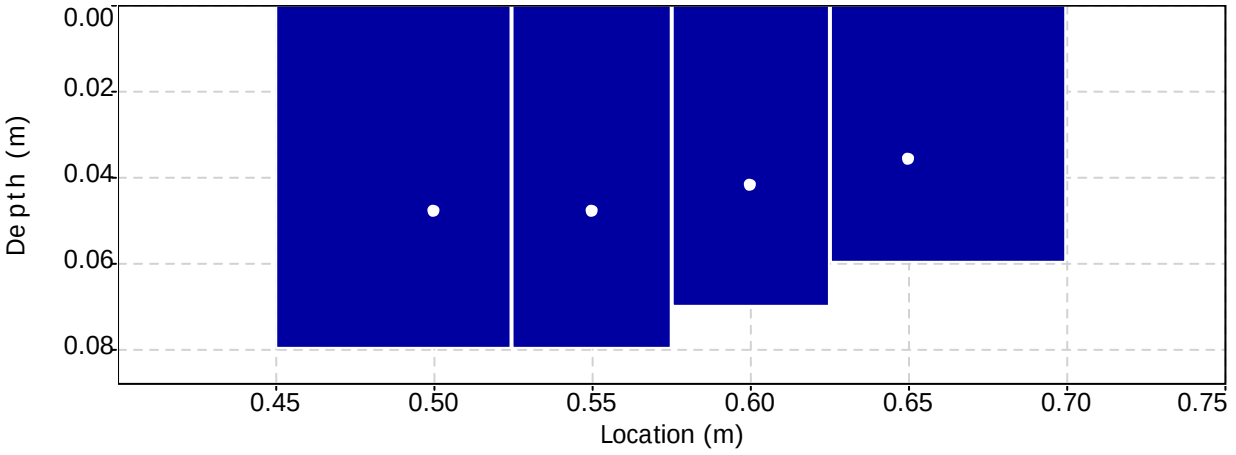
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW11.WAD |
| Start Date and Time | 2009/10/08 18:06:37 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW11.WAD |
| Start Date and Time | 2009/10/08 18:06:37 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 1 | 0.65 | 0.6 | SNR (52.8) is different from typical SNR (40.8) |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/10/08 12:16:43 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.6% | 3.8% |
| Velocity | 1.3% | 2.6% |
| Width | 0.2% | 0.2% |
| Method | 2.5% | - |
| # Stations | 3.9% | - |
| Overall | 4.9% | 4.7% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 13 |
| Start Edge | LEW | Total Width | 2.100 |
| Mean SNR | 39.7 dB | Total Area | 0.323 |
| Mean Temp | 10.67 °C | Mean Depth | 0.154 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2742 |
| | | Total Discharge | 0.0886 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 12:16 | 2.30 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 12:16 | 2.10 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0317 | 1.00 | 0.0317 | 0.016 | 0.0005 | 0.6 |
| 2 | 12:20 | 1.90 | 0.6 | 0.120 | 0.6 | 0.048 | 0.1218 | 1.00 | 0.1218 | 0.024 | 0.0029 | 3.3 |
| 3 | 12:27 | 1.70 | 0.6 | 0.150 | 0.6 | 0.060 | 0.2311 | 1.00 | 0.2311 | 0.030 | 0.0069 | 7.8 |
| 4 | 12:29 | 1.50 | 0.6 | 0.230 | 0.6 | 0.092 | 0.2767 | 1.00 | 0.2767 | 0.046 | 0.0127 | 14.4 |
| 5 | 12:34 | 1.30 | 0.8/0.2 | 0.270 | 0.2 | 0.216 | 0.3593 | 1.00 | 0.3216 | 0.054 | 0.0174 | 19.6 |
| *5* | *12:32* | *1.30* | *0.8/0.2* | *0.270* | *0.8* | *0.054* | *0.2839* | | | | | |
| 6 | 12:38 | 1.10 | 0.6 | 0.260 | 0.6 | 0.104 | 0.3935 | 1.00 | 0.3935 | 0.039 | 0.0153 | 17.3 |
| 7 | 12:41 | 1.00 | 0.6 | 0.220 | 0.6 | 0.088 | 0.3737 | 1.00 | 0.3737 | 0.022 | 0.0082 | 9.3 |
| 8 | 12:43 | 0.90 | 0.6 | 0.240 | 0.6 | 0.096 | 0.3577 | 1.00 | 0.3577 | 0.024 | 0.0086 | 9.7 |
| 9 | 12:46 | 0.80 | 0.6 | 0.180 | 0.6 | 0.072 | 0.3613 | 1.00 | 0.3613 | 0.036 | 0.0130 | 14.7 |
| 10 | 12:49 | 0.50 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1388 | 1.00 | 0.1388 | 0.020 | 0.0028 | 3.1 |
| 11 | 12:50 | 0.30 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0142 | 1.00 | 0.0142 | 0.012 | 0.0002 | 0.2 |
| 12 | 12:50 | 0.20 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

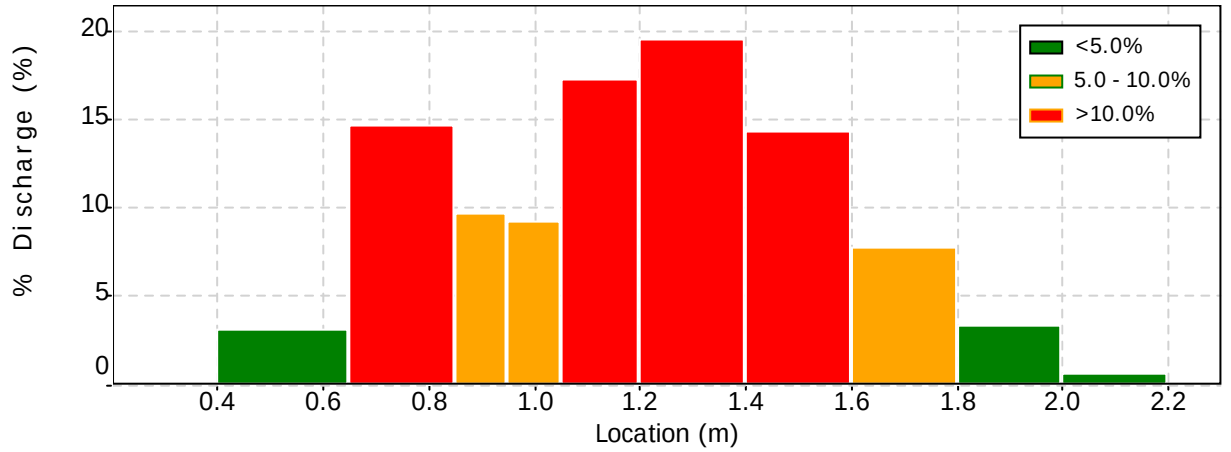
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

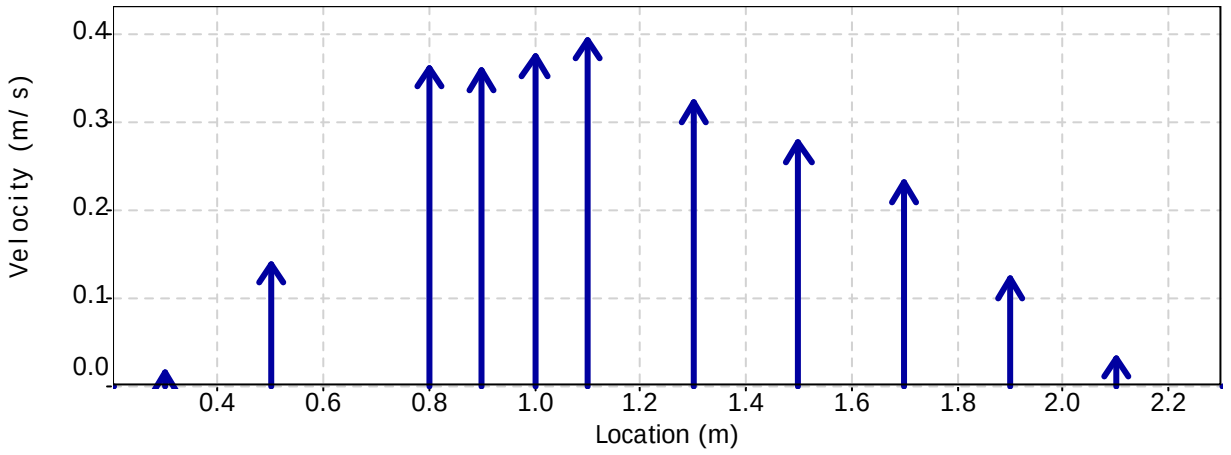
# Discharge Measurement Summary

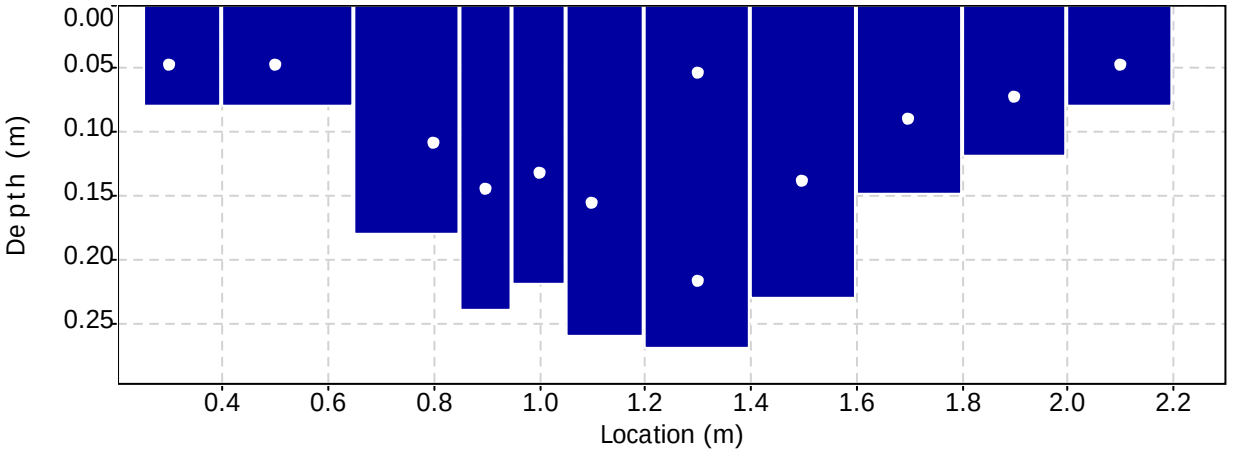
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/10/08 12:16:43 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW13.WAD |
| Start Date and Time | 2009/10/08 12:16:43 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 9 | 0.80 | 0.6 | High angle: -26 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/10/08 14:48:54 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.8% | 2.8% |
| Velocity | 2.3% | 10.9% |
| Width | 0.3% | 0.3% |
| Method | 3.9% | - |
| # Stations | 5.8% | - |
| Overall | 7.5% | 11.3% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 9 |
| Start Edge | REW | Total Width | 1.200 |
| Mean SNR | 40.6 dB | Total Area | 0.082 |
| Mean Temp | 10.53 °C | Mean Depth | 0.068 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.3068 |
| | | Total Discharge | 0.0251 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 14:48 | 1.90 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 14:51 | 1.45 | 0.6 | 0.100 | 0.6 | 0.040 | 0.4079 | 1.00 | 0.4079 | 0.025 | 0.0102 | 40.7 |
| 2 | 14:54 | 1.40 | 0.6 | 0.100 | 0.6 | 0.040 | 0.5744 | 1.00 | 0.5744 | 0.008 | 0.0043 | 17.2 |
| 3 | 14:57 | 1.30 | 0.6 | 0.110 | 0.6 | 0.044 | 0.5934 | 1.00 | 0.5934 | 0.011 | 0.0065 | 26.0 |
| 4 | 15:00 | 1.20 | 0.6 | 0.120 | 0.6 | 0.048 | 0.2700 | 1.00 | 0.2700 | 0.009 | 0.0024 | 9.7 |
| 5 | 15:03 | 1.15 | 0.6 | 0.110 | 0.6 | 0.044 | 0.1240 | 1.00 | 0.1240 | 0.008 | 0.0010 | 4.1 |
| 6 | 15:06 | 1.05 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0910 | 0.00 | 0.0000 | 0.014 | 0.0000 | 0.0 |
| 7 | 15:09 | 0.80 | 0.6 | 0.040 | 0.6 | 0.016 | 0.0849 | 1.00 | 0.0849 | 0.007 | 0.0006 | 2.4 |
| 8 | 15:09 | 0.70 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

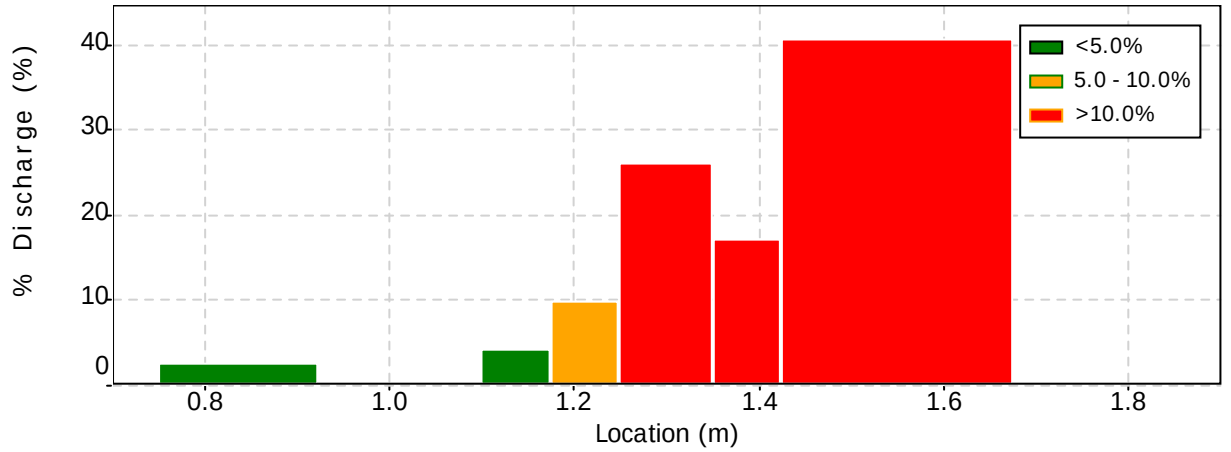
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

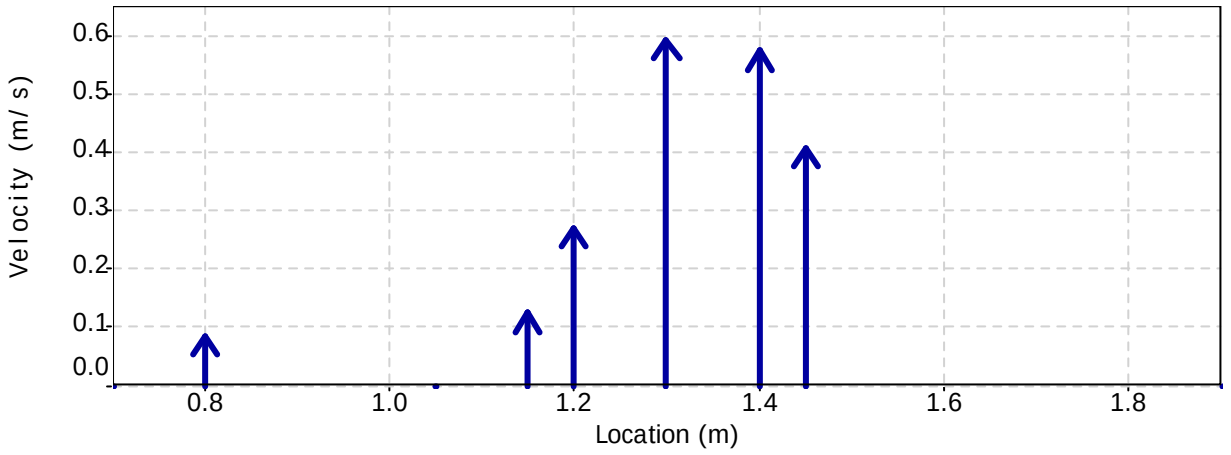
# Discharge Measurement Summary

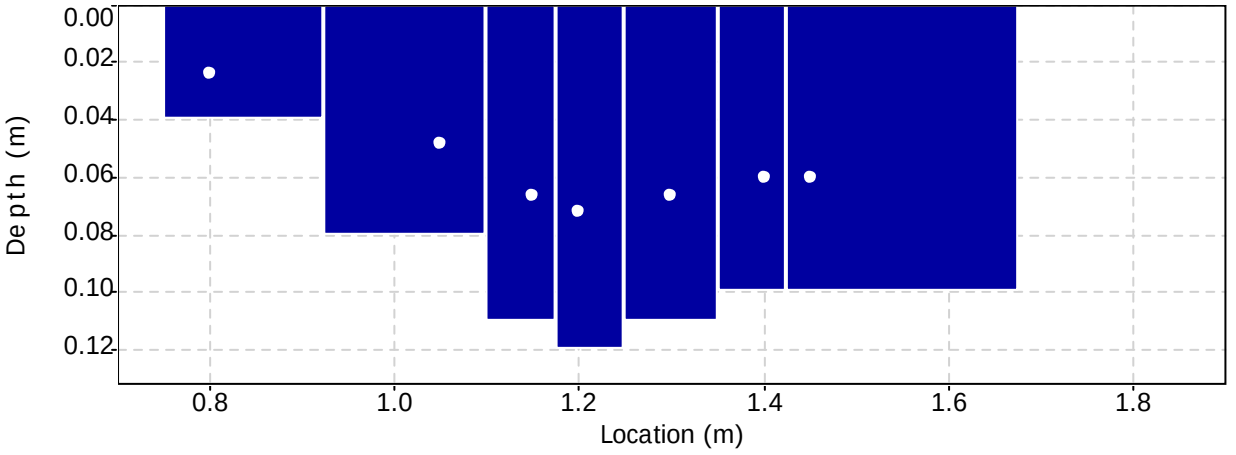
Date Generated: Wed Oct 14 2009

| File Information | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/10/08 14:48:54 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/10/08 14:48:54 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 7 | 0.80 | 0.6 | High angle: 36 |

# Discharge Measurement Summary

Date Generated: Wed Oct 14 2009

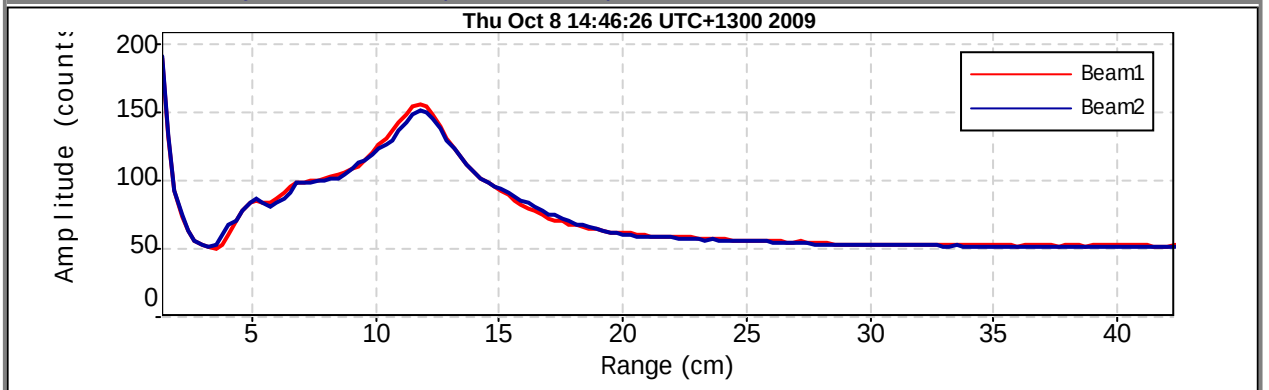
## File Information

| | |
|---|---|
| File Name | TUISW100.WAD |
| Start Date and Time | 2009/10/08 14:48:54 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW5.TUI.WAD |
| Start Date and Time | 2009/11/17 11:52:06 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.7% | 1.3% |
| Velocity | 1.3% | 5.1% |
| Width | 0.2% | 0.2% |
| Method | 3.3% | - |
| # Stations | 5.1% | - |
| Overall | 6.4% | 5.4% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 10 |
| Start Edge | LEW | Total Width | 0.500 |
| Mean SNR | 36.8 dB | Total Area | 0.032 |
| Mean Temp | 13.83 °C | Mean Depth | 0.063 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2563 |
| | | Total Discharge | 0.0081 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 11:52 | 0.60 | None | 0.010 | 0.0 | 0.0 | 0.0000 | 1.00 | -0.0002 | 0.001 | 0.0000 | 0.0 |
| *1* | *11:52* | *0.70* | *0.6* | *0.060* | *0.6* | *0.024* | *-0.0002* | *1.00* | *-0.0002* | *0.005* | *0.0000* | *0.0* |
| 2 | 11:53 | 0.75 | 0.6 | 0.060 | 0.6 | 0.024 | 0.0445 | 1.00 | 0.0445 | 0.003 | 0.0001 | 1.7 |
| 3 | 11:55 | 0.80 | 0.6 | 0.070 | 0.6 | 0.028 | 0.0943 | 1.00 | 0.0943 | 0.004 | 0.0003 | 4.1 |
| 4 | 11:56 | 0.85 | 0.6 | 0.080 | 0.6 | 0.032 | 0.2145 | 1.00 | 0.2145 | 0.004 | 0.0009 | 10.6 |
| 5 | 11:57 | 0.90 | 0.6 | 0.080 | 0.6 | 0.032 | 0.3404 | 1.00 | 0.3404 | 0.004 | 0.0014 | 16.9 |
| 6 | 11:58 | 0.95 | 0.6 | 0.080 | 0.6 | 0.032 | 0.5025 | 1.00 | 0.5025 | 0.004 | 0.0020 | 24.9 |
| 7 | 11:59 | 1.00 | 0.6 | 0.080 | 0.6 | 0.032 | 0.4878 | 1.00 | 0.4878 | 0.004 | 0.0020 | 24.2 |
| 8 | 12:00 | 1.05 | 0.6 | 0.080 | 0.6 | 0.032 | 0.3576 | 1.00 | 0.3576 | 0.004 | 0.0014 | 17.7 |
| 9 | 12:00 | 1.10 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

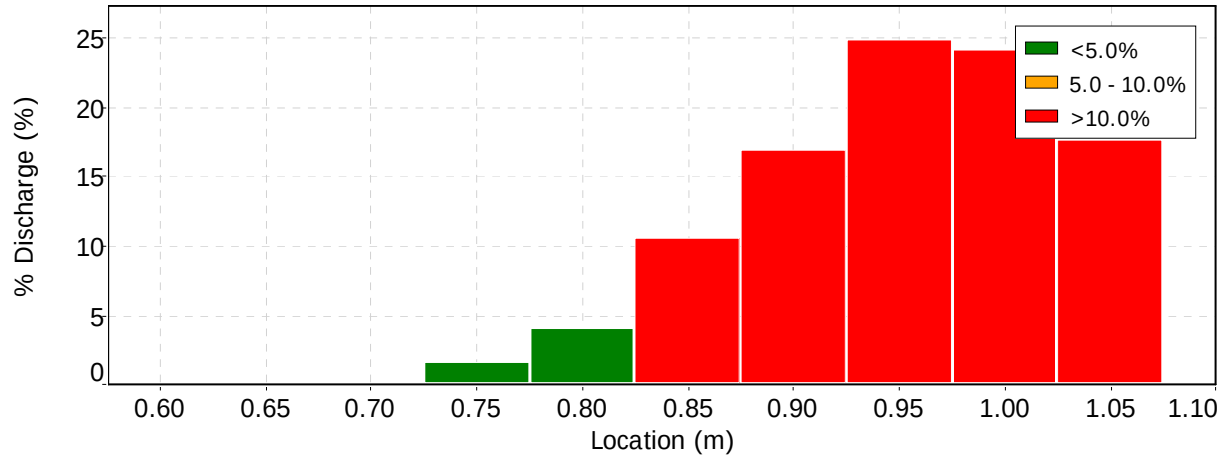
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

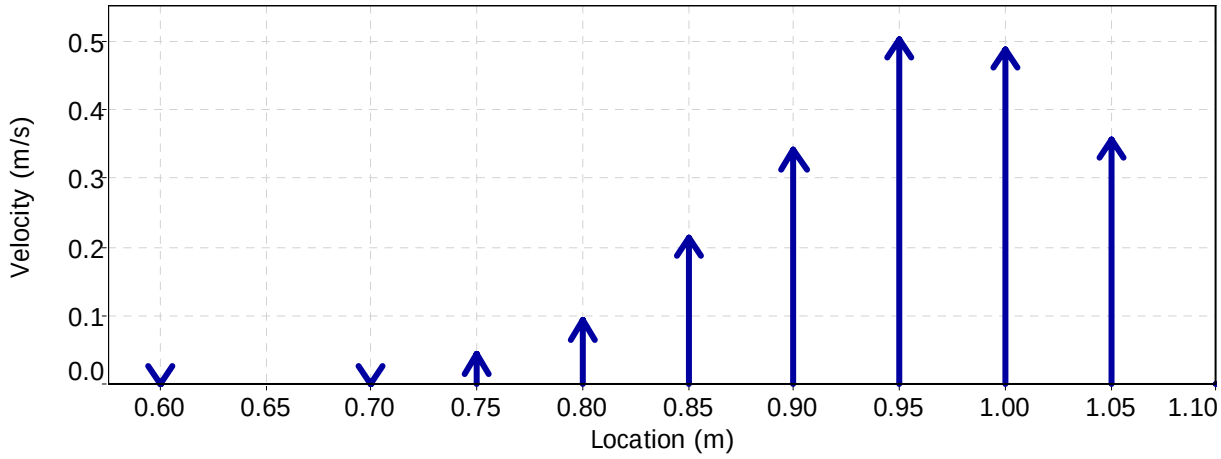
# Discharge Measurement Summary

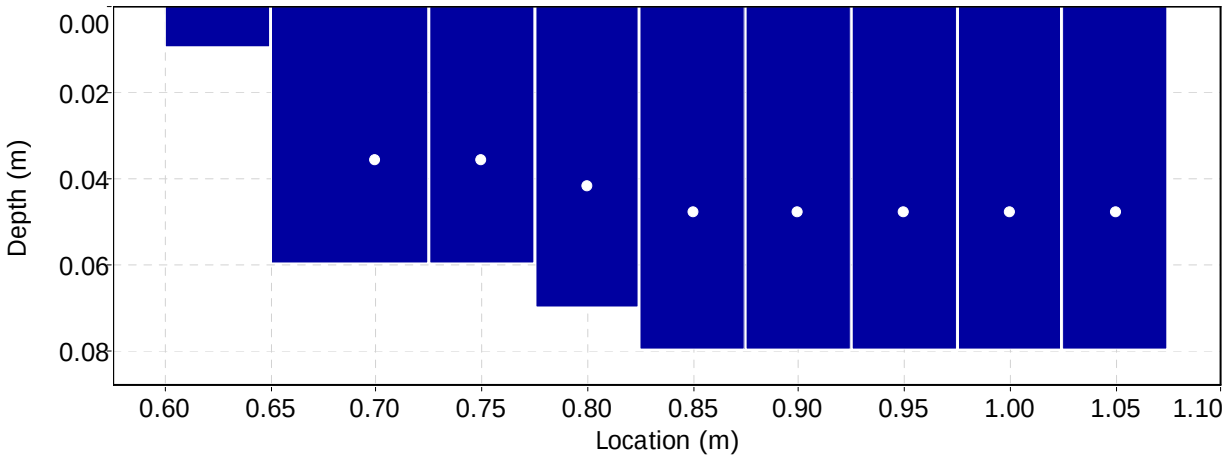
Date Generated: Wed Nov 18 2009

| File Information | |
|---|---|
| File Name | SW5.TUI.WAD |
| Start Date and Time | 2009/11/17 11:52:06 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW5.TUI.WAD |
| Start Date and Time | 2009/11/17 11:52:06 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 1 | 0.70 | 0.6 | SNR (60.0) is different from typical SNR (36.8) |

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

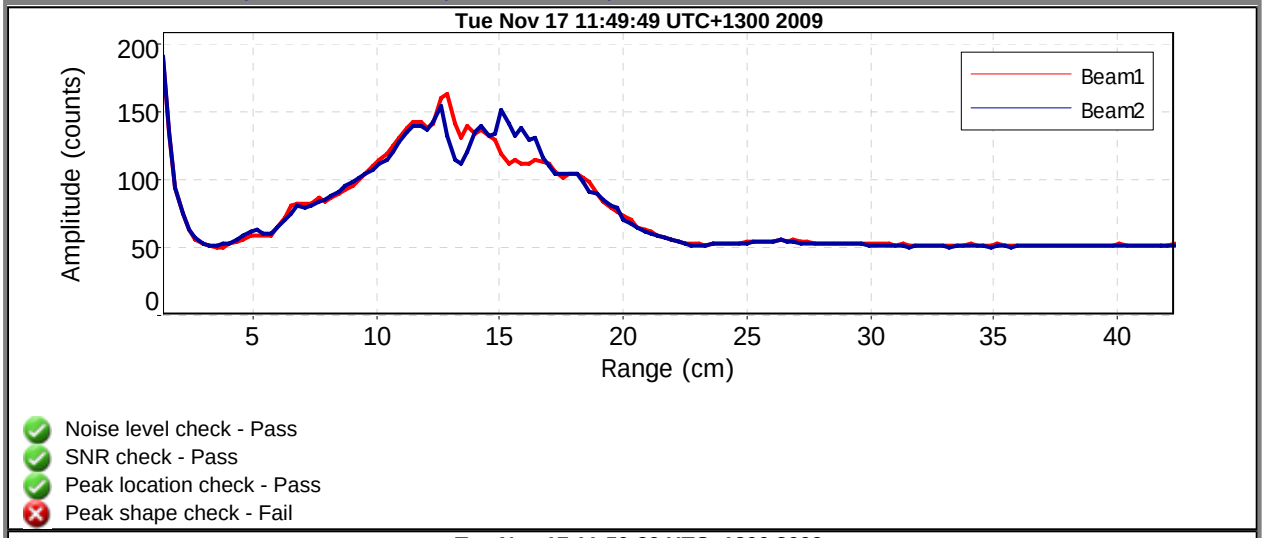
## File Information

| | |
|---|---|
| File Name | SW5.TUI.WAD |
| Start Date and Time | 2009/11/17 11:52:06 |

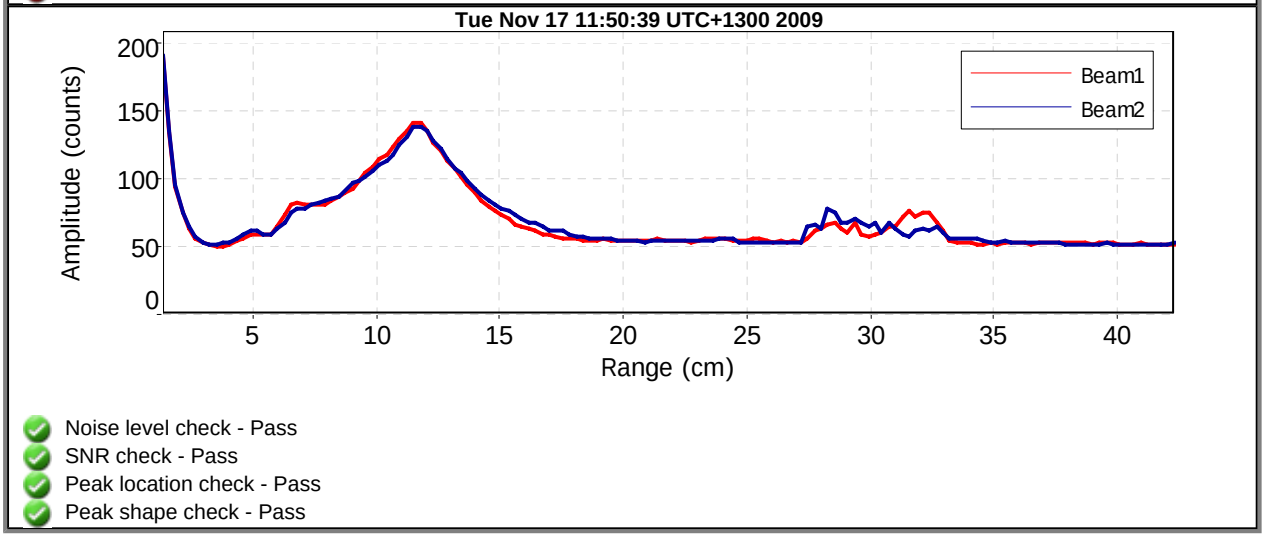
## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Fail




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW7.TUI.WAD |
| Start Date and Time | 2009/11/17 08:02:32 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.6% | 5.0% |
| Velocity | 3.5% | 10.3% |
| Width | 0.2% | 0.2% |
| Method | 2.9% | - |
| # Stations | 6.6% | - |
| Overall | 8.1% | 11.5% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 8 |
| Start Edge | LEW | Total Width | 0.700 |
| Mean SNR | 38.4 dB | Total Area | 0.104 |
| Mean Temp | 11.04 °C | Mean Depth | 0.149 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1904 |
| | | Total Discharge | 0.0198 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 08:02 | 0.50 | None | 0.160 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.2752 | 0.008 | 0.0022 | 11.1 |
| 1 | 08:02 | 0.60 | 0.6 | 0.160 | 0.6 | 0.064 | 0.2752 | 1.00 | 0.2752 | 0.016 | 0.0044 | 22.2 |
| 2 | 08:05 | 0.70 | 0.6 | 0.210 | 0.6 | 0.084 | 0.1207 | 1.00 | 0.1207 | 0.021 | 0.0025 | 12.8 |
| 3 | 08:07 | 0.80 | 0.6 | 0.180 | 0.6 | 0.072 | 0.1326 | 1.00 | 0.1326 | 0.018 | 0.0024 | 12.1 |
| 4 | 08:09 | 0.90 | 0.6 | 0.180 | 0.6 | 0.072 | 0.2117 | 1.00 | 0.2117 | 0.018 | 0.0038 | 19.2 |
| *5* | *08:10* | *1.00* | *0.6* | *0.130* | *0.6* | *0.052* | *0.2503* | *1.00* | *0.2503* | *0.013* | *0.0033* | *16.4* |
| *6* | *08:12* | *1.10* | *0.6* | *0.100* | *0.6* | *0.040* | *0.1211* | *1.00* | *0.1211* | *0.010* | *0.0012* | *6.1* |
| 7 | 08:12 | 1.20 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

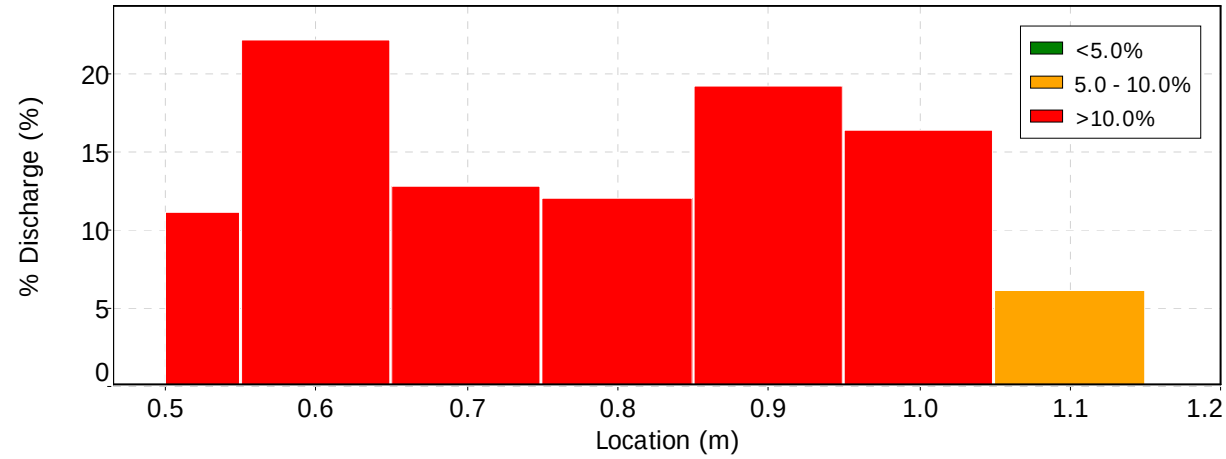
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

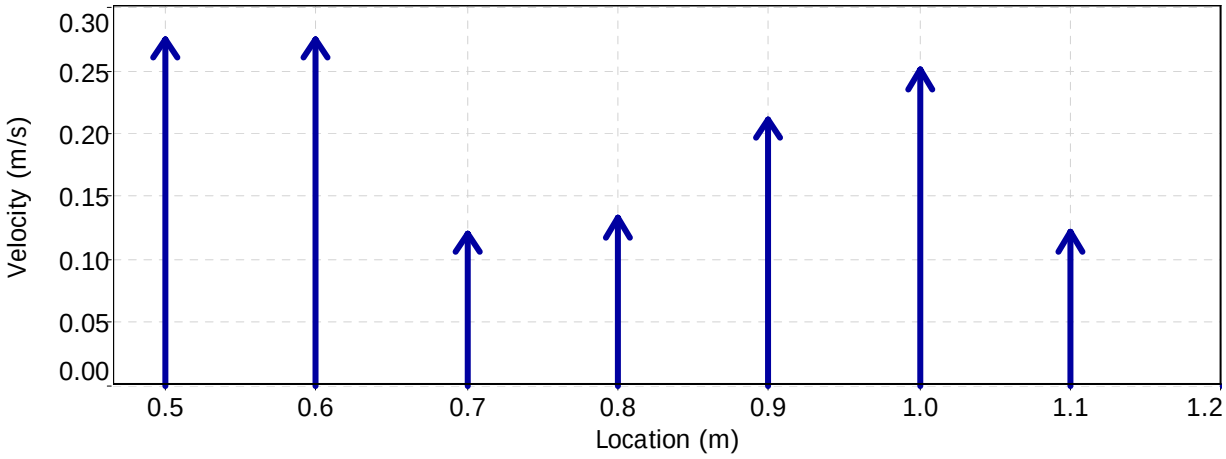
# Discharge Measurement Summary

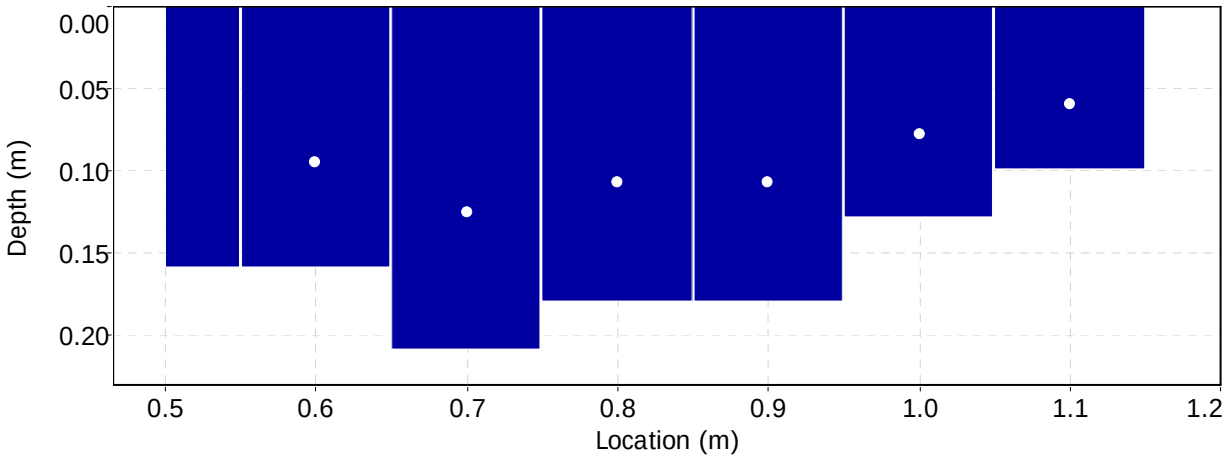
Date Generated: Wed Nov 18 2009

| File Information | |
|---|---|
| File Name | SW7.TUI.WAD |
| Start Date and Time | 2009/11/17 08:02:32 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW7.TUI.WAD |
| Start Date and Time | 2009/11/17 08:02:32 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 5 | 1.00 | 0.6 | High angle: 23 |
| 6 | 1.10 | 0.6 | High angle: 28 |

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW8.TUI.WAD |
| Start Date and Time | 2009/11/17 07:19:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.5% | 3.7% |
| Velocity | 1.8% | 4.9% |
| Width | 0.2% | 0.2% |
| Method | 2.3% | - |
| # Stations | 2.6% | - |
| Overall | 4.1% | 6.2% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 19 |
| Start Edge | LEW | Total Width | 5.000 |
| Mean SNR | 24.7 dB | Total Area | 0.498 |
| Mean Temp | 10.78 °C | Mean Depth | 0.100 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.0766 |
| | | Total Discharge | 0.0382 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 07:19 | 0.70 | None | 0.080 | 0.0 | 0.0 | 0.0000 | 1.00 | -0.0313 | 0.004 | -0.0001 | -0.3 |
| *1* | *07:19* | *0.80* | *0.6* | *0.080* | *0.6* | *0.032* | *-0.0313* | *1.00* | *-0.0313* | *0.012* | *-0.0004* | *-1.0* |
| 2 | 07:21 | 1.00 | 0.6 | 0.150 | 0.6 | 0.060 | -0.0139 | 1.00 | -0.0139 | 0.030 | -0.0004 | -1.1 |
| 3 | 07:23 | 1.20 | 0.6 | 0.190 | 0.6 | 0.076 | 0.0459 | 1.00 | 0.0459 | 0.038 | 0.0017 | 4.6 |
| 4 | 07:25 | 1.40 | 0.6 | 0.180 | 0.6 | 0.072 | 0.0930 | 1.00 | 0.0930 | 0.036 | 0.0033 | 8.8 |
| 5 | 07:26 | 1.60 | 0.6 | 0.180 | 0.6 | 0.072 | 0.1134 | 1.00 | 0.1134 | 0.045 | 0.0051 | 13.4 |
| *6* | *07:29* | *1.90* | *0.6* | *0.130* | *0.6* | *0.052* | *0.1551* | *1.00* | *0.1551* | *0.039* | *0.0060* | *15.8* |
| *7* | *07:31* | *2.20* | *0.6* | *0.150* | *0.6* | *0.060* | *0.0953* | *1.00* | *0.0953* | *0.045* | *0.0043* | *11.2* |
| *8* | *07:33* | *2.50* | *0.6* | *0.150* | *0.6* | *0.060* | *0.0806* | *1.00* | *0.0806* | *0.045* | *0.0036* | *9.5* |
| *9* | *07:35* | *2.80* | *0.6* | *0.100* | *0.6* | *0.040* | *0.0933* | *1.00* | *0.0933* | *0.030* | *0.0028* | *7.3* |
| 10 | 07:37 | 3.10 | 0.6 | 0.080 | 0.6 | 0.032 | 0.0904 | 1.00 | 0.0904 | 0.024 | 0.0022 | 5.7 |
| 11 | 07:38 | 3.40 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1077 | 1.00 | 0.1077 | 0.024 | 0.0026 | 6.8 |
| 12 | 07:40 | 3.70 | 0.6 | 0.080 | 0.6 | 0.032 | 0.1108 | 1.00 | 0.1108 | 0.024 | 0.0027 | 7.0 |
| 13 | 07:41 | 4.00 | 0.6 | 0.060 | 0.6 | 0.024 | 0.0847 | 1.00 | 0.0847 | 0.018 | 0.0015 | 4.0 |
| *14* | *07:43* | *4.30* | *0.6* | *0.050* | *0.6* | *0.020* | *0.0736* | *1.00* | *0.0736* | *0.015* | *0.0011* | *2.9* |
| *15* | *07:45* | *4.60* | *0.6* | *0.040* | *0.6* | *0.016* | *0.0488* | *1.00* | *0.0488* | *0.020* | *0.0010* | *2.6* |
| *16* | *07:47* | *5.30* | *0.6* | *0.065* | *0.6* | *0.026* | *0.0311* | *1.00* | *0.0311* | *0.029* | *0.0009* | *2.4* |
| 17 | 07:49 | 5.50 | 0.6 | 0.100 | 0.6 | 0.040 | 0.0102 | 1.00 | 0.0102 | 0.020 | 0.0002 | 0.5 |
| 18 | 07:49 | 5.70 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

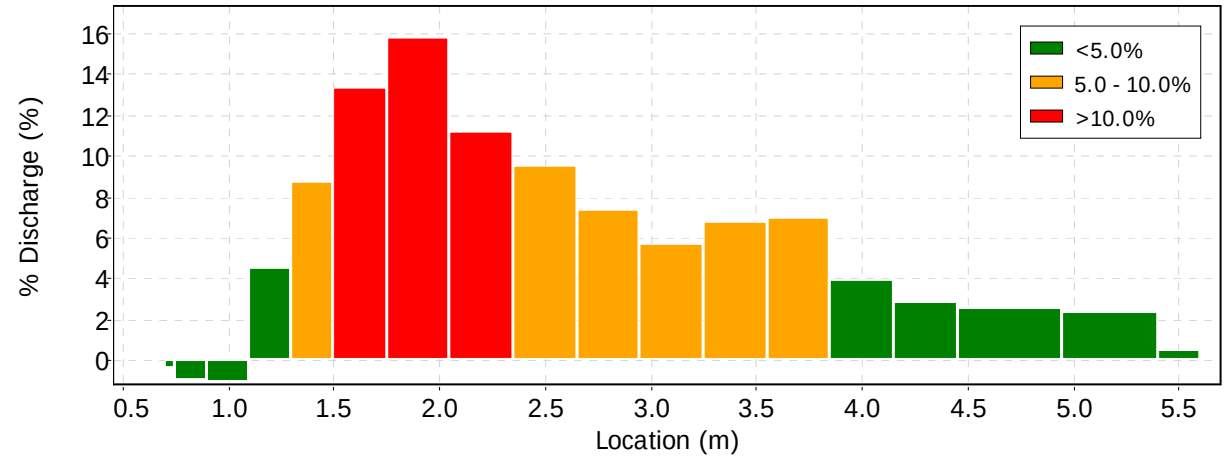
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

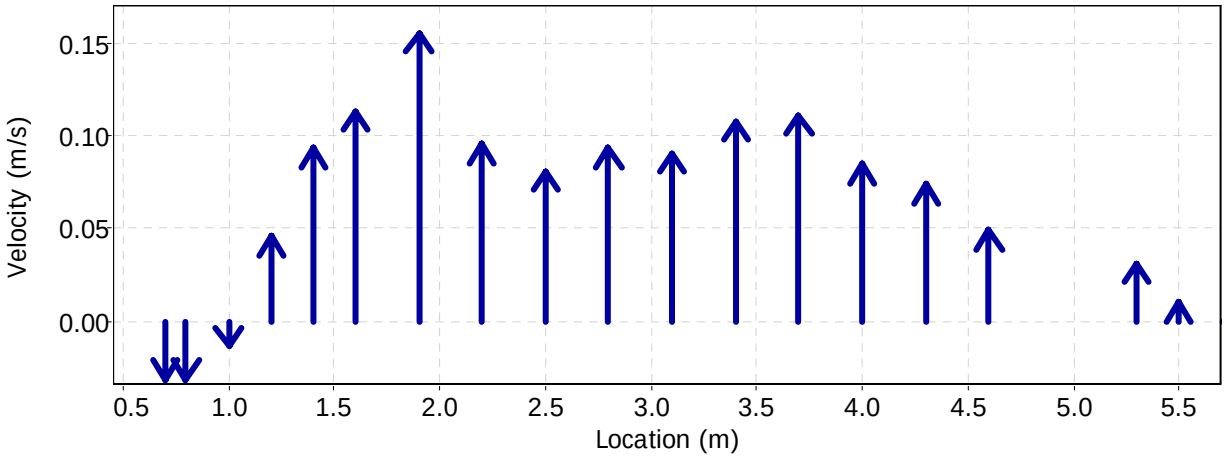
# Discharge Measurement Summary

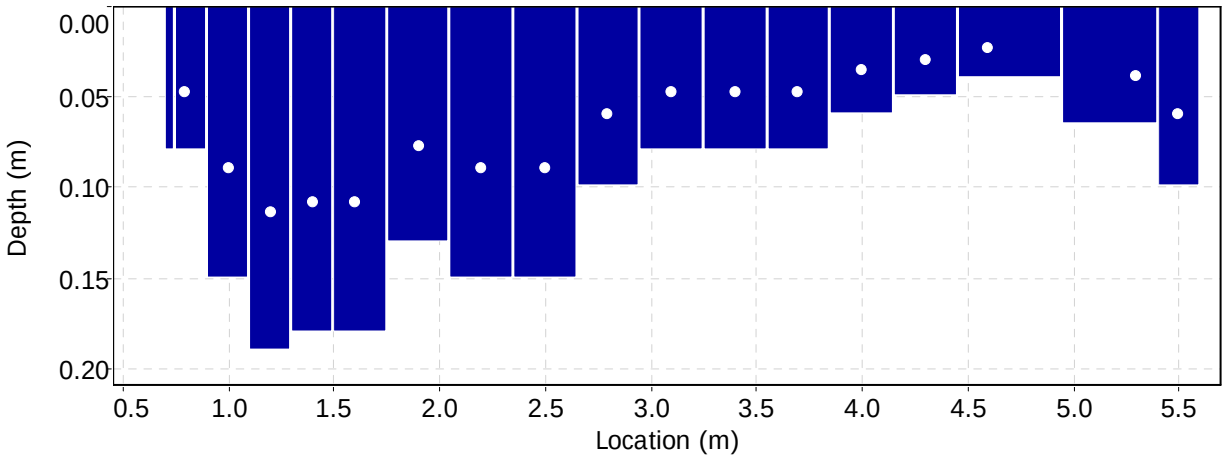
Date Generated: Wed Nov 18 2009

| File Information | |
|---|---|
| File Name | SW8.TUI.WAD |
| Start Date and Time | 2009/11/17 07:19:24 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW8.TUI.WAD |
| Start Date and Time | 2009/11/17 07:19:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 1 | 0.80 | 0.6 | High angle: 175 |
| | | 0.6 | Boundary QC is Poor; possible boundary interference |
| 6 | 1.90 | 0.6 | High angle: -23 |
| 7 | 2.20 | 0.6 | High angle: -45 |
| 8 | 2.50 | 0.6 | High angle: -50 |
| 9 | 2.80 | 0.6 | High angle: -20 |
| 14 | 4.30 | 0.6 | SNR (13.3) is different from typical SNR (24.7) |
| 15 | 4.60 | 0.6 | SNR (13.7) is different from typical SNR (24.7) |
| 16 | 5.30 | 0.6 | High angle: 22 |
| | | 0.6 | SNR (10.1) is different from typical SNR (24.7) |

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

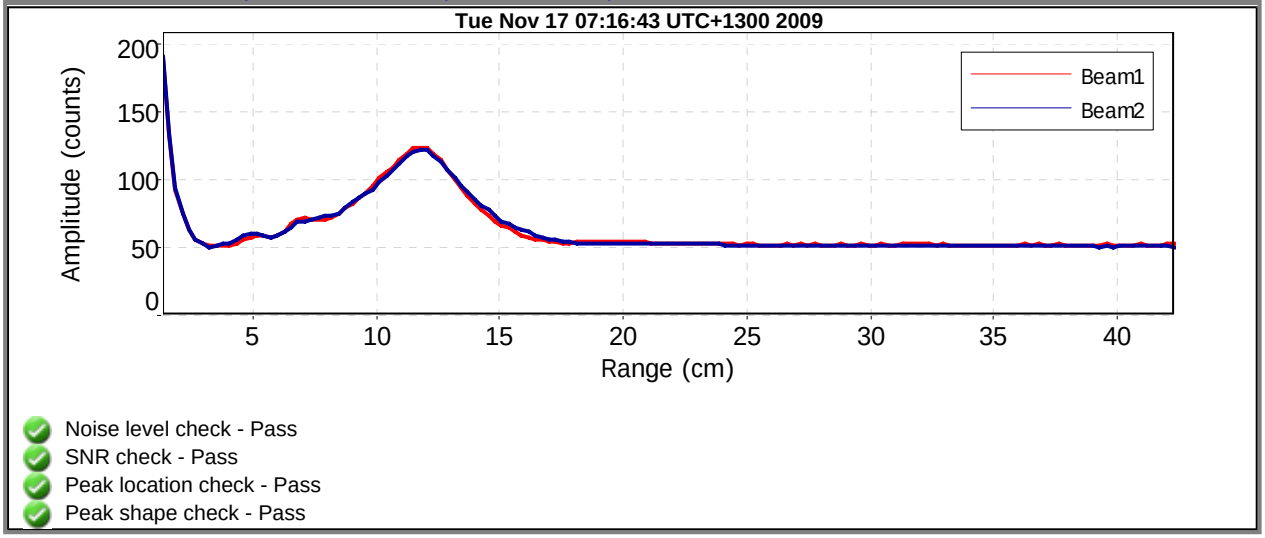
## File Information

| | |
|---|---|
| File Name | SW8.TUI.WAD |
| Start Date and Time | 2009/11/17 07:19:24 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW13.TUI.WAD |
| Start Date and Time | 2009/11/17 09:11:01 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.6% | 3.8% |
| Velocity | 2.4% | 9.9% |
| Width | 0.2% | 0.2% |
| Method | 2.8% | - |
| # Stations | 4.2% | - |
| Overall | 5.7% | 10.6% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 12 |
| Start Edge | LEW | Total Width | 1.200 |
| Mean SNR | 36.1 dB | Total Area | 0.218 |
| Mean Temp | 11.55 °C | Mean Depth | 0.182 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.1048 |
| | | Total Discharge | 0.0229 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 09:11 | 0.70 | None | 0.020 | 0.0 | 0.0 | 0.0000 | 1.00 | -0.0200 | 0.001 | 0.0000 | -0.1 |
| *1* | *09:11* | *0.80* | *0.6* | *0.090* | *0.6* | *0.036* | *-0.0200* | *1.00* | *-0.0200* | *0.009* | *-0.0002* | *-0.8* |
| *2* | *09:12* | *0.90* | *0.6* | *0.130* | *0.6* | *0.052* | *-0.0345* | *1.00* | *-0.0345* | *0.013* | *-0.0004* | *-2.0* |
| 3 | 09:13 | 1.00 | 0.6 | 0.200 | 0.6 | 0.080 | 0.1003 | 1.00 | 0.1003 | 0.020 | 0.0020 | 8.8 |
| 4 | 09:15 | 1.10 | 0.6 | 0.210 | 0.6 | 0.084 | 0.1463 | 1.00 | 0.1463 | 0.021 | 0.0031 | 13.4 |
| *5* | *09:16* | *1.20* | *0.6* | *0.230* | *0.6* | *0.092* | *0.1296* | *1.00* | *0.1296* | *0.023* | *0.0030* | *13.0* |
| 6 | 09:19 | 1.30 | 0.6 | 0.180 | 0.6 | 0.072 | 0.1707 | 1.00 | 0.1707 | 0.018 | 0.0031 | 13.4 |
| 7 | 09:20 | 1.40 | 0.6 | 0.190 | 0.6 | 0.076 | 0.1454 | 1.00 | 0.1454 | 0.019 | 0.0028 | 12.1 |
| 8 | 09:21 | 1.50 | 0.6 | 0.200 | 0.6 | 0.080 | 0.1128 | 1.00 | 0.1128 | 0.020 | 0.0023 | 9.9 |
| 9 | 09:23 | 1.60 | 0.6 | 0.270 | 0.6 | 0.108 | 0.0867 | 1.00 | 0.0867 | 0.034 | 0.0029 | 12.8 |
| 10 | 09:24 | 1.75 | 0.6 | 0.270 | 0.6 | 0.108 | 0.1096 | 1.00 | 0.1096 | 0.041 | 0.0044 | 19.4 |
| 11 | 09:24 | 1.90 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

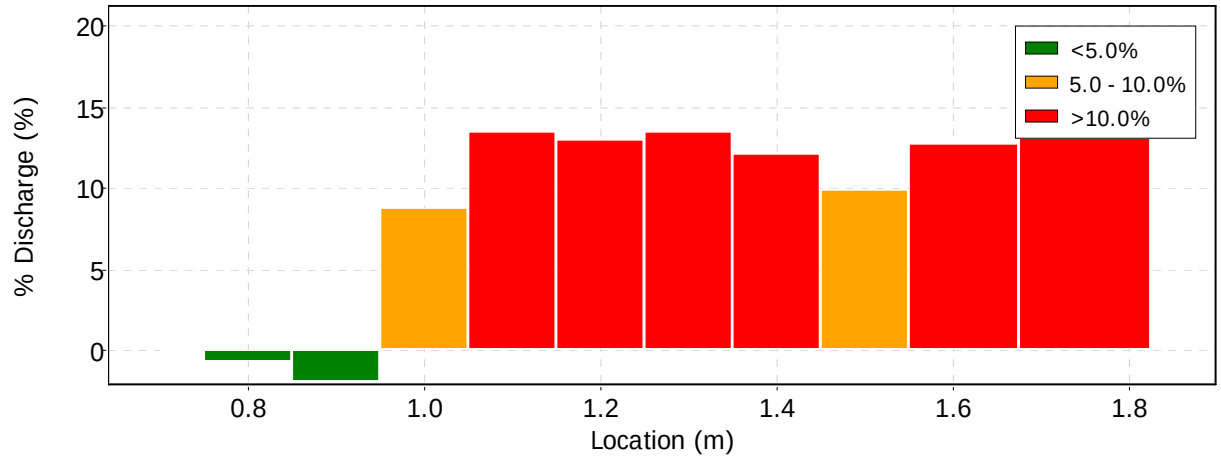
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

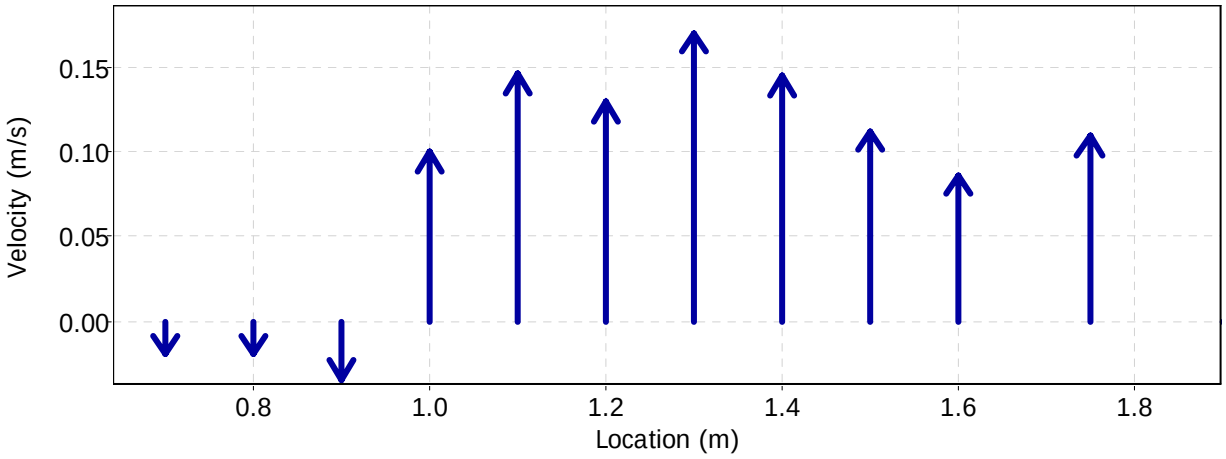
# Discharge Measurement Summary

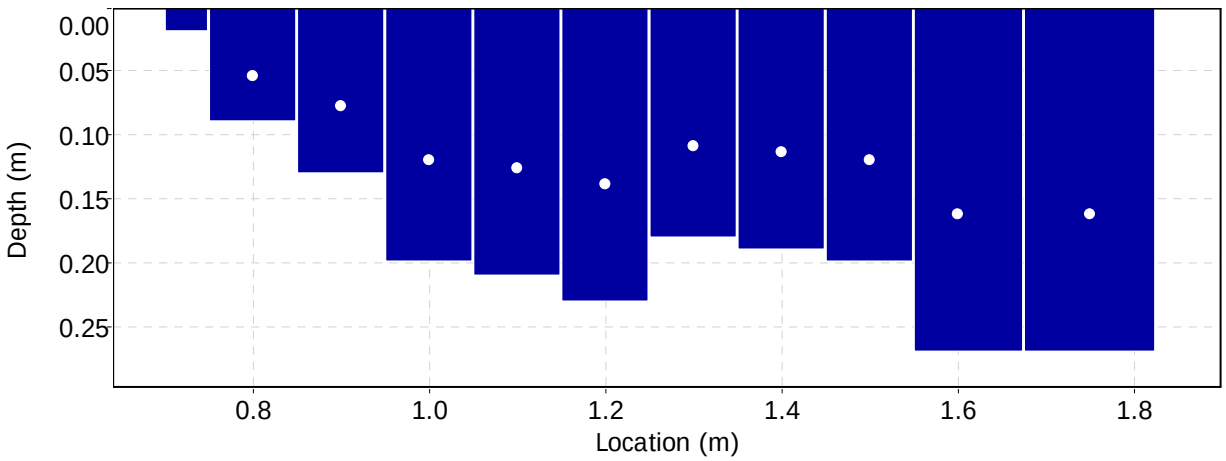
Date Generated: Wed Nov 18 2009

| File Information | |
|---|---|
| File Name | SW13.TUI.WAD |
| Start Date and Time | 2009/11/17 09:11:01 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW13.TUI.WAD |
| Start Date and Time | 2009/11/17 09:11:01 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 1 | 0.80 | 0.6 | High angle: -147 |
| 2 | 0.90 | 0.6 | High angle: 143 |
| 5 | 1.20 | 0.6 | High angle: 22 |

# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW100.TUI.WAD |
| Start Date and Time | 2009/11/17 10:52:29 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2225 |
| CPU Firmware Version | 3.5 |
| Software Ver | 2.20 |

## Units (Metric Units)

| | |
|---|---|
| Distance | m |
| Velocity | m/s |
| Area | m^2 |
| Discharge | m^3/s |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.8% | 6.0% |
| Velocity | 2.8% | 19.4% |
| Width | 0.3% | 0.3% |
| Method | 4.1% | - |
| # Stations | 6.6% | - |
| Overall | 8.4% | 20.3% |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 8 |
| Start Edge | LEW | Total Width | 0.800 |
| Mean SNR | 40.0 dB | Total Area | 0.047 |
| Mean Temp | 12.27 °C | Mean Depth | 0.058 |
| Disch. Equation | Mid-Section | Mean Velocity | 0.2874 |
| | | Total Discharge | 0.0134 |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10:52 | 0.90 | None | 0.020 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0086 | 0.002 | 0.0000 | 0.1 |
| *1* | *10:53* | *1.10* | *0.6* | *0.050* | *0.6* | *0.020* | *0.0086* | *1.00* | *0.0086* | *0.008* | *0.0001* | *0.5* |
| 2 | 10:55 | 1.20 | 0.6 | 0.070 | 0.6 | 0.028 | 0.0862 | 1.00 | 0.0862 | 0.007 | 0.0006 | 4.5 |
| 3 | 10:56 | 1.30 | 0.6 | 0.090 | 0.6 | 0.036 | 0.3642 | 1.00 | 0.3642 | 0.009 | 0.0033 | 24.5 |
| 4 | 10:58 | 1.40 | 0.6 | 0.080 | 0.6 | 0.032 | 0.7053 | 1.00 | 0.7053 | 0.008 | 0.0056 | 42.2 |
| 5 | 10:59 | 1.50 | 0.6 | 0.080 | 0.6 | 0.032 | 0.3927 | 1.00 | 0.3927 | 0.008 | 0.0031 | 23.5 |
| 6 | 11:00 | 1.60 | 0.6 | 0.050 | 0.6 | 0.020 | 0.1230 | 1.00 | 0.1230 | 0.005 | 0.0006 | 4.6 |
| 7 | 11:00 | 1.70 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

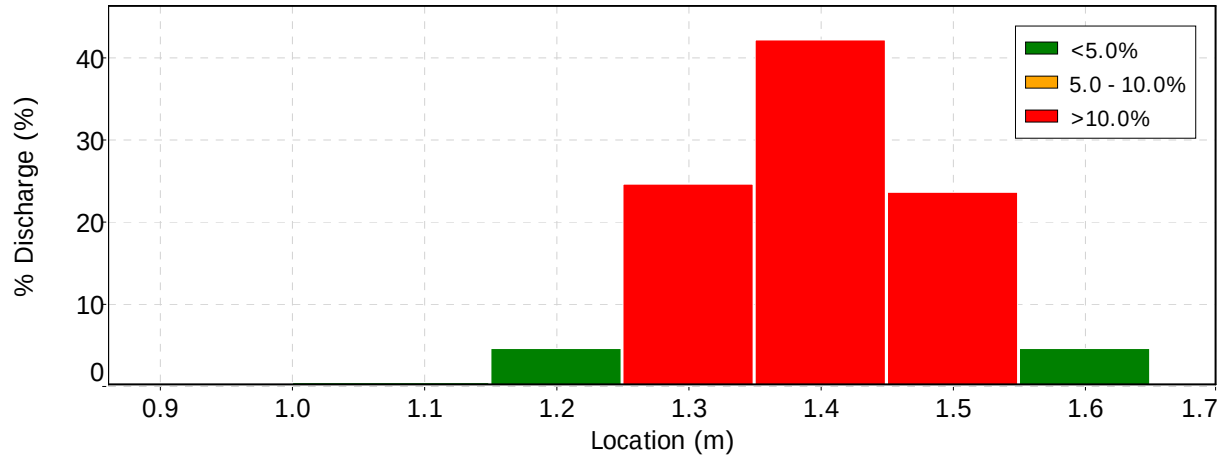
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

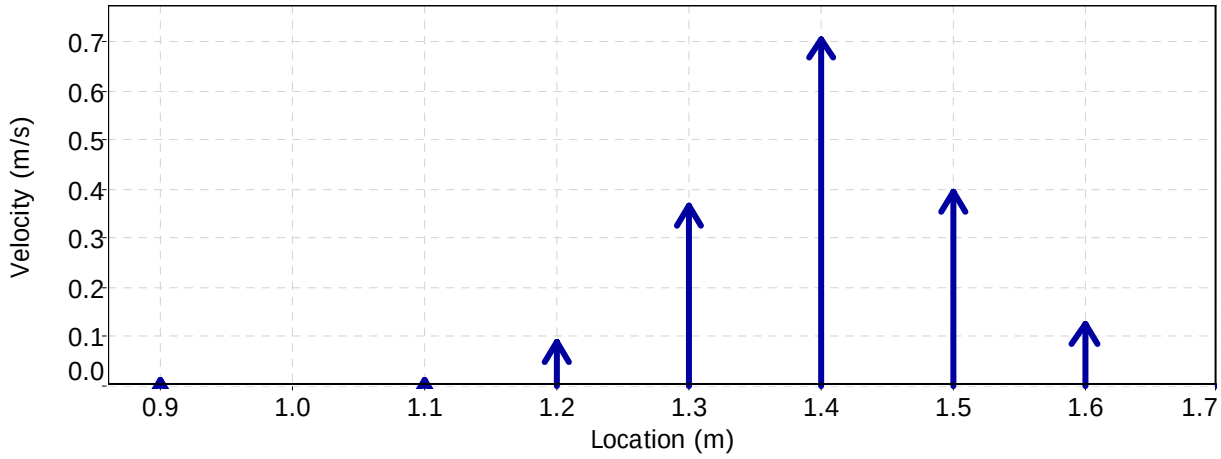
# Discharge Measurement Summary

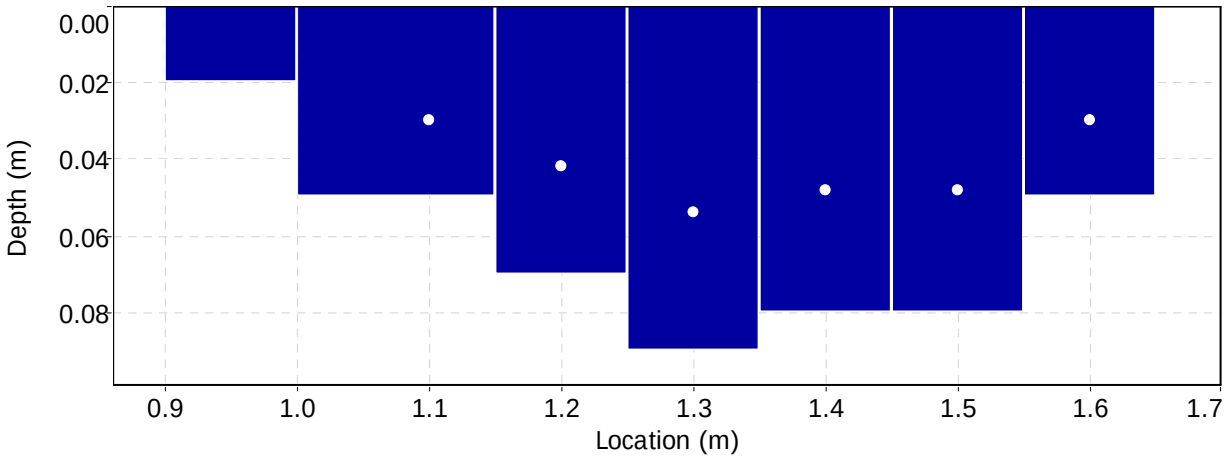
Date Generated: Wed Nov 18 2009

| File Information | |
|---|---|
| File Name | SW100.TUI.WAD |
| Start Date and Time | 2009/11/17 10:52:29 |

| Site Details | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |



# Discharge Measurement Summary

Date Generated: Wed Nov 18 2009

## File Information

| | |
|---|---|
| File Name | SW100.TUI.WAD |
| Start Date and Time | 2009/11/17 10:52:29 |

## Site Details

| | |
|---|---|
| Site Name | TUI |
| Operator(s) | REM |

## Quality Control

| St | Loc | % Dep | Message |
|---|---|---|---|
| 1 | 1.10 | 0.6 | SNR (51.1) is different from typical SNR (40.0) |

## Flow Calculations

The equation used determining the flow from a V-notch weir was a standard engineering equation (see below) obtained from *Mechanics of Fluids, Potter & Wiggert* and *Hydraulic Structures, C.D. Smith* and based on Bernoulli's equation solved for an idealised velocity and integrating throughout the nappe above the crest.

$$\mathbf{Q = C_d * 8/15 * \sqrt{2g} * Tan(\theta/2) * Y^{(5/2)}}$$

Experiments by King and Brater in 1963 (Handbook of Hydraulics) have shown that a **Cd = 0.58** is acceptable for engineering calculations for triangular weirs for $22.5° > \theta > 120°$ and, therefore, this value was used in our calculations.

## Flow Calculations for V-Notch Weir

$Q = C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g} \cdot y^{5/2}$

Where:

| | | |
|---|---|---|
| Cd = Coefficient Discharge = | 0.58 | |
| Tan(θ/2) for θ = 90° = | 1 | |
| g = gravity = | 9.81 | $m/s^2$ |
| y = v-notch reading = | y | m |

So that:

$C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g}$ = 1.3702

And:

$$\mathbf{Q = 0.31\sqrt{2g}.y^{5/2}}$$

$Q_1$ SW5

y = 0.1 m

$Q_1$ = 0.0043 $m^3/s$

$Q_1$ = 4.3329 L/s

$Q_1$ = 0.0043 $m^3/s$

$Q_2$ SW11

y = 0.06 m

$Q_2$ = 0.0012 $m^3/s$

$Q_2$ = 1.2082 L/s

$Q_1$ = 0.0012 $m^3/s$

$Q_3$ SW3

y = 0.027 m

$Q_3$ = 0.0002 $m^3/s$

$Q_3$ = 0.1641 L/s

$Q_1$ = 0.0002 $m^3/s$

## Flow Calculations for V-Notch Weir

$Q = C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g} \cdot y^{5/2}$

Where:

| | | |
|---|---|---|
| Cd = Coefficient Discharge = | 0.58 | |
| Tan(θ/2) for θ = 90° = | 1 | |
| g = gravity = | 9.81 | $m/s^2$ |
| y = v-notch reading = | y | m |

So that:

$C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g}$ = 1.3702

And:

$$\mathbf{Q = 0.31\sqrt{2g}.y^{5/2}}$$

$Q_1$ SW5

y = 0.1275 m

$Q_1$ = 0.008 $m^3/s$

$Q_1$ = 7.9534 L/s

$Q_1$ = 0.008 $m^3/s$

$Q_2$ SW11

y = 0.072 m

$Q_2$ = 0.0019 $m^3/s$

$Q_2$ = 1.9059 L/s

$Q_1$ = 0.0019 $m^3/s$

$Q_3$ SW3

y = 0.075 m

$Q_3$ = 0.0021 $m^3/s$

$Q_3$ = 2.1107 L/s

$Q_1$ = 0.0021 $m^3/s$

## Flow Calculations for V-Notch Weir

$Q = C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g} \cdot y^{5/2}$

Where:

| | | |
|---|---|---|
| Cd = Coefficient Discharge = | 0.58 | |
| Tan(θ/2) for θ = 90° = | 1 | |
| g = gravity = | 9.81 | $m/s^2$ |
| y = v-notch reading = | y | m |

So that:

$C_d \cdot 8/15 \cdot \tan(\theta/2) \cdot \sqrt{2g}$ = 1.3702

And:

$$\mathbf{Q = 0.31\sqrt{2g}.y^{5/2}}$$

$Q_1$ SW5

y = m

$Q_1$ = 0 $m^3/s$

$Q_1$ = 0 L/s

$Q_1$ = 0 $m^3/s$

$Q_2$ SW11

y = 0.058 m

$Q_2$ = 0.0011 $m^3/s$

$Q_2$ = 1.1101 L/s

$Q_1$ = 0.0011 $m^3/s$

$Q_3$ SW3

y = 0.037 m

$Q_3$ = 0.0004 $m^3/s$

$Q_3$ = 0.3608 L/s

$Q_1$ = 0.0004 $m^3/s$

# Appendix G

**Table G-1: Water Quality Results for Tui Mine Baseline Monitoring at SW3**

| Sample Location | | Level 4 Adit (SW3) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | A808 | A963 | SW3 | ADIT4 | ADIT4 | ADIT4 | SW3 | SW3 | SW3 |
| Sampled By | | URS | URS | URS | Sharplin | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | | 19/12/00 | 22/02/01 | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | 155596/3 | 158764/3 | | | | | 728224.1 | 734195.1 | 744474.1 |
| Flow Rate | L/s | | | | 0.253 | 0.81 | 0.573 | | | |
| Flow Rate | $m^3$/sec | | | 0.005 | 0.000253 | 0.00081 | 0.000573 | 0.0002 | 0.0021 | 0.0004 |
| Field: | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | 11.3 | 11 | 10.6 | 10.36 | 10.17 | 10.97 |
| pH | pH units | - | - | - | 6.79 | 6.92 | 7.05 | 7.84 | 6.76 | 7.42 |
| Conductivity | mS/m | - | - | - | 89.8 | 74.4 | 68.4 | 92.09 | 65.08 | 10.8 |
| ORP | mV | - | - | - | - | - | - | 176 | 301 | 258 |
| Dissolved Oxygen | mg/L | - | - | - | 8.47 | 7.6 | - | 10.64 | 10.15 | 9.1 |
| Turbidity | NTU | - | - | - | - | - | - | <5 | <5 | 0.9 |
| | | | | | | | | | | |
| Laboratory: | | | | | | | | | | |
| pH | pH units | 7 | 6.6 | 6.7 | - | - | - | 6.7 | 7.8 | 6.7 |
| Conductivity | mS/m | 14 | 10.3 | 88 | - | - | - | 11.7 | 8.6 | 11.2 |
| Total Suspended Solids | $g/m^3$ | <3 | <3 | 5 | - | - | - | < 3.0 | < 3.0 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | 13 | 12 | 12 |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | |
| | | - | - | - | - | - | - | - | - | - |
| Anions | meq | - | - | - | - | - | - | 1.1 | 0.78 | 1.2 |
| Cations | meq | - | - | - | - | - | - | 1.1 | 0.77 | 1 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 23 | 13 | 11 | 11 | 17 | 8 | 17 | 11 | 16 |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | 18.8 | 26.3 | 12.2 | 21 | 14 | 19 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | 36 | 23 | 33 |
| Calcium | $g/m^3$ | 11.9 | 7.74 | 5.71 | 11 | 8.72 | 7 | 10 | 6.7 | 9.9 |
| Magnesium | $g/m^3$ | 2.61 | 1.92 | 1.42 | 3.08 | 1.84 | 1.5 | 2.4 | 1.5 | 2.1 |
| Potassium | $g/m^3$ | 0.61 | 0.6 | - | 0.5 | 0.42 | 0.4 | 0.51 | 0.41 | 0.47 |
| Sodium | $g/m^3$ | 7.15 | 6.98 | - | 7.61 | 7.4 | 7 | 7.9 | 6.8 | 7.3 |
| Chloride | $g/m^3$ | 10.3 | 10.3 | - | 10.3 | 9.72 | 9 | 10 | 10 | 9.9 |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | < 0.0020 | < 0.0020 | < 0.0020 |
| Nitrate-N | $g/m^3$ | 0.122 | 0.158 | - | - | - | - | 0.14 | 0.17 | 0.16 |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | 0.14 | 0.17 | 0.16 |
| Sulphate | $g/m^3$ | 27.4 | 15.9 | 14.2 | 26.4 | 17.6 | 12 | 20 | 12 | 28 |
| | | | | | | | | | | |
| Metals | | | | | | | | | | |
| | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.0032 | 0.016 | < 0.0032 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0072 | 0.0046 | < 0.0032 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Arsenic Dissolved | $g/m^3$ | <0.001 | <0.001 | - | <d.l. | <d.l. | <d.l. | < 0.0011 | < 0.0011 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | <0.001 | <0.001 | - | <d.l. | 0.001 | <d.l. | < 0.0011 | < 0.0011 | < 0.0011 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.0068 | 0.0044 | 0.0063 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0071 | 0.0047 | 0.0067 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.012 | 0.011 | 0.012 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.011 | 0.0099 | 0.011 |
| Cadmium Dissolved | $g/m^3$ | 0.0103 | 0.00409 | 0.00237 | 0.005 | 0.003 | 0.0025 | 0.0036 | 0.0016 | 0.0038 |
| Cadmium Total Recoverable | $g/m^3$ | 0.0106 | 0.0042 | 0.00309 | 0.005 | 0.004 | 0.00251 | 0.0038 | 0.0015 | 0.004 |
| Calcium Dissolved | $g/m^3$ | - | - | 5.71 | - | - | - | 9.8 | 6.7 | 9.9 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 9.7 | 6.6 | 9.7 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0059 | 0.0052 | 0.0043 | 0.004 | 0.001 | 0.00089 | 0.0019 | 0.00096 | 0.0013 |
| Copper Total Recoverable | $g/m^3$ | 0.0115 | 0.012 | 0.0124 | 0.004 | 0.038 | 0.00107 | 0.0029 | 0.0012 | 0.016 |
| Iron Dissolved | $g/m^3$ | <0.02 | <0.02 | <0.02 | 0.016 | 0.016 | 0.00446 | < 0.021 | < 0.021 | < 0.021 |
| Iron Total Recoverable | $g/m^3$ | 0.22 | 0.07 | 1.27 | 0.029 | 0.417 | 0.526 | < 0.021 | < 0.021 | < 0.021 |
| Lead Dissolved | $g/m^3$ | 0.001 | 0.0013 | 0.0006 | <d.l. | <d.l. | <d.l. | 0.00058 | 0.00049 | 0.00093 |
| Lead Total Recoverable | $g/m^3$ | 0.0037 | 0.012 | 0.0697 | 0.003 | 0.008 | 0.00553 | 0.0013 | 0.0008 | 0.0011 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.002 | 0.0017 | 0.0019 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0021 | 0.0016 | 0.0019 |
| Magnesium Dissolved | $g/m^3$ | - | - | 1.42 | - | - | - | 2.3 | 1.6 | 2.2 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 2.3 | 1.5 | 2 |
| Manganese Dissolved | $g/m^3$ | - | - | - | 0.003 | 0.0006 | 0.00041 | 0.0024 | < 0.00053 | 0.00086 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | 0.003 | 0.006 | 0.00077 | 0.0024 | 0.0007 | 0.00077 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | <0.0005 | <0.0005 | <0.0005 | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Nickel Total Recoverable | $g/m^3$ | <0.0005 | <0.0005 | <0.0005 | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.46 | 0.41 | 0.43 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.47 | 0.41 | 0.44 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | 0.0047 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | 7.2 | 6.6 | 7.3 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 7.2 | 6.3 | 7.5 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 1.26 | 0.494 | 0.253 | 0.595 | 0.306 | 0.18499 | 0.41 | 0.18 | 0.43 |
| Zinc Total Recoverable | $g/m^3$ | 1.2 | 0.519 | 0.381 | 0.572 | 0.376 | 0.18564 | 0.39 | 0.18 | 0.42 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-2: Water Quality Results for Tui Mine Baseline Monitoring at SW5**

| Sample Location | | Level 5 Adit (SW5) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | 04 | A810 | A964 | SW5 | ADIT5 | ADIT5 | ADIT5 | ADIT5 | SW5 | SW5 | SW5 |
| Sampled By | | URS | URS | URS | URS | Sharplin | Sharplin | Sharplin | Sharplin | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 6/12/00 | 19/12/00 | 22/02/01 | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | 154963/4 | 155596/5 | 158764/5 | | | | | | 728224.3 | 734195.3 | 744474.2 |
| Flow Rate | L/s | | | | | 9.91 | 6.97 | 12.01 | 14.3 | | | |
| Flow rate | $m^3$/sec | | | | 0.01 | 0.00991 | 0.00697 | 0.01201 | 0.0143 | 0.0057 | 0.0102 | 0.0081 |
| Field: | | | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | - | 15.47 | 14.8 | 13.1 | 14.2 | 14.35 | 12.92 | 13.98 |
| pH | pH units | - | - | - | - | 7.17 | 6.54 | 7.31 | 7.18 | 7.63 | 6.31 | 7.29 |
| Conductivity | mS/m | - | - | - | - | 52 | 51.4 | 45.5 | 52.5 | 56.29 | 46.55 | 61.4 |
| ORP | mV | - | - | - | - | - | - | - | - | 194 | 225 | 297 |
| Dissolved Oxygen | mg/L | - | - | - | - | 9.82 | 8.62 | - | 9.58 | 9.66 | 9.47 | 9.91 |
| Turbidity | NTU | - | - | - | - | - | - | - | - | <5 | <5 | 19 |
| | | | | | | | | | | | | |
| Laboratory: | | | | | | | | | | | | |
| pH (pH units) | pH units | 7.1 | 7.3 | 6.9 | 7.3 | - | - | - | - | 7.2 | 7.1 | 7.3 |
| Conductivity | mS/m | 66.1 | 69 | 62.5 | 56 | - | - | - | - | 65.7 | 54.6 | 62.8 |
| Total Suspended Solids | $g/m^3$ | 15 | 16 | 13 | 13 | - | - | - | - | 14 | 14 | 14 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | 17 | 17 | 16 |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | | | | | | |
| Anions | meq | - | - | - | - | - | - | - | - | 7.4 | 5.6 #2 | 7.5 |
| Cations | meq | - | - | - | - | - | - | - | - | 6.5 | 4.9 #2 | 6.8 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 68 | 74 | 57 | 49 | 57 | 46 | 48 | - | 68 | 43 | 64 |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | 80 | 81.7 | 65.3 | - | 83 | 52 | 78 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | - | 290 | 220 | 300 |
| Calcium | $g/m^3$ | 89.1 | 87.6 | 80.4 | 61.5 | 81.5 | 80.5 | 82 | - | 88 | 64 | 91 |
| Magnesium | $g/m^3$ | 17.7 | 17.9 | 16.4 | 11.9 | 14.9 | 15.8 | 15 | - | 18 | 14 | 18 |
| Potassium | $g/m^3$ | 1.26 | 1.23 | 1.21 | | 1.2 | 1.1 | 1.4 | - | 1.3 | 0.93 | 1.3 |
| Sodium | $g/m^3$ | 14.8 | 14.4 | 14.6 | - | 14.5 | 14.6 | 14.5 | - | 15 | 12 | 15 |
| Chloride | $g/m^3$ | 10.9 | 10.9 | 10.3 | - | 10.2 | 10.2 | 10.2 | - | 10 | 11 | 10 |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0020 | < 0.0020 | < 0.0020 |
| Nitrate-N | $g/m^3$ | 0.03 | 0.019 | 0.036 | | - | - | - | - | 0.024 | 0.062 | 0.033 |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | 0.025 | 0.063 | 0.033 |
| Sulphate | $g/m^3$ | 280 | 281 | 268 | 235 | 278 | 268 | 276.24 | 292 | 270 | 210 | 280 |
| | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.0046 | 0.0083 | 0.0044 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.26 | 0.44 | 0.26 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00063 | 0.00037 | 0.00061 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.001 | 0.00073 | 0.001 |
| Arsenic Dissolved | $g/m^3$ | 0.001 | 0.001 | 0.001 | - | 0.001 | 0.0008 | 0.001379 | 0.0015 | < 0.0021 | < 0.0053 | 0.0014 |
| Arsenic Total Recoverable | $g/m^3$ | 0.005 | 0.006 | 0.005 | - | 0.004 | 0.003 | 0.003981 | 0.0052 | 0.0052 | 0.0038 | 0.0048 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.024 | 0.022 | 0.026 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.024 | 0.023 | 0.027 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.024 | 0.019 | 0.027 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.023 | 0.022 | 0.026 |
| Cadmium Dissolved | $g/m^3$ | 0.107 | 0.103 | 0.189 | 0.133 | 0.033 | 0.103 | 0.16 | 0.12 | 0.13 | 0.19 | 0.12 |
| Cadmium Total Recoverable | $g/m^3$ | 0.116 | 0.114 | 0.19 | 0.144 | 0.108 | 0.114 | 0.144 | 0.13 | 0.15 | 0.21 | 0.14 |
| Calcium Dissolved | $g/m^3$ | - | - | - | 61.5 | - | - | - | - | 86 | 58 | 84 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 85 | 63 | 89 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | 0.00058 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0064 | 0.0051 | 0.0162 | 0.0145 | 0.008 | 0.005 | 0.02489 | 0.012 | 0.0085 | 0.043 | 0.0093 |
| Copper Total Recoverable | $g/m^3$ | 0.175 | 0.167 | 0.283 | 0.222 | 0.135 | 0.099 | 0.433 | 0.19 | 0.2 | 0.49 | 0.21 |
| Iron Dissolved | $g/m^3$ | <0.02 | <0.02 | <0.02 | <0.02 | 0.0032 | 0.012 | 0.457 | <0.020 | < 0.021 | < 0.021 | < 0.021 |
| Iron Total Recoverable | $g/m^3$ | 4.22 | 4.85 | 3.47 | 3.03 | 2.46 | 3.16 | 2.724 | 3.7 | 4.7 | 4.4 | 4.2 |
| Lead Dissolved | $g/m^3$ | 0.0013 | 0.0028 | 0.001 | 0.0009 | 0.001 | <d.l. | <d.l. | 0.0003 | 0.00025 | 0.00077 | 0.00026 |
| Lead Total Recoverable | $g/m^3$ | 0.0878 | 0.0771 | 0.0953 | 0.0979 | 0.04 | 0.03 | 0.03137 | 0.077 | 0.072 | 0.15 | 0.077 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.02 | 0.015 | 0.021 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.019 | 0.015 | 0.02 |
| Magnesium Dissolved | $g/m^3$ | - | - | - | 11.9 | | | | | 18 | 13 | 18 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 18 | 14 | 19 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | 1.52 | 1.54 | 0.364 | 1.6 | 1.9 | 1.5 | 1.7 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | 1.57 | 1.61 | 1.388 | 1.6 | 1.8 | 1.6 | 1.7 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00058 | 0.00027 | 0.00043 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00059 | 0.00036 | 0.00046 |
| Nickel Dissolved | $g/m^3$ | 0.0223 | 0.0233 | 0.0212 | 0.0186 | - | - | - | - | 0.025 | 0.021 | 0.023 |
| Nickel Total Recoverable | $g/m^3$ | 0.0215 | 0.0236 | 0.0217 | 0.0195 | - | - | - | - | 0.025 | 0.021 | 0.023 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 1.1 | 0.85 | 1.2 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 1.1 | 0.94 | 1.1 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0021 | < 0.0053 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0021 | 0.0029 | < 0.0021 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | <0.0001. | <0.0002 | <0.0001 | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | <0.0001 | <0.0005 | <0.0001 | - | < 0.00011 | < 0.00011 | 0.0003 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 13 | 11 | 15 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 13 | 11 | 14 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | *15.9* | *15.9* | *23.7* | *17.4* | 17 | 14.6 | 24.60025 | 18 | 20 | 27 | 19 |
| Zinc Total Recoverable | $g/m^3$ | 18.5 | 18.7 | 26.4 | 19.4 | 18.3 | 16.8 | 25.5738 | 20 | 22 | 30 | 22 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-3: Water Quality Results for Tui Mine Baseline Monitoring at SW7**

| Sample Location | | Tunakohoia N Branch, Downstream (SW7) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | | | 12 | A816 | A973 | F237 | TK2 | TK2 | SW7 | SW7 | SW7 |
| Sampled By | | URS | URS | URS | URS | URS | URS | Sharplin | Sharplin | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 25/03/98 | 20/05/98 | 6/12/00 | 19/12/00 | 22/02/01 | 15/12/01 | 3/05/07 | 27/07/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | 154963/12 | 155596/11 | 158764/13 | | | | 728224.5 | 734195.5 | 744474.15 |
| Flow Rate | L/s | | | | | | | 53.4 | 27 | | | |
| Flow rate | $m^3$/sec | | | | | | | 0.0534 | 0.027 | 0.0179 | 0.1089 | 0.0198 |
| Field: | | | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | - | - | - | 13.1 | 10.3 | 11.89 | 10.27 | 11.36 |
| pH | pH units | - | - | - | - | - | - | 5.98 | 6.95 | 6.97 | 6.57 | 6.39 |
| Conductivity | mS/m | - | - | - | - | - | - | 27.6 | 19.1 | 30.07 | 15.68 | 34.6 |
| ORP | mV | - | - | - | - | - | - | - | - | 233 | 589 | 330 |
| Dissolved Oxygen | mg/L | - | - | - | - | - | - | 10.1 | 8.55 | 10.77 | 11.08 | 10.45 |
| Turbidity | NTU | - | - | - | - | - | - | - | - | <5 | <5 | 5.4 |
| | | | | | | | | | | | | |
| Laboratory: | | | | | | | | | | | | |
| pH | pH units | 7.2 | 7.4 | 6.8 | 7 | 6.8 | 6.9 | - | - | 7.3 | 7.4 | 7 |
| Conductivity | mS/m | 36.5 | 39.8 | 40.2 | 47.8 | 35.7 | 26.1 | - | - | 36.7 | 20.8 | 35.8 |
| Total Suspended Solids | $g/m^3$ | <3 | <3 | <3 | <3 | <3 | 4 | - | - | < 3.0 | < 3.0 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | | | | - | - | - |
| Anions | meq | - | - | - | - | - | - | - | - | - | - | - |
| Cations | meq | - | - | - | - | - | - | - | - | - | - | - |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 24 | 27 | 24 | 32 | 23 | 16 | - | - | - | - | - |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | - | - | 29.9 | 17.2 | - | - | - |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | - | - | - | - |
| Calcium | $g/m^3$ | 38.1 | 46.9 | 42.8 | 51.7 | 37.6 | 20.8 | 36.6 | 30 | - | - | - |
| Magnesium | $g/m^3$ | 10.3 | 12.2 | 12.2 | 14.2 | 10 | 6.4 | 11 | 11 | - | - | - |
| Potassium | $g/m^3$ | 1 | 1.1 | 1.12 | 1.18 | 1.02 | - | 0.91 | 0.6 | - | - | - |
| Sodium | $g/m^3$ | 11.2 | 12 | 11.9 | 12.8 | 11.3 | - | 11.2 | 11 | - | - | - |
| Chloride | $g/m^3$ | 11 | 10.6 | 11.9 | 11 | 11.3 | - | 11.1 | 11 | - | - | - |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| Nitrate-N | $g/m^3$ | - | - | 0.02 | 0.013 | 0.099 | - | - | - | - | - | - |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| Sulphate | $g/m^3$ | 133 | 140 | 156 | 189 | 132 | 80.6 | 133 | 102.72 | - | - | - |
| | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.16 | 0.084 | 0.055 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.38 | 0.29 | 0.34 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00022 | < 0.00021 | 0.00074 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00027 | 0.00027 | 0.0013 |
| Arsenic Dissolved | $g/m^3$ | - | - | - | <0.001 | <0.001 | - | <d.l. | 0.000676 | < 0.0011 | < 0.0011 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | - | - | <0.001 | <0.001 | <0.001 | - | <d.l. | 0.00464 | < 0.0011 | 0.0041 | < 0.0011 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.024 | 0.021 | 0.025 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.024 | 0.023 | 0.025 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.015 | 0.013 | 0.015 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.016 | 0.014 | 0.017 |
| Cadmium Dissolved | $g/m^3$ | 0.0522 | 0.0559 | - | 0.0532 | 0.0639 | 0.0313 | 0.027 | 0.045 | 0.046 | 0.028 | 0.049 |
| Cadmium Total Recoverable | $g/m^3$ | - | - | 0.0461 | 0.0542 | 0.0614 | 0.0329 | 0.027 | 0.0458 | 0.048 | 0.029 | 0.049 |
| Calcium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 36 | 18 | 36 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 37 | 19 | 36 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0123 | 0.0096 | - | 0.0075 | 0.0101 | 0.0095 | 0.008 | 0.0015 | 0.021 | 0.02 | 0.0099 |
| Copper Total Recoverable | $g/m^3$ | - | - | 0.0187 | 0.0176 | 0.0289 | 0.0651 | 0.02 | 0.06185 | 0.041 | 0.065 | 0.042 |
| Iron Dissolved | $g/m^3$ | <0.05 | <0.05 | - | <0.02 | <0.02 | <0.02 | 0.02 | 0.03268 | 0.16 | 0.037 | < 0.021 |
| Iron Total Recoverable | $g/m^3$ | - | - | 0.11 | 0.12 | 0.17 | 0.83 | 0.299 | 0.841 | 0.41 | 0.41 | 0.55 |
| Lead Dissolved | $g/m^3$ | 0.0077 | 0.0033 | - | 0.0115 | 0.0095 | 0.0037 | 0.003 | 0.00249 | 0.014 | 0.012 | 0.0036 |
| Lead Total Recoverable | $g/m^3$ | - | - | 0.0252 | 0.0251 | 0.0346 | 0.0688 | 0.01 | 0.02983 | 0.033 | 0.1 | 0.036 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.0095 | 0.0047 | 0.0092 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.0097 | 0.005 | 0.0098 |
| Magnesium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 11 | 5.5 | 10 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 11 | 5.6 | 11 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.471 | 0.368 | 0.55 | 0.23 | 0.55 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.441 | 0.365 | 0.57 | 0.24 | 0.63 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00021 | 0.0045 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00021 | 0.005 | 0.00023 |
| Nickel Dissolved | $g/m^3$ | - | - | - | 0.0123 | 0.0094 | 0.0067 | - | - | 0.011 | 0.0046 | 0.0094 |
| Nickel Total Recoverable | $g/m^3$ | - | - | 0.0106 | 0.0126 | 0.01 | 0.0069 | - | - | 0.011 | 0.005 | 0.01 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.99 | 1.6 | 0.94 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 1 | 1.8 | 1 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0011 | < 0.0011 | 0.0012 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 11 | 9.5 | 12 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 11 | 9.6 | 12 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | 0.00057 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 5.29 | 6.99 | - | 7.11 | 7.79 | 4.13 | 6.02 | 6.155 | 6.6 | 3.9 | 6.8 |
| Zinc Total Recoverable | $g/m^3$ | - | - | 6.29 | 7.02 | 8.04 | 4.46 | 6.31 | 6.314 | 7 | 4.1 | 7.2 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-4: Water Quality Results for Tui Mine Baseline Monitoring at SW8**

| Sample Location | | Tunakohoia S Branch, Downstream (SW8) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | | | 11 | A817 | A972 | SW8 | SW8 | SW8 | SW8 |
| Sampled By | | URS | URS | URS | URS | URS | URS | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 25/03/98 | 20/05/98 | 6/12/00 | 19/12/00 | 22/02/01 | | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | 154963/11 | 155596/12 | 158764/12 | | 728224.7 | 734195.7 | 744474.16 |
| Flow Rate | L/s | | | | | | | | | |
| Flow rate | $m^3$/sec | | | | | | | 0.025 | 0.1237 | 0.0382 |
| Field: | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | - | - | - | 11.28 | 8.62 | 11.42 |
| pH | pH units | - | - | - | - | - | 6.9 | 7.3 | 7.93 | 6.06 |
| Conductivity | mS/m | - | - | - | - | - | 8.7 | 8.4 | 6 | 9 |
| ORP | mV | - | - | - | - | - | - | 242 | 796 | 350 |
| Dissolved Oxygen | mg/L | - | - | - | - | - | - | 10.7 | 11.42 | 12.4 |
| Turbidity | NTU | - | - | - | - | - | - | <5 | <5 | 1.6 |
| | | | | | | | | | | |
| Laboratory: | | | | | | | | | | |
| pH | pH units | 7.1 | 7.2 | 6.8 | 7 | 6.9 | - | 7.7 | 7.7 | 7.3 |
| Conductivity | mS/m | 9.9 | 9.6 | 9.2 | 10.9 | 9.7 | - | 10.4 | 8.3 | 9.2 |
| Total Suspended Solids | $g/m^3$ | <3 | <3 | <3 | <3 | <3 | <3 | < 3.0 | < 3.0 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | - |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - |
| | | | | | | | | | | |
| Anions | meq | - | - | - | - | - | - | - | - | - |
| Cations | meq | - | - | - | - | - | - | - | - | - |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 15 | 14 | 13 | 18 | 14 | 12 | - | - | - |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | - | - | - | - | - |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | - | - |
| Calcium | $g/m^3$ | 6.5 | 6.97 | 6.12 | 7.38 | 6.75 | 5.07 | - | - | - |
| Magnesium | $g/m^3$ | 2.31 | 2.66 | 2.18 | 2.58 | 2.36 | 1.89 | - | - | - |
| Potassium | $g/m^3$ | 0.4 | 0.5 | 0.47 | 0.54 | 0.46 | - | - | - | - |
| Sodium | $g/m^3$ | 7.4 | 6.6 | 7.01 | 7.65 | 7.52 | - | - | - | - |
| Chloride | $g/m^3$ | 10.7 | 10.3 | 10.7 | 10.5 | 10.3 | - | - | - | - |
| Nitrite-N | $g/m^3$ | | | | | | - | - | - | - |
| Nitrate-N | $g/m^3$ | - | | | | | | - | - | - |
| Nitrate-N+Nitrite-N | $g/m^3$ | | | | | | | - | - | - |
| Sulphate | $g/m^3$ | 13 | 17 | 13.1 | 15.9 | 13.4 | 10.7 | - | - | - |
| | | | | | | | | | | |
| Metals | | | | | | | | | | |
| | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.016 | 0.051 | 0.03 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.03 | 0.074 | 0.048 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | 0.00027 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | 0.00066 |
| Arsenic Dissolved | $g/m^3$ | - | - | - | <0.001 | <0.001 | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | - | - | <0.001 | <0.001 | <0.001 | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.0061 | 0.0054 | 0.0058 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0063 | 0.0063 | 0.0061 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.0094 | 0.0095 | 0.01 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0099 | 0.011 | 0.0087 |
| Cadmium Dissolved | $g/m^3$ | 0.00005 | <0.00005 | - | <0.00005 | 0.00005 | 0.00024 | < 0.000053 | < 0.000053 | < 0.000053 |
| Cadmium Total Recoverable | $g/m^3$ | - | - | <0.00005 | <0.00005 | <0.00005 | <0.00005 | < 0.000053 | < 0.000053 | < 0.000053 |
| Calcium Dissolved | $g/m^3$ | - | - | - | - | - | 5.07 | 6.6 | 5.1 | 6.4 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 6.9 | 5.5 | 6 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0008 | 0.0008 | - | 0.0005 | 0.0011 | 0.0006 | < 0.00053 | < 0.00053 | 0.00063 |
| Copper Total Recoverable | $g/m^3$ | - | - | 0.0012 | 0.0006 | 0.0007 | 0.0006 | < 0.00053 | 0.0006 | 0.00076 |
| Iron Dissolved | $g/m^3$ | 0.00005 | <0.00005 | - | <0.00005 | 0.00005 | 0.02 | < 0.021 | 0.026 | 0.029 |
| Iron Total Recoverable | $g/m^3$ | - | - | <0.00005 | <0.00005 | <0.00005 | 0.06 | 0.025 | 0.036 | 0.052 |
| Lead Dissolved | $g/m^3$ | 0.0001 | <0.0001 | - | 0.0011 | 0.0001 | 0.0002 | < 0.00011 | < 0.00011 | < 0.00011 |
| Lead Total Recoverable | $g/m^3$ | - | - | 0.0021 | 0.0002 | 0.0003 | 0.0003 | < 0.00011 | 0.00036 | 0.00041 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.00051 | 0.0007 | 0.0005 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.00059 | 0.00079 | 0.00059 |
| Magnesium Dissolved | $g/m^3$ | - | - | - | - | - | 1.89 | 2.6 | 2 | 2.3 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 2.7 | 2.1 | 2 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | 0.0014 | 0.0011 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.0014 | 0.0028 | 0.0019 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | - | - | - | <0.0005 | <0.0005 | <0.0005 | < 0.00053 | < 0.00053 | < 0.00053 |
| Nickel Total Recoverable | $g/m^3$ | - | - | 0.0009 | <0.0005 | <0.0005 | <0.0005 | < 0.00053 | < 0.00053 | < 0.00053 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.51 | 0.45 | 0.46 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.53 | 0.49 | 0.45 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | 7.9 | 7 | 7.8 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 8.1 | 7.3 | 7.2 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 0.009 | 0.002 | - | 0.016 | 0.015 | 0.017 | 0.0017 | 0.0015 | <0.0011 |
| Zinc Total Recoverable | $g/m^3$ | - | - | 0.01 | 0.003 | 0.002 | 0.001 | 0.0013 | < 0.0011 | 0.0024 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-5: Water Quality Results for Tui Mine Baseline Monitoring at SW11**

| Sample Location | | Tailings Drainage, Tui Tributary (SW11) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | | | 06 | A814 | A969 | F240 | TD2 | TD2 | TD2 | SW11 | SW11 | SW11 |
| Sampled By | | URS | URS | URS | URS | URS | URS | Sharplin | Sharplin | Sharplin | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 25/03/98 | 20/05/98 | 6/12/00 | 19/12/00 | 22/02/01 | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 18/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | 154963/6 | 155596/9 | 158764/9 | | | | | 728224.9 | 734195.9 | 744474.5 |
| Flow Rate | L/s | | | | | | | 0.163 | 0.141 | 5.27 | | | |
| Flow rate | $m^3$/sec | | | | | | | 0.000163 | 0.000141 | 0.00527 | 0.0012 | 0.002 | 0.001110059 |
| Field: | | | | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | - | - | - | 16.3 | 14.9 | 11.1 | 12.37 | 11.70 | 13.95 |
| pH | pH units | - | - | - | - | - | - | 3.38 | 3.27 | 2.91 | 3.29 | 3.04 | 3.36 |
| Conductivity | mS/m | - | - | - | - | - | - | 107 | 104 | 101 | 52.9 | 61.8 | 69.3 |
| ORP | mV | - | - | - | - | - | - | - | - | - | 496 | 516 | 477 |
| Dissolved Oxygen | mg/L | - | - | - | - | - | - | 3.25 | 2.29 | 5.95 | 10.31 | 9.33 | 10.84 |
| Turbidity | NTU | - | - | - | - | - | - | - | - | - | <5 | <5 | 5 |
| | | | | | | | | | | | | | |
| Laboratory: | | | | | | | | | | | | | |
| pH | pH units | 3.6 | 3.5 | 3.7 | 3.6 | 3.5 | 3.9 | - | - | - | 3.2 | 3.2 | 3.3 |
| Conductivity | mS/m | 42.5 | 49 | 52 | 56.5 | 58.4 | - | - | - | - | 72.2 | 82.1 | 71.9 |
| Total Suspended Solids | $g/m^3$ | 4 | 8 | 4 | 4 | 5 | 8 | - | - | - | 24 | 11 | 25 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0022 | 0.0025 | 0.0026 |
| | | | | | | | | | | | | | |
| Anions | meq | - | - | - | - | - | - | - | - | - | - | - | - |
| Cations | meq | - | - | - | - | - | - | - | - | - | - | - | - |
| Alkalinity | $g/m^3$ as $CaCO_3$ | <1 | <1 | <1 | <1 | <1 | <1 | | | | - | - | - |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | - | - | - | - | - | - | - | - |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | - | - | - | - | - |
| Calcium | $g/m^3$ | 22 | 26.4 | 28 | 27.3 | 29.7 | 21.1 | 42.7 | 43 | 42 | - | - | - |
| Magnesium | $g/m^3$ | 10.2 | 12.5 | 14.5 | 14.4 | 15.4 | 8.64 | 30.4 | 30 | 30 | - | - | - |
| Potassium | $g/m^3$ | 1.2 | 1.6 | 1.48 | 1.44 | 1.62 | - | 2.7 | 2.5 | 2.6 | - | - | - |
| Sodium | $g/m^3$ | 10.5 | 10.1 | 10.8 | 10.6 | 11.8 | - | 10.4 | 10 | 10 | - | - | - |
| Chloride | $g/m^3$ | 12 | 11.9 | 14.1 | 12.5 | 12.5 | - | 10.5 | 11 | 11 | - | - | - |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - |
| Nitrate-N | $g/m^3$ | - | - | 0.34 | 0.3 | 0.31 | | | | | - | - | - |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - |
| Sulphate | $g/m^3$ | 158 | 184 | 242 | 227 | 239 | 153 | 731 | 661 | 703 | - | - | - |
| | | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 10 | 14 | 10 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 10 | 14 | 12 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00044 | 0.00072 | 0.00039 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00055 | 0.00077 | 0.00041 |
| Arsenic Dissolved | $g/m^3$ | - | - | 0.001 | <0.001 | 0.001 | <0.001 | 0.03 | 0.11 | 0.03 | 0.018 | 0.026 | 0.012 |
| Arsenic Total Recoverable | $g/m^3$ | - | - | 0.003 | 0.002 | 0.002 | 0.004 | 0.16 | 0.133 | 0.03 | 0.023 | 0.028 | 0.014 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.03 | 0.031 | 0.033 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.031 | 0.03 | 0.031 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00062 | 0.0008 | 0.00067 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00058 | 0.00072 | 0.0007 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.012 | 0.012 | 0.013 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.011 | 0.011 | 0.014 |
| Cadmium Dissolved | $g/m^3$ | 0.0367 | 0.0428 | 0.0708 | 0.0692 | 0.0709 | 0.0338 | 0.16 | 0.18 | 0.2 | 0.11 | 0.14 | 0.12 |
| Cadmium Total Recoverable | $g/m^3$ | - | - | 0.0688 | 0.0695 | 0.0649 | 0.0325 | 0.15 | 0.17 | 0.2 | 0.11 | 0.14 | 0.11 |
| Calcium Dissolved | $g/m^3$ | - | - | - | - | - | 21.1 | - | - | - | 26 | 24 | 25 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 25 | 23 | 26 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0028 | 0.0037 | 0.003 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0027 | 0.0037 | 0.003 |
| Copper Dissolved | $g/m^3$ | 0.222 | 0.234 | 0.403 | 0.419 | 0.342 | 0.245 | 0.78 | 0.9 | 4 | 0.96 | 1.7 | 0.97 |
| Copper Total Recoverable | $g/m^3$ | - | - | 0.415 | 0.426 | 0.347 | 0.252 | 0.78 | 0.9 | 4.4 | 1 | 1.6 | 0.99 |
| Iron Dissolved | $g/m^3$ | 2.07 | 2.82 | 1.25 | 1 | 1.97 | 1.72 | 104 | 114 | 77 | 20 | 26 | 17 |
| Iron Total Recoverable | $g/m^3$ | - | - | 2.39 | 1.67 | 3.11 | 3.73 | 103 | 119 | 78 | 22 | 26 | 19 |
| Lead Dissolved | $g/m^3$ | 0.293 | 0.354 | 0.302 | 0.418 | 0.405 | 0.187 | 2.7 | 2.2 | 1.4 | 0.71 | 0.89 | 0.87 |
| Lead Total Recoverable | $g/m^3$ | - | - | 0.314 | 0.406 | 0.428 | 0.219 | 2.8 | 2.2 | 1.7 | 0.77 | 0.91 | 0.87 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.017 | 0.022 | 0.021 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.016 | 0.021 | 0.021 |
| Magnesium Dissolved | $g/m^3$ | 10.2 | 12.5 | 14.5 | 14.4 | 15.4 | 8.64 | - | - | - | 13 | 15 | 14 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 13 | 15 | 15 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | - | - | 18 | 17 | 10 | 5.4 | 6.9 | 5.9 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 19 | 18 | 11 | 5.5 | 6.7 | 6.1 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | - | - | 0.0444 | 0.0451 | 0.0478 | 0.0176 | - | - | - | 0.054 | 0.066 | 0.053 |
| Nickel Total Recoverable | $g/m^3$ | - | - | 0.0439 | 0.0453 | 0.0473 | 0.0178 | - | - | - | 0.054 | 0.065 | 0.054 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 1.4 | 1.5 | 1.5 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 1.4 | 1.4 | 1.5 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0022 | < 0.0053 | < 0.0021 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0022 | < 0.0053 | 0.0024 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 9.3 | 9.4 | 11 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 9 | 8.9 | 11 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00079 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.00018 | 0.00023 | 0.00023 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | 0.0002 | 0.00024 | 0.00022 |
| Zinc Dissolved | $g/m^3$ | 6.58 | 9.82 | 14.3 | 13.4 | 14.7 | 6.58 | 44 | 46 | 46 | 19 | 25 | 20 |
| Zinc Total Recoverable | $g/m^3$ | - | - | 13.9 | 14.3 | 14.4 | 6.66 | 44 | 46 | 47 | 19 | 25 | 20 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-6: Water Quality Results for Tui Mine Baseline Monitoring at SW13**

| Sample Location | | Tui Stream (SW13) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | | | 09 | A815 | A970 | SW13 | TUI2 | TUI2 | TUI2 | TUI2 | SW13 | SW13 | SW13 |
| Sampled By | | URS | URS | URS | URS | URS | URS 2002 | Sharplin | Sharplin | Sharplin | Sharplin | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 25/03/98 | 20/05/98 | 6/12/00 | 19/12/00 | 22/02/01 | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | 154963/9 | 155596/10 | 158764/10 | | | | | | 728224.11 | 734195.11 | 744474.6 |
| Flow Rate | L/s | | | | | | | 20.5 | 11.3 | 136.7 | 33.6 | | | |
| Flow rate | $m^3$/sec | | | | | | | 0.0205 | 0.0113 | 0.1367 | 0.0336 | 0.0178 | 0.0886 | 0.0229 |
| Field: | | | | | | | | | | | | | | |
| Temperature | (ºC) | - | - | - | - | - | - | 16.1 | 9.71 | 12.1 | 12 | 12.15 | 10.53 | 11.76 |
| pH | pH units | - | - | - | - | - | - | 6.71 | 6.57 | 6.5 | 6.51 | 6.99 | 7.05 | 6.99 |
| Conductivity | mS/m | - | - | - | - | - | - | 12.7 | 12 | 9.2 | 11.6 | 13.8 | 8.96 | 15.3 |
| ORP | mV | - | - | - | - | - | - | - | - | - | - | 206 | 548 | 312 |
| Dissolved Oxygen | mg/L | - | - | - | - | - | - | 6.25 | 9.86 | 11.3 | 10.07 | 10.28 | 10.96 | 10.98 |
| Turbidity | NTU | - | - | - | - | - | - | - | - | - | - | <5 | <5 | 3.7 |
| | | | | | | | | | | | | | | |
| Laboratory: | | | | | | | | | | | | | | |
| pH | pH units | 6.9 | 7.1 | 6.7 | 6.9 | 6.7 | 6.8 | - | - | - | - | 6.6 | 6.5 | 6.8 |
| Conductivity | mS/m | 17.6 | 17.2 | 17.5 | 19.4 | 16.4 | 16 | - | - | - | - | 16.1 | 12.2 | 15.8 |
| Total Suspended Solids | $g/m^3$ | <3 | <3 | <3 | <3 | 3 | - | - | - | - | - | < 3.0 | 5.2 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - | |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.0010 | < 0.0010 | < 0.0010 |
| | | | | | | | | | | | | | | |
| Anions | meq | | | | | | | | | | | - | - | - |
| Cations | meq | | | | | | | | | | | - | - | - |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 13 | 14 | 15 | 18 | 15 | - | - | 6 | 5 | - | - | - | - |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | - | - | - | 12.8 | 11.3 | - | - | - | - |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | | | | - | - | - |
| Calcium | $g/m^3$ | 13 | 13.8 | 13 | 14 | 12.3 | - | 11.4 | 10.7 | 9 | - | - | - | - |
| Magnesium | $g/m^3$ | 4.89 | 5.59 | 4.99 | 5.31 | 4.69 | - | 5.56 | 3.85 | 3.5 | - | - | - | - |
| Potassium | $g/m^3$ | 0.7 | 0.8 | 0.88 | 0.87 | 0.83 | - | 0.78 | 0.79 | 0.7 | - | - | - | - |
| Sodium | $g/m^3$ | 9.6 | 9.6 | 9.79 | 10.1 | 10.1 | - | 9.31 | 9.54 | 9.5 | - | - | - | - |
| Chloride | $g/m^3$ | 10.5 | 10.1 | 11.5 | 10.7 | 10.7 | - | 10.9 | 10.7 | 10.5 | - | - | - | - |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nitrate-N | $g/m^3$ | - | - | <0.02 | 0.003 | 0.028 | - | - | - | - | - | - | - | - |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sulphate | $g/m^3$ | 50 | 49 | 48.1 | 53.6 | 40.8 | - | 42.4 | 39.2 | 29 | 37 | - | - | - |
| | | | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.067 | 0.051 | 0.099 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.49 | 0.39 | 0.46 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Arsenic Dissolved | $g/m^3$ | - | - | <0.001 | <0.001 | 0.001 | - | <d.l. | <d.l. | <d.l. | <d.l. | < 0.0011 | < 0.0011 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | - | - | - | <0.001 | 0.002 | - | <d.l. | <d.l. | 0.013192 | 0.0006 | < 0.0011 | < 0.0011 | < 0.0011 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.0092 | 0.0075 | 0.0095 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.0098 | 0.0081 | 0.0097 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.012 | 0.012 | 0.013 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.011 | 0.011 | 0.013 |
| Cadmium Dissolved | $g/m^3$ | 0.0059 | 0.00432 | 0.00487 | 0.00456 | 0.00399 | 0.00573 | 0.001 | 0.002 | 0.00574 | 0.0039 | 0.0045 | 0.0037 | 0.0054 |
| Cadmium Total Recoverable | $g/m^3$ | - | - | - | 0.00488 | 0.00399 | 0.00573 | 0.003 | 0.002 | 0.0054 | 0.0039 | 0.0048 | 0.0038 | 0.0054 |
| Calcium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 11 | 7.8 | 12 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 11 | 7.8 | 12 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0075 | 0.0043 | 0.0067 | 0.0076 | 0.0053 | 0.008 | 0.001 | 0.003 | 0.00845 | 0.0054 | 0.0081 | 0.0075 | 0.011 |
| Copper Total Recoverable | $g/m^3$ | - | - | - | 0.0183 | 0.0113 | 0.0342 | 0.006 | 0.007 | 0.09865 | 0.019 | 0.027 | 0.026 | 0.027 |
| Iron Dissolved | $g/m^3$ | <0.05 | <0.05 | <0.02 | <0.02 | <0.02 | 0.06 | 0.009 | 0.015 | 0.0221 | <0.020 | < 0.021 | 0.022 | 0.024 |
| Iron Total Recoverable | $g/m^3$ | - | - | - | 0.08 | 0.09 | 0.53 | 0.08 | 0.117 | 3.686 | 0.29 | 0.21 | 0.26 | 0.15 |
| Lead Dissolved | $g/m^3$ | 0.0023 | 0.002 | 0.0016 | 0.0028 | 0.0019 | 0.0025 | <dL | <d.l. | 0.00209 | 0.0014 | 0.0038 | 0.0023 | 0.0061 |
| Lead Total Recoverable | $g/m^3$ | - | - | - | 0.0126 | 0.0107 | 0.031 | 0.016 | 0.005 | 0.21708 | 0.024 | 0.026 | 0.022 | 0.025 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.0031 | 0.0026 | 0.0033 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.0032 | 0.0024 | 0.0034 |
| Magnesium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 4.7 | 3.4 | 4.7 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 4.7 | 3.2 | 4.7 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | - | - | 0.113 | 0.165 | 0.189 | 0.23 | 0.21 | 0.16 | 0.25 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | - | - | 0.107 | 0.18 | 0.231 | 0.22 | 0.22 | 0.16 | 0.25 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | - | - | 0.0044 | 0.0045 | 0.0037 | 0.004 | - | - | - | - | 0.0041 | 0.0026 | 0.004 |
| Nickel Total Recoverable | $g/m^3$ | - | - | - | 0.0047 | 0.0037 | 0.0041 | - | - | - | - | 0.0042 | 0.0029 | 0.004 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.78 | 0.7 | 0.75 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 0.81 | 0.72 | 0.78 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.0011 | < 0.0011 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 9.5 | 8.2 | 10 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | 9.5 | 8.4 | 10 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 1.34 | 0.992 | 0.83 | 0.755 | 0.76 | 1.11 | 0.5 | 0.5 | 0.67 | 0.78 | 0.78 | 0.62 | 0.92 |
| Zinc Total Recoverable | $g/m^3$ | - | - | - | 0.818 | 0.813 | 1.18 | 0.563 | 0.563 | 1 | 0.81 | 0.85 | 0.67 | 0.98 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

| Table G-7: Water Quality Results for Tui Mine Baseline Monitoring at SW15 | | | | |
|---|---|---|---|---|
| Sample Location | | Tunakohoia Stream Tailings Discharge (SW15 | | |
| Sample No. | | SW15 | SW15 | SW15 |
| Sampled By | | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 18/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | 728224.13 | 734195.13 | 744474.11 |
| | | | | |
| Flow rate | $m^3$/sec | 0.002 | 0.010 | 0.002 |
| Field: | | | | |
| Temperature | (ºC) | 12.52 | 12.39 | 12.87 |
| pH | pH units | 5.67 | 5.19 | 5.86 |
| Conductivity | mS/m | 7.91 | 18.1 | 2.1 |
| ORP | mV | 190 | 217 | 270 |
| Dissolved Oxygen | mg/L | 9.93 | 9.42 | 11.31 |
| Turbidity | NTU | <5 | <5 | 0.3 |
| | | | | |
| Laboratory: | | | | |
| pH | pH units | 6.3 | 6 | 6.2 |
| Conductivity | mS/m | 22.1 | 23.4 | 22.1 |
| Total Suspended Solids | $g/m^3$ | < 3.0 | 3 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | - | - | - |
| Total Cyanide | $g/m^3$ | < 0.0010 | < 0.0010 | < 0.0010 |
| | | | | |
| Anions | meq | - | - | - |
| Cations | meq | - | - | - |
| Alkalinity | $g/m^3$ as $CaCO_3$ | - | - | - |
| Bicarbonate | $g/m^3$ at 25°C | 0.03 | 0.17 | 0.019 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 0.032 | 0.23 | 0.019 |
| Calcium | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 |
| Magnesium | $g/m^3$ | < 0.00021 | 0.00044 | < 0.00021 |
| Potassium | $g/m^3$ | 0.0039 | 0.021 | 0.0022 |
| Sodium | $g/m^3$ | 0.0046 | 0.024 | 0.003 |
| Chloride | $g/m^3$ | 0.02 | 0.028 | 0.024 |
| Nitrite-N | $g/m^3$ | 0.021 | 0.028 | 0.021 |
| Nitrate-N | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Nitrate-N+Nitrite-N | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Sulphate | $g/m^3$ | 0.013 | 0.012 | 0.015 |
| | | | | |
| | | | | |
| Metals | | | | |
| | | | | |
| Aluminium Dissolved | $g/m^3$ | 0.03 | 0.17 | 0.019 |
| Aluminium Total Recoverable | $g/m^3$ | 0.032 | 0.23 | 0.019 |
| Antimony Dissolved | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 |
| Antimony Total Recoverable | $g/m^3$ | < 0.00021 | 0.00044 | < 0.00021 |
| Arsenic Dissolved | $g/m^3$ | 0.0039 | 0.021 | 0.0022 |
| Arsenic Total Recoverable | $g/m^3$ | 0.0046 | 0.024 | 0.003 |
| Barium Dissolved | $g/m^3$ | 0.02 | 0.028 | 0.024 |
| Barium Total Recoverable | $g/m^3$ | 0.021 | 0.028 | 0.021 |
| Beryllium Dissolved | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Total Recoverable | $g/m^3$ | 0.013 | 0.014 | 0.016 |
| Cadmium Dissolved | $g/m^3$ | 0.0094 | 0.018 | 0.012 |
| Cadmium Total Recoverable | $g/m^3$ | 0.0093 | 0.018 | 0.01 |
| Calcium Dissolved | $g/m^3$ | 17 | 19 | 20 |
| Calcium Total Recoverable | $g/m^3$ | 17 | 20 | 19 |
| Chromium Dissolved | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | < 0.00053 | 0.00075 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.038 | 0.17 | 0.029 |
| Copper Total Recoverable | $g/m^3$ | 0.039 | 0.17 | 0.028 |
| Iron Dissolved | $g/m^3$ | 0.22 | 1.1 | 0.12 |
| Iron Total Recoverable | $g/m^3$ | 0.23 | 1.1 | 0.12 |
| Lead Dissolved | $g/m^3$ | 0.065 | 0.24 | 0.089 |
| Lead Total Recoverable | $g/m^3$ | 0.067 | 0.24 | 0.079 |
| Lithium Dissolved | $g/m^3$ | 0.0057 | 0.0059 | 0.0059 |
| Lithium Total Recoverable | $g/m^3$ | 0.0057 | 0.0059 | 0.0062 |
| Magnesium Dissolved | $g/m^3$ | 6.6 | 7.1 | 7.1 |
| Magnesium Total Recoverable | $g/m^3$ | 6.7 | 7.1 | 7.2 |
| Manganese Dissolved | $g/m^3$ | 0.02 | 0.099 | 0.032 |
| Manganese Total Recoverable | $g/m^3$ | 0.02 | 0.094 | 0.033 |
| Mercury Dissolved | $g/m^3$ | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | < 0.00021 | 0.00098 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | < 0.00021 | 0.001 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | 0.0022 | 0.0032 | 0.0024 |
| Nickel Total Recoverable | $g/m^3$ | 0.0022 | 0.0033 | 0.0022 |
| Potassium Dissolved | $g/m^3$ | 0.98 | 1.1 | 1 |
| Potassium Total Recoverable | $g/m^3$ | 0.97 | 1.1 | 1 |
| Selenium Dissolved | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | < 0.0011 | 0.0011 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | 10 | 9.9 | 11 |
| Sodium Total Recoverable | $g/m^3$ | 11 | 11 | 12 |
| Tin Dissolved | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 1.6 | 2.8 | 1.8 |
| Zinc Total Recoverable | $g/m^3$ | 1.6 | 2.8 | 1.7 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-8: Water Quality Results for Tui Mine Baseline Monitoring at SW100**

| Sample Location | | Tunakohoia N Branch, Access Road (SW100) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | | 05 | A811 | A966 | F242 | TK3 | TK3 | TK3 | TK3 | SW100 | SW100 | SW100 |
| Sampled By | | URS | URS | URS | URS | Sharplin | Sharplin | Sharplin | Sharplin | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 6/12/00 | 19/12/00 | 22/02/01 | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | | | | | | | 728224.15 | 734195.15 | 744474.3 |
| Flow Rate | L/s | | | | | 7.97 | 4.18 | 33.15 | 16.24 | | | |
| Flow rate | $m^3$/sec | | | | | 0.0080 | 0.0042 | 0.0332 | 0.0162 | 0.0021 | 0.0103 | 0.0017 |
| Field: | | - | - | - | - | | | | | | | |
| Temperature | (ºC) | - | - | - | - | 17.13 | 13.1 | 11 | 13.5 | 14.1 | 10.66 | 12.37 |
| pH | pH units | - | - | - | - | 7.13 | 6.35 | 7.16 | 6.82 | 7.58 | 6.73 | 6.97 |
| Conductivity | mS/m | - | - | - | - | 41.1 | 34.3 | 27.9 | 40.8 | 44.9 | 19.92 | 47 |
| ORP | mV | - | - | - | - | - | - | - | - | 189 | 342 | 317 |
| Dissolved Oxygen | mg/L | - | - | - | - | 8.8 | 8.77 | 8 | 9.48 | 9.91 | 10.39 | 10.82 |
| Turbidity | NTU | - | - | - | - | - | - | - | - | <5 | <5 | 12.8 |
| | | | | | | | | | | | | |
| Laboratory: | | | | | | | | | | | | |
| pH | pH units | 7 | 7.2 | 6.8 | 7 | 7.13 | 6.35 | 7.16 | 6.82 | 7.2 | 6.9 | 7.6 |
| Conductivity | mS/m | 52.1 | 62.2 | 46.1 | 36.7 | 41.1 | 34.3 | 27.9 | 40.8 | 52.6 | 27.9 | 48.4 |
| Total Suspended Solids | $g/m^3$ | 28 | 18 | 4 | 5 | - | - | - | - | 10 | 3.2 | 7.7 |
| Total Dissolved Silica | $g/m^3$ | - | - | - | - | - | - | - | - | 16 | 14 | 15 |
| Total Cyanide | $g/m^3$ | - | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | | | | | | |
| Anions | meq | - | - | - | - | - | - | - | - | 5.8 | 2.9 | 5.6 |
| Cations | meq | - | - | - | - | - | - | - | - | 4.9 | 2.4 | 4.5 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 50 | 62 | 38 | 27 | 38 | 25 | 28 | | 49 | 20 | 44 |
| Bicarbonate | $g/m^3$ at 25°C | - | - | - | - | 55 | 50.2 | 39.7 | - | 59 | 24 | 54 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | - | - | - | - | - | - | - | - | 220 | 96 | 200 |
| Calcium | $g/m^3$ | 64.5 | 79 | 53.1 | 37.2 | 55.2 | 50.5 | 50 | - | 64 | 27 | 59 |
| Magnesium | $g/m^3$ | 13.5 | 16.5 | 11.5 | 7.82 | 12.6 | 11.5 | 11 | - | 13 | 7 | 12 |
| Potassium | $g/m^3$ | 1.05 | 1.18 | 0.97 | - | 0.88 | 0.81 | 1 | - | 1.1 | 0.67 | 0.99 |
| Sodium | $g/m^3$ | 12.3 | 13.8 | 11.6 | - | 11.8 | 11.1 | 11 | - | 13 | 9.5 | 12 |
| Chloride | $g/m^3$ | 10.9 | 10 | 10.4 | - | 10.8 | 10.3 | 10 | - | 11 | 11 | 10 |
| Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | 0.004 | < 0.0020 | 0.0052 |
| Nitrate-N | $g/m^3$ | 0.06 | 0.036 | 0.084 | - | - | - | - | - | 0.049 | 0.13 | 0.061 |
| Nitrate-N+Nitrite-N | $g/m^3$ | - | - | - | - | - | - | - | - | 0.053 | 0.13 | 0.066 |
| Sulphate | $g/m^3$ | 209 | 252 | 179 | 140 | 183 | 163 | 161 | 201 | 220 | 110 | 210 |
| | | | | | | | | | | | | |
| Metals | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Aluminium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0032 | 0.014 | < 0.0032 |
| Aluminium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.15 | 0.14 | 0.12 |
| Antimony Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00068 | < 0.00021 | 0.00049 |
| Antimony Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00096 | 0.0005 | 0.00076 |
| Arsenic Dissolved | $g/m^3$ | <0.001 | <0.001 | <0.001 | - | <d.l. | <d.l. | 0.000516 | 0.0005 | < 0.0011 | < 0.0021 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | 0.006 | 0.005 | 0.003 | - | 0.001 | 0.001 | 0.00195 | 0.0022 | 0.0028 | < 0.0021 | 0.002 |
| Barium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.025 | 0.019 | 0.026 |
| Barium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.026 | 0.021 | 0.027 |
| Beryllium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.018 | 0.014 | 0.024 |
| Boron Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.021 | 0.015 | 0.019 |
| Cadmium Dissolved | $g/m^3$ | 0.0822 | 0.0937 | 0.122 | 0.0771 | 0.089 | 0.057 | 0.103 | 0.087 | 0.098 | 0.077 | 0.088 |
| Cadmium Total Recoverable | $g/m^3$ | 0.092 | 0.102 | 0.121 | 0.0793 | 0.1 | 0.059 | 0.102 | 0.094 | 0.11 | 0.083 | 0.099 |
| Calcium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 62 | 26 | 61 |
| Calcium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 65 | 27 | 60 |
| Chromium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0097 | 0.0087 | 0.0159 | 0.0157 | 0.009 | 0.008 | 0.001986 | 0.012 | 0.0076 | 0.033 | 0.0085 |
| Copper Total Recoverable | $g/m^3$ | 0.198 | 0.146 | 0.175 | 0.119 | 0.006 | 0.043 | 0.12776 | 0.11 | 0.12 | 0.17 | 0.1 |
| Iron Dissolved | $g/m^3$ | <0.02 | <0.02 | <0.02 | <0.02 | 0.987 | 0.01 | 0.00617 | <0.020 | < 0.021 | 0.033 | < 0.021 |
| Iron Total Recoverable | $g/m^3$ | 3.73 | 3.57 | 1.93 | 1.47 | 1.24 | 1.04 | 1.423 | 1.7 | 2.4 | 1.2 | 2.1 |
| Lead Dissolved | $g/m^3$ | 0.0074 | 0.008 | 0.0061 | 0.003 | 0.01 | 0.001 | 0.00176 | 0.0055 | 0.0042 | 0.005 | 0.0028 |
| Lead Total Recoverable | $g/m^3$ | 0.174 | 0.106 | 0.0872 | 0.0806 | 0.062 | 0.012 | 0.0326 | 0.058 | 0.054 | 0.075 | 0.053 |
| Lithium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.014 | 0.0074 | 0.015 |
| Lithium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.016 | 0.0069 | 0.014 |
| Magnesium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 13 | 6.5 | 14 |
| Magnesium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 15 | 6.9 | 12 |
| Manganese Dissolved | $g/m^3$ | - | - | - | - | 0.699 | 0.711 | 0.733 | 0.91 | 1.1 | 0.49 | 1.1 |
| Manganese Total Recoverable | $g/m^3$ | - | - | - | - | 0.689 | 0.699 | 0.648 | 0.92 | 1.2 | 0.52 | 1 |
| Mercury Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00033 | < 0.00021 | 0.00032 |
| Molybdenum Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.00033 | < 0.00021 | 0.00031 |
| Nickel Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.02 | 0.0091 | 0.017 |
| Nickel Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 0.019 | 0.0091 | 0.016 |
| Potassium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 0.92 | 0.62 | 0.97 |
| Potassium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 1 | 0.67 | 0.95 |
| Selenium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0021 | < 0.0021 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.0011 | < 0.0021 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | 12 | 8.4 | 13 |
| Sodium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | 12 | 8.7 | 13 |
| Tin Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | - | - | - | - | - | - | - | - | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 11.5 | 13.7 | 15.2 | 10.1 | 10.6 | 9.35 | 13.35 | 12 | 13 | 11 | 13 |
| Zinc Total Recoverable | $g/m^3$ | 14.5 | 16.1 | 16.9 | 10.8 | 11.5 | 9.97 | 14.235 | 14 | 15 | 12 | 14 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

| Table G-9: Water Quality Results for Tui Mine Baseline Monitoring at SW101 | | | | |
|---|---|---|---|---|
| Sample Location | | Ruakaka Tributary (SW101) | | |
| Sample No. | | SW101 | SW101 | SW101 |
| Sampled By | | PDP 2009 | PDP 2009 | PDP 2009 |
| Sampling date | | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | 728224.17 | 734195.17 | 744474.4 |
| | | | | |
| Flow rate | $m^3$/sec | 0.001 | 0.025 | 0.001 |
| Field: | | | | |
| Temperature | (ºC) | 11.57 | 9.55 | 10.73 |
| pH | pH units | 7.23 | 6.57 | 6.57 |
| Conductivity | mS/m | 10.5 | 7.05 | 11.3 |
| ORP | mV | 207 | 379 | 306 |
| Dissolved Oxygen | mg/L | 10.49 | 10.64 | 11.29 |
| Turbidity | NTU | <5 | <5 | 0.5 |
| | | | | |
| Laboratory: | | | | |
| pH (pH units) | pH units | 7.2 | 7 | 7.5 |
| Conductivity | mS/m | 12.7 | 9.6 | 30 |
| Total Suspended Solids | $g/m^3$ | < 3.0 | < 3.0 | < 3.0 |
| Total Dissolved Silica | $g/m^3$ | 14 | 12 | 12 |
| Total Cyanide | $g/m^3$ | - | - | - |
| | | | | |
| Anions | meq | 1.2 | 0.88 #2 | 1.2 |
| Cations | meq | 1.0 | 0.71 #2 | 0.98 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 10 | 10 | 9.8 |
| Bicarbonate | $g/m^3$ at 25°C | 12 | 12 | 12 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 33 | 19 | 30 |
| Calcium | $g/m^3$ | *8.7* | *4.8* | *7.6* |
| Magnesium | $g/m^3$ | *2.7* | *1.7* | *2.7* |
| Potassium | $g/m^3$ | *0.73* | *0.54* | *0.72* |
| Sodium | $g/m^3$ | *8.5* | *7.1* | *8.5* |
| Chloride | $g/m^3$ | 12 | 12 | 12 |
| Nitrite-N | $g/m^3$ | < 0.0020 | < 0.0020 | < 0.0020 |
| Nitrate-N | $g/m^3$ | 0.16 | 0.25 | 0.14 |
| Nitrate-N+Nitrite-N | $g/m^3$ | 0.16 | 0.25 | 0.14 |
| Sulphate | $g/m^3$ | 30 | 16 | 32 |
| | | | | |
| Metals | | | | |
| | | | | |
| Aluminium Dissolved | $g/m^3$ | 0.0053 | 0.012 | 0.0065 |
| Aluminium Total Recoverable | $g/m^3$ | 0.013 | 0.018 | 0.008 |
| Antimony Dissolved | $g/m^3$ | 0.00046 | < 0.00021 | 0.00037 |
| Antimony Total Recoverable | $g/m^3$ | 0.00051 | 0.00036 | 0.00047 |
| Arsenic Dissolved | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 |
| Arsenic Total Recoverable | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 |
| Barium Dissolved | $g/m^3$ | 0.018 | 0.015 | 0.017 |
| Barium Total Recoverable | $g/m^3$ | 0.019 | 0.015 | 0.018 |
| Beryllium Dissolved | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Beryllium Total Recoverable | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Boron Dissolved | $g/m^3$ | 0.012 | 0.012 | 0.013 |
| Boron Total Recoverable | $g/m^3$ | 0.012 | 0.013 | 0.012 |
| Cadmium Dissolved | $g/m^3$ | 0.015 | 0.014 | 0.016 |
| Cadmium Total Recoverable | $g/m^3$ | 0.016 | 0.014 | 0.017 |
| Calcium Dissolved | $g/m^3$ | 8 | 5.6 | 7.6 |
| Calcium Total Recoverable | $g/m^3$ | 8.2 | 5.5 | 7.3 |
| Chromium Dissolved | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Chromium Total Recoverable | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Copper Dissolved | $g/m^3$ | 0.0046 | 0.0073 | 0.0057 |
| Copper Total Recoverable | $g/m^3$ | 0.0051 | 0.0073 | 0.0057 |
| Iron Dissolved | $g/m^3$ | < 0.021 | < 0.021 | < 0.021 |
| Iron Total Recoverable | $g/m^3$ | < 0.021 | < 0.021 | < 0.021 |
| Lead Dissolved | $g/m^3$ | 0.2 | 0.16 | 0.21 |
| Lead Total Recoverable | $g/m^3$ | 0.23 | 0.17 | 0.23 |
| Lithium Dissolved | $g/m^3$ | 0.0022 | 0.0015 | 0.0022 |
| Lithium Total Recoverable | $g/m^3$ | 0.0023 | 0.0015 | 0.0021 |
| Magnesium Dissolved | $g/m^3$ | 3 | 2.1 | 2.7 |
| Magnesium Total Recoverable | $g/m^3$ | 3.1 | 2.2 | 2.5 |
| Manganese Dissolved | $g/m^3$ | 0.0018 | 0.003 | 0.0014 |
| Manganese Total Recoverable | $g/m^3$ | 0.0021 | 0.0035 | 0.0013 |
| Mercury Dissolved | $g/m^3$ | < 0.000080 | < 0.000080 | < 0.000080 |
| Mercury Total Recoverable | $g/m^3$ | < 0.000080 | < 0.000080 | < 0.000080 |
| Molybdenum Dissolved | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 |
| Molybdenum Total Recoverable | $g/m^3$ | < 0.00021 | < 0.00021 | < 0.00021 |
| Nickel Dissolved | $g/m^3$ | 0.0014 | 0.0011 | 0.0012 |
| Nickel Total Recoverable | $g/m^3$ | 0.0015 | 0.0012 | 0.0011 |
| Potassium Dissolved | $g/m^3$ | 0.68 | 0.61 | 0.67 |
| Potassium Total Recoverable | $g/m^3$ | 0.7 | 0.6 | 0.68 |
| Selenium Dissolved | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 |
| Selenium Total Recoverable | $g/m^3$ | < 0.0011 | < 0.0011 | < 0.0011 |
| Silver Dissolved | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Silver Total Recoverable | $g/m^3$ | < 0.00011 | < 0.00011 | < 0.00011 |
| Sodium Dissolved | $g/m^3$ | 8 | 7.6 | 8.4 |
| Sodium Total Recoverable | $g/m^3$ | 8.2 | 7.7 | 8.6 |
| Tin Dissolved | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Tin Total Recoverable | $g/m^3$ | < 0.00053 | < 0.00053 | < 0.00053 |
| Uranium Dissolved | $g/m^3$ | < 0.000021 | < 0.000021 | < 0.000021 |
| Uranium Total Recoverable | $g/m^3$ | < 0.000021 | < 0.000021 | < 0.000021 |
| Zinc Dissolved | $g/m^3$ | 1.7 | 1.6 | 1.8 |
| Zinc Total Recoverable | $g/m^3$ | 1.7 | 1.6 | 1.7 |

*Notes:*

1. *"-" Parameter not measured*
2. *Anion/cation balanced outside DQOs*

**Table G-10: Results of Quality Assurance/Quality Control Samples**

| | | Round 1 | | | | | | | | | | | | Round 2 | | | | | | Round 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Duplicates | | | | | | Split | | | | | | Duplicate | | | Split | | | Duplicate | | | Split | | |
| Parameter | Units | SW13 | SW23 | %RPD | SW100 | SW120 | %RPD | SW13 | SW13 | %RPD | SW100 | SW100 | %RPD | SW5 | SW25 | %RPD | SW5 | SW5 | %RPD | SW11 | SW21 | %RPD | SW101 | SW101 | |
| | | Hills | Hills | | Hills | Hills | | Hills | Watercare | | Hills | Watercare | | Hills | Hills | | Hills | Watercare | | Hills | Hills | | Hills | Watercare | |
| Cation/Anion Profile | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cations (meq) | meq | | | | 5.8 | 5.8 | 0.00% | | | | 5.8 | 4.84 | 18.05% | 5.6 | 6.3 | -11.76% | 4.9 | 5.00 | -2.02% | 5.6 | 6.3 | -11.76% | 1.2 | 1.2 | 0.00% |
| Anions (meq) | meq | | | | 4.9 | 4.9 | 0.00% | | | | 4.9 | 5.62 | -13.69% | 4.9 | 4.9 | 0.00% | 5.6 | 5.80 | -3.51% | 4.9 | 4.9 | 0.00% | 0.98 | 0.96 | 2.06% |
| pH | pH Units | | | | 7.2 | 7.4 | -2.74% | | | | 7.2 | 7.4 | -2.74% | 7.1 | 6.8 | 4.32% | 7.1 | 6.90 | 2.86% | 7.1 | 6.8 | 4.32% | 7.5 | 7.1 | 5.48% |
| Alkalinity | ($g/m^3$ as $CaCO_3$) | | | | 49 | 48 | 2.06% | | | | 49 | 44.3 | 10.08% | 43 | 44 | -2.30% | 43 | 37 | 15.00% | 43 | 44 | -2.30% | 9.8 | 11 | -11.54% |
| Bicarbonate | ($g/m^3$ at 25°C) | | | | 59 | 59 | 0.00% | | | | 59 | 54.1 | 8.66% | 52 | 54 | -3.77% | 52 | 48 | 8.00% | 52 | 54 | -3.77% | 12 | 13 | -8.00% |
| Total Hardness | ($g/m^3$ as $CaCO_3$) | | | | 220 | 220 | 0.00% | | | | 220 | 217.5 | 1.14% | 220 | 220 | 0.00% | 220 | 205 | 7.06% | 220 | 220 | 0.00% | 30 | 27.77 | 7.72% |
| Electrical Conductivity | mS/m | | | | 52.6 | 52.7 | -0.19% | | | | 52.6 | 52.9 | -0.57% | 54.6 | 54.4 | 0.37% | 54.6 | 55 | 0.00% | 54.6 | 54.4 | 0.37% | 11.6 | 11.8 | -1.71% |
| Dissolved Calcium | $g/m^3$ | | | | 64 | 65 | -1.55% | | | | 64 | 63 | 1.57% | 64 | 64 | 0.00% | 64 | 59 | 8.13% | 64 | 64 | 0.00% | 7.6 | 7.7 | -1.31% |
| Dissolved Magnesium | $g/m^3$ | | | | 13 | 14 | -7.41% | | | | 13 | 14 | -7.41% | 14 | 15 | -6.90% | 14 | 14 | 0.00% | 14 | 15 | -6.90% | 2.7 | 2.7 | 0.00% |
| Dissolved Potassium | $g/m^3$ | | | | 1.1 | 1 | 9.52% | | | | 1.1 | 0.93 | 16.75% | 0.93 | 0.95 | -2.13% | 0.93 | 0.93 | 0.00% | 0.93 | 0.95 | -2.13% | 0.72 | 0.61 | 16.54% |
| Dissolved Sodium | $g/m^3$ | | | | 13 | 13 | 0.00% | | | | 13 | 12 | 8.00% | 12 | 12 | 0.00% | 12 | 14.00 | -15.38% | 12 | 12 | 0.00% | 8.5 | 7.9 | 7.32% |
| Chloride | $g/m^3$ | | | | 11 | 10 | 9.52% | | | | 11 | 10.8 | 1.83% | 11 | 10 | 9.52% | 11 | 10.70 | 2.76% | 11 | 10 | 9.52% | 12 | 11.1 | 7.79% |
| Nitrite-N | $g/m^3$ | | | | 0.004 | 0.0035 | 13.33% | | | | 0.004 | <0.002 | | < 0.0020 | < 0.0020 | | < 0.0020 | < 0.0020 | | < 0.0020 | < 0.0020 | - | < 0.0020 | <0.002 | - |
| Nitrate-N | $g/m^3$ | | | | 0.049 | 0.048 | 2.06% | | | | 0.049 | 0.04 | 20.22% | 0.062 | 0.063 | -1.60% | 0.062 | 0.048 | 25.45% | 0.062 | 0.063 | -1.60% | 0.14 | 0.102 | 31.40% |
| NitrateN+ Nirite-N | $g/m^3$ | | | | 0.053 | 0.051 | 3.85% | | | | 0.053 | 0.04 | 27.96% | 0.063 | 0.063 | 0.00% | 0.063 | 0.048 | 27.03% | 0.063 | 0.063 | 0.00% | 0.14 | 0.102 | 31.40% |
| Sulphate | $g/m^3$ | | | | 220 | 220 | 0.00% | | | | 220 | 213 | 3.23% | 210 | 240 | -13.33% | 210 | 228.00 | -8.22% | 210 | 240 | -13.33% | 32 | 23.1 | 32.30% |
| Metals -dissolved | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Aluminium* | $g/m^3$ | *0.067* | *0.056* | *17.89%* | | | | *0.067* | *0.071* | *-5.80%* | | | | *0.0083* | *0.0082* | *1.21%* | *0.0083* | *0.0067* | *21.33%* | *0.0083* | *0.0082* | *1.21%* | *0.0065* | *0.0072* | *-10.22%* |
| *Antimony* | $g/m^3$ | *< 0.00021* | *< 0.00021* | - | | | | *< 0.00021* | *<0.001* | - | | | | *0.00037* | *0.00038* | *-2.67%* | *0.00037* | *<0.001* | - | *0.00037* | *0.00038* | *-2.67%* | *0.00037* | *<0.001* | - |
| *Arsenic* | $g/m^3$ | *< 0.0011* | *< 0.0011* | - | | | | *< 0.0011* | *0.00017* | - | | | | *< 0.0053* | *< 0.0053* | - | *< 0.0053* | *0.00097* | - | *< 0.0053* | *< 0.0053* | - | *< 0.0011* | *<0001* | - |
| *Barium* | $g/m^3$ | *0.0092* | *0.0099* | *-7.33%* | | | | *0.0092* | *0.0099* | *-7.33%* | | | | *0.022* | *0.024* | *-8.70%* | *0.022* | *0.022* | *0.00%* | *0.022* | *0.024* | *-8.70%* | *0.017* | *0.017* | *0.00%* |
| *Beryllium* | $g/m^3$ | *< 0.00011* | *< 0.00011* | - | | | | *< 0.00011* | *<0.00005* | - | | | | *< 0.00011* | *< 0.00011* | - | *< 0.00011* | *<0.00005* | - | *< 0.00011* | *< 0.00011* | - | *< 0.00011* | *<0.00005* | - |
| *Boron* | $g/m^3$ | *0.012* | *0.012* | *0.00%* | | | | *0.012* | *0.018* | *-40.00%* | | | | *0.019* | *0.02* | *-5.13%* | *0.019* | *0.018* | *5.41%* | *0.019* | *0.02* | *-5.13%* | *0.013* | *0.013* | *0.00%* |
| *Cadmium* | $g/m^3$ | *0.0045* | *0.0045* | *0.00%* | | | | *0.0045* | *0.0047* | *-4.35%* | | | | *0.19* | *0.2* | *-5.13%* | *0.19* | *0.19* | *0.00%* | *0.19* | *0.2* | *-5.13%* | *0.016* | *0.015* | *6.45%* |
| *Calcium* | $g/m^3$ | *11* | *11* | *0.00%* | | | | *11* | *12* | *-8.70%* | | | | *58* | *65* | *-11.38%* | *58* | *61* | *-5.04%* | *58* | *65* | *-11.38%* | *7.6* | *7.1* | *6.80%* |
| *Chromium* | $g/m^3$ | *< 0.00053* | *< 0.00053* | - | | | | *< 0.00053* | *<0.0001* | - | | | | *< 0.00053* | *< 0.00053* | - | *< 0.00053* | *<0.0001* | - | *< 0.00053* | *< 0.00053* | - | *< 0.00053* | *<0.0001* | - |
| *Copper* | $g/m^3$ | *0.0081* | *0.0078* | *3.77%* | | | | *0.0081* | *0.008* | *1.24%* | | | | *0.043* | *0.042* | *2.35%* | *0.043* | *0.04* | *7.23%* | *0.043* | *0.042* | *2.35%* | *0.0057* | *0.0056* | *1.77%* |
| *Iron* | $g/m^3$ | *< 0.021* | *< 0.021* | - | | | | *< 0.021* | *0.022* | - | | | | *< 0.021* | *< 0.021* | - | *< 0.021* | *0.0041* | - | *< 0.021* | *< 0.021* | - | *< 0.021* | *0.036* | - |
| *Lead* | $g/m^3$ | *0.0038* | *0.003* | *23.53%* | | | | *0.0038* | *0.0038* | *0.00%* | | | | *0.00077* | *0.0009* | *-15.57%* | *0.00077* | *0.00075* | *2.63%* | *0.00077* | *0.0009* | *-15.57%* | *0.21* | *0.2* | *4.88%* |
| *Lithium* | $g/m^3$ | *0.0031* | *0.003* | *3.28%* | | | | *0.0031* | *0.0029* | *6.67%* | | | | *0.015* | *0.016* | *-6.45%* | *0.015* | *0.014* | *6.90%* | *0.015* | *0.016* | *-6.45%* | *0.0022* | *0.002* | *9.52%* |
| *Magnesium* | $g/m^3$ | *4.7* | *4.8* | *-2.11%* | | | | *4.7* | *4.5* | *4.35%* | | | | *13* | *15* | *-14.29%* | *13* | *14* | *-7.41%* | *13* | *15* | *-14.29%* | *2.7* | *2.6* | *3.77%* |
| *Manganese* | $g/m^3$ | *0.21* | *0.22* | *-4.65%* | | | | *0.21* | *0.2* | *4.88%* | | | | *1.5* | *1.7* | *-12.50%* | *1.5* | *1.4* | *6.90%* | *1.5* | *1.7* | *-12.50%* | *0.00136* | *0.0011* | *21.14%* |
| *Mercury* | $g/m^3$ | *< 0.000080* | *< 0.000080* | - | | | | *< 0.000080* | *<0.00005* | - | | | | *< 0.000080* | *< 0.000080* | - | *< 0.000080* | *< 0.00005* | - | *< 0.000080* | *< 0.000080* | - | *< 0.000080* | *< 0.000080* | - |
| *Molybdenum* | $g/m^3$ | *< 0.00021* | *< 0.00021* | - | | | | *< 0.00021* | *<0.0003* | - | | | | *0.00027* | *0.00026* | *3.77%* | *0.00027* | *0.0003* | *-10.53%* | *0.00027* | *0.00026* | *3.77%* | *< 0.00021* | *<0.0003* | - |
| *Nickel* | $g/m^3$ | *0.0041* | *0.0038* | *7.59%* | | | | *0.0041* | *0.0035* | *15.79%* | | | | *0.021* | *0.022* | *-4.65%* | *0.021* | *0.021* | *0.00%* | *0.021* | *0.022* | *-4.65%* | *0.0012* | *0.001* | *18.18%* |
| *Potassium* | $g/m^3$ | *0.78* | *0.8* | *-2.53%* | | | | *0.78* | *0.77* | *1.29%* | | | | *0.85* | *0.95* | *-11.11%* | *0.85* | *0.93* | *-8.99%* | *0.85* | *0.95* | *-11.11%* | *0.67* | *0.66* | *1.50%* |
| *Silver* | $g/m^3$ | *< 0.0011* | *< 0.0011* | - | | | | *< 0.0011* | *<0.00005* | - | | | | *< 0.0053* | *< 0.0053* | - | *< 0.0053* | *<0.00005* | - | *< 0.0053* | *< 0.0053* | - | *< 0.0011* | *0.00007* | - |
| *Selenium* | $g/m^3$ | *< 0.00011* | *< 0.00011* | - | | | | *< 0.00011* | *<0.0005* | - | | | | *< 0.00011* | *< 0.00011* | - | *< 0.00011* | *<0.0005* | - | *< 0.00011* | *< 0.00011* | - | *< 0.00011* | *<0.0005* | - |
| *Sodium* | $g/m^3$ | *9.5* | *10* | *-5.13%* | | | | *9.5* | *9.5* | *0.00%* | | | | *11* | *12* | *-8.70%* | *11* | *11* | *0.00%* | *11* | *12* | *-8.70%* | *8.4* | *7.9* | *6.13%* |
| *Tin* | $g/m^3$ | *< 0.00053* | *< 0.00053* | - | | | | *< 0.00053* | *<0.0001* | - | | | | *< 0.00053* | *< 0.00053* | - | *< 0.00053* | *<0.0001* | - | *< 0.00053* | *< 0.00053* | - | *< 0.00053* | *<0.0001* | - |
| *Uranium* | $g/m^3$ | *< 0.000021* | *< 0.000021* | - | | | | *< 0.000021* | *<0.00001* | - | | | | *< 0.000021* | *< 0.000021* | - | *< 0.000021* | *<0.00001* | - | *< 0.000021* | *< 0.000021* | - | *< 0.000021* | *<0.00001* | - |
| *Zinc* | $g/m^3$ | *0.78* | *0.78* | *0.00%* | | | | *0.78* | *0.74* | *5.26%* | | | | *27* | *29* | *-7.14%* | *27* | *25* | *7.69%* | *27* | *29* | *-7.14%* | *1.8* | *1.7* | *5.71%* |
| Metal (Total) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminium | $g/m^3$ | 0.49 | 0.49 | 0.00% | | | | 0.49 | 0.46 | 6.32% | | | | 0.44 | 0.44 | 0.00% | 0.44 | 0.39 | 12.05% | 0.44 | 0.44 | 0.00% | 0.008 | 0.01 | -22.22% |
| Antimony | $g/m^3$ | < 0.00021 | < 0.00021 | - | | | | < 0.00021 | <0.001 | - | | | | 0.00073 | 0.00097 | -28.24% | 0.00073 | <0.001 | - | 0.00073 | 0.00097 | -28.24% | 0.00047 | <0.001 | - |
| Arsenic | $g/m^3$ | < 0.0011 | < 0.0011 | - | | | | < 0.0011 | 0.0004 | - | | | | 0.0038 | 0.0054 | -34.78% | 0.0038 | 0.0037 | 2.67% | 0.0038 | 0.0054 | -34.78% | < 0.0011 | 0.00012 | - |
| Barium | $g/m^3$ | 0.0098 | 0.011 | -11.54% | | | | 0.0098 | 0.011 | -11.54% | | | | 0.023 | 0.023 | 0.00% | 0.023 | 0.022 | 4.44% | 0.023 | 0.023 | 0.00% | 0.018 | 0.017 | 5.71% |
| Beryllium | $g/m^3$ | < 0.00011 | < 0.00011 | - | | | | < 0.00011 | <0.00005 | - | | | | < 0.00011 | < 0.00011 | - | < 0.00011 | 0.00005 | - | < 0.00011 | < 0.00011 | - | < 0.00011 | <0.00005 | - |
| Boron | $g/m^3$ | 0.011 | 0.011 | 0.00% | | | | 0.011 | 0.018 | -48.28% | | | | 0.022 | 0.02 | 9.52% | 0.022 | 0.018 | 20.00% | 0.022 | 0.02 | 9.52% | 0.012 | 0.013 | -8.00% |
| Cadmium | $g/m^3$ | 0.0048 | 0.0047 | 2.11% | | | | 0.0048 | 0.0049 | -2.06% | | | | 0.21 | 0.21 | 0.00% | 0.21 | 0.2 | 4.88% | 0.21 | 0.21 | 0.00% | 0.017 | 0.015 | 12.50% |
| Calcium | $g/m^3$ | 11 | 11 | 0.00% | | | | 11 | 12 | -8.70% | | | | 63 | 63 | 0.00% | 63 | 59 | 6.56% | 63 | 63 | 0.00% | 7.3 | 7 | 4.20% |
| Chromium | $g/m^3$ | < 0.00053 | < 0.00053 | - | | | | < 0.00053 | 0.00028 | - | | | | 0.00058 | 0.00055 | 5.31% | 0.00058 | 0.0005 | 14.81% | 0.00058 | 0.00055 | 5.31% | < 0.00053 | <0.0001 | - |
| Copper | $g/m^3$ | 0.027 | 0.026 | 3.77% | | | | 0.027 | 0.026 | 3.77% | | | | 0.49 | 0.49 | 0.00% | 0.49 | 0.41 | 17.78% | 0.49 | 0.49 | 0.00% | 0.0057 | 0.0058 | -1.74% |
| Iron | $g/m^3$ | 0.21 | 0.23 | -9.09% | | | | 0.21 | 0.18 | 15.38% | | | | 4.4 | 4.4 | 0.00% | 4.4 | 4.1 | 7.06% | 4.4 | 4.4 | 0.00% | < 0.021 | 0.0051 | - |
| Lead | $g/m^3$ | 0.026 | 0.023 | 12.24% | | | | 0.026 | 0.024 | 8.00% | | | | 0.15 | 0.15 | 0.00% | 0.15 | 0.14 | 6.90% | 0.15 | 0.15 | 0.00% | 0.23 | 0.21 | 9.09% |
| Lithium | $g/m^3$ | 0.0032 | 0.0032 | 0.00% | | | | 0.0032 | 0.0029 | 9.84% | | | | 0.015 | 0.016 | -6.45% | 0.015 | 0.014 | 6.90% | 0.015 | 0.016 | -6.45% | 0.0021 | 0.002 | 4.88% |
| Magnesium | $g/m^3$ | 4.7 | 4.7 | 0.00% | | | | 4.7 | 4.5 | 4.35% | | | | 14 | 14 | 0.00% | 14 | 14 | 0.00% | 14 | 14 | 0.00% | 2.5 | 2.5 | 0.00% |
| Manganese | $g/m^3$ | 0.22 | 0.22 | 0.00% | | | | 0.22 | 0.21 | 4.65% | | | | 1.6 | 1.6 | 0.00% | 1.6 | 1.4 | 13.33% | 1.6 | 1.6 | 0.00% | 0.0013 | 0.0012 | 8.00% |
| Mercury | $g/m^3$ | < 0.000080 | < 0.000080 | - | | | | < 0.000080 | <0.00005 | - | | | | < 0.000080 | < 0.000080 | - | < 0.000080 | < 0.00005 | - | < 0.000080 | < 0.000080 | - | < 0.000080 | < 0.00005 | - |
| Molybdenum | $g/m^3$ | < 0.00021 | < 0.00021 | - | | | | < 0.00021 | <0.0003 | - | | | | 0.00036 | 0.00033 | 8.70% | 0.00036 | 0.00031 | 14.93% | 0.00036 | 0.00033 | 8.70% | < 0.00021 | <0.0003 | - |
| Nickel | $g/m^3$ | 0.0042 | 0.0041 | 2.41% | | | | 0.0042 | 0.004 | 4.88% | | | | 0.021 | 0.021 | 0.00% | 0.021 | 0.021 | 0.00% | 0.021 | 0.021 | 0.00% | 0.0011 | 0.0011 | 0.00% |
| Potassium | $g/m^3$ | 0.81 | 0.79 | 2.50% | | | | 0.81 | 0.78 | 3.77% | | | | 0.94 | 0.9 | 4.35% | 0.94 | 0.93 | 1.07% | 0.94 | 0.9 | 4.35% | 0.68 | 0.67 | 1.48% |
| Selenium | $g/m^3$ | < 0.0011 | < 0.0011 | - | | | | < 0.0011 | <0.0005 | - | | | | 0.0029 | < 0.0053 | - | 0.0029 | < 0.005 | - | 0.0029 | < 0.0053 | - | < 0.0011 | 0.00007 | - |
| Silver | $g/m^3$ | < 0.00011 | < 0.00011 | - | | | | < 0.00011 | <0.00005 | - | | | | < 0.00011 | < 0.00011 | - | < 0.00011 | < 0.00005 | - | < 0.00011 | < 0.00011 | - | < 0.00011 | <0.0005 | - |
| Sodium | $g/m^3$ | 9.5 | 10 | -5.13% | | | | 9.5 | 9.4 | 1.06% | | | | 11 | 12 | -8.70% | 11 | 14 | -24.00% | 11 | 12 | -8.70% | 8.6 | 7.8 | 9.76% |
| Tin | $g/m^3$ | < 0.00053 | < 0.00053 | - | | | | < 0.00053 | <0.0001 | - | | | | < 0.00053 | < 0.00053 | - | < 0.00053 | <0.0001 | - | < 0.00053 | < 0.00053 | - | < 0.00053 | <0.0001 | - |
| Uranium | $g/m^3$ | < 0.000021 | < 0.000021 | - | | | | < 0.000021 | <0.00001 | - | | | | < 0.000021 | < 0.000021 | - | < 0.000021 | 0.00001 | - | < 0.000021 | < 0.000021 | - | < 0.000021 | <0.00001 | - |
| Zinc | $g/m^3$ | 0.85 | 0.84 | 1.18% | | | | 0.85 | 0.79 | 7.32% | | | | 30 | 30 | 0.00% | 30 | 27 | 10.53% | 30 | 30 | 0.00% | 1.7 | 1.7 | 0.00% |

*Note "-" in %RPD calculation field indicates that a RPD could not be calculated due to the fact that one or more value was below the analytical detection limit.*

# Appendix H

**PATTLE DELAMORE PARTNERS LTD**
Level 4, 235 Broadway, Newmarket
Auckland, PO Box 9528
Newmarket, Auckland, New Zealand

Tel +9 **523 6900** Fax +9 **523 6901**
Web Site **http://www.pdp.co.nz**
**Auckland** Wellington Christchurch



***solutions*** *for your environment*

9 December 2009

Ghassan Basheer
Project Manager
Environment Waikato
PO Box 4010
**HAMILTON EAST 3247**

Dear Ghassan

**TUI MINE MONITORING: CYANIDE ANALYSIS MATRIX INTERFERENCE STUDY**

As requested, Pattle Delamore Partners Ltd (PDP) has undertaken some additional analysis for cyanide after the respective tests results of split water samples for cyanide from the Tui Mine monitoring sent to Hill Laboratories and SGS did not agree within the project data quality objectives. The aim of the additional analysis is to determine if known analytical inferences with the cyanide analysis are affecting the cyanide analysis by Hills Laboratories, and hence to validate that Hill Laboratories cyanide analysis are accurate. To do this, several water quality parameters were analysed to determine if there was a chemical interference present which could potentially affect the analysis of cyanide in the water samples collected as part of the Tui Mine baseline study. Also, modified sample preservation and handling techniques which may overcome any potential interference were also trialled and spiked cyanide samples were analysed to check the accuracy of the analytical results.

The additional analysis has shown that Hill Laboratories analyses are accurate and there are no known chemical interferences present in the water samples. The report also recommends that certain activities should be followed for future sampling at the site to ensure that no interference occurs in the future.

This report presents the details and results of the additional analysis.

## 1.0 Introduction

The first sampling round of monitoring of the water quality of streams potentially impacted by discharges from the former Tui Mine and tailings impoundment was undertaken by PDP on 17 September 2009. During the sampling round, a split water sample that was analysed for cyanide at both SGS and Hill Laboratories did not meet the project's data quality objectives (DQOs) (see Table 1). The project DQOs for duplicate and split water samples required samples whose concentration were less than five times the laboratories' detection limit to have a relative percentage difference (RPD) between the two samples to be less than 100%. The cyanide concentration in the split water sample reported by SGS was approximately 10 times higher than the concentration reported by Hill Laboratories and the RPD between the two samples was 160%. Upon conducting further enquiries with both laboratories, it was initially concluded that the most likely answer in the variation of the cyanide results was that there was matrix interference within the samples which could be causing either a positive (i.e. making the result higher) or negative (making the result lower) interference in the cyanide analysed by either laboratories.

| **Table 1: Cyanide Analysis Results Obtained during baseline monitoring** | | | | | | |
|---|---|---|---|---|---|---|
| Sample Location | | SW11 | | | SW11 | |
| Sample Name: | units | SW11 | SW11b | SW11a | SW11 | |
| | | Duplicate | Duplicate | Split Sample | Duplicate | Duplicate |
| Laboratory | | Hills | Hills | SGS | Hills | Hills |
| Sampling date | | 17-Sep-09 | 17-Sep-09 | 17-Sep-09 | 18-Oct-09 | 18-Oct-09 |
| Lab Number: | | 728224.9 | 728224.22 | | 734195.5 | 734195.12 |
| Total Cyanide | $g/m^3$ | 0.0022 ± 0.0011 | 0.0022 ± 0.0011 | 0.019 | 0.0025± 0.0012 | 0.0021 ± 0.0011 |

PDP undertook a literature survey to identify the nature of any potential interference, which included reviewing analytical methodology (APHA, ASTM and US EPA published methods), published scientific methodology, US EPA published technical notes, and consulting with a number of New Zealand and Overseas experts on cyanide analysis. The literature review identified a number of potential matrix interferences which could adversely impact on the quality of the cyanide analysis, including:

- Elemental sulphur
- Sulphides (including metal sulphides)
- Sulphite, thio-sulphite and poly thio-sulphite
- Oxidised nitrogen compounds (i.e. nitrite and nitrate)
- Strong oxidising agents (such as chlorine)
- Chloramines
- Volatile fatty acids
- Aldehydes
- Alkalinity
- Turbidity

Based upon PDP's knowledge of the site and the analytical results obtained as part of this baseline study and previous work undertaken at the site, PDP believed that the most likely interference was reduced sulphur compounds (either elemental sulphur, sulphite, thio-sulphite or metal sulphides) as there are significant quantities of metal sulphides present in the Tui tailings impoundment. Although the PDP monitoring to date indicates that the discharges are highly oxidised (Oxidation-reduction potentials of between 200-600 mV), it was considered that reduced sulphur compounds may still be present as the oxidation of these species into sulphate may be kinetically sluggish.

However, other analytical interferences may also be present in the sample matrix as well, such as strong oxidising agents or high alkalinity (at locations other than SW11, as the pH at SW11 is around 3 pH units, which is too low for any carbonate species to be present). Based upon previous analytical data collected at the site and knowledge of the site geochemistry PDP does not believe that aldehydes, chloramides, chlorine compounds, oxidising nitrogen compounds or turbidity are likely to be present at sufficient concentrations to cause an analytical interference in the samples collected as part of this study.

PDP's research shows that there are a number of different ways to overcome the interference, which could include analysing the sample within 48 hours, using different preservatives depending on the type and concentration of the interference present, and field filtering the sample before analysis.

## 2.0 Methodology

Based upon the assumption that reduced sulphur compounds are the most likely potential interferences present in the samples, PDP undertook additional sampling at two sites (SW11 (Upper reaches of the Tui Stream below Tailings dam) and SW15 (North Branch of the Tunakohoia Stream receiving a discharge from the Tailings dam)) to evaluate if a matrix interference had adversely impacted on the analysis of cyanide in the water samples.

### 2.1 Sample collection procedures

Water samples were collected upstream of the sampler and before physiochemical measurements were undertaken. The water grab samples were collected mid-stream in the main flow and care was taken not to disturb any of the sediment at the bottom of the stream. For parameters, which do not require preservatives in the sample containers (anion/cation and pH), the sample container was used to collect the sample directly and the sample container was sealed under water to prevent the loss of any dissolved gases or contamination of the sample. All sample containers were filled to the top of the containers to minimise changes to the sample due to volatilisation or oxygenation of the samples.

A multi-parameter Hannah 9828 handheld meter was used to collect physiochemical measurements at each site (Dissolved oxygen, electrical conductivity, pH, redox potential and temperature). Before use the meter was calibrated against NITS traceable standards as per the manufacturer's instructions, and in accordance with good lab practices (GLP) as detailed by USEPA and APHA / AWWA / WEF "Standard Methods for the Examination of Water and Waste Water" (21$^{st}$ edition). After the field measurements were collected, the accuracy of the pH probe was confirmed using a NITS traceable buffer solution (pH 4 at SW11 and pH 7 at SW15). The measurements of the buffer solutions obtained by the meter were within 0.05 pH units of the NITS certified value for the buffer solutions. The multi-parameter meter probes were cleaned with deionised water between monitoring sites to prevent contamination of the samples.

### 2.2 Sample analysis and preservative techniques

At each sampling site (SW11 and SW15) two sets of water samples were collected, and depending on the purpose of the analysis being undertaken on the samples, different sample handling, preservation techniques and/or laboratory procedures were used.

- In the first set of water samples (labelled sample SW11A and SW15A), the samples were analysed for anion/cation suite (alkalinity, bicarbonate, calcium, chloride, electrical conductivity, hardness, magnesium, nitrate-N, nitrite-N, pH, potassium, sodium and sulphate) and total sulphide. The aim of analysing these other compounds was to determine if elevated alkalinity, nitrate or sulphide species are present in the samples at concentrations high enough to be potential analytical interferences. These samples were also analysed for total cyanide using the standard sample handling and preservative techniques (i.e. sample were preserved using NaOH to adjust the pH to greater than 12 pH units). The purpose of this sample was to act as a control sample to compare with the cyanide results obtained using the modified sampling protocol that was used in the collection, preservation and analysis of the second set of water samples.
- A second set of water samples was sampled and collected using a modified protocol and analysed for cyanide. The purpose of the second set of samples was to test the effectiveness of the modified sampling to eliminate the effects of any matrix interferences and to test the accuracy of Hill Laboratories analysis. The modified protocol is outlined below:

1. Starch iodine paper was used to test for the presence of any strong oxidising compounds presence in the stream discharge. If there is a strong oxidising agent present in the sample then ascorbic acid will be added to the sample container instead of sodium hydroxide.
2. The sample is field filtered using 0.45 $\mu$m filter. This step is designed to remove any particulate metal sulphides, elemental sulphur or high turbidity which might act as a potential analytical inference.
3. The samples were dispatched to the laboratory immediately and tested using lead acetate test strips to confirm that the sulphide concentration within the sample was less than 50 ppm. If the sulphide concentration was less than 50 ppm, the sample was then adjusted to pH 12 using sodium hydroxide and analysed within 24 hours. If the sample tested positive using the lead acetate test strips (sulphide concentration greater than 50 ppm), then sample pH would have been adjusted to pH 11 and cadmium chloride would have been added to the sample to precipitate the sulphide compounds. If the sample contains high alkalinity or carbonate concentrations then potassium hydroxide instead of sodium hydroxide is used to adjust the pH of the sample.
4. Once the second set of samples had been preserved correctly, the sample was split into two sub-samples. One sub-sample was analysed for total cyanide (labelled as SW11B and SW15B) and the second sub-sample (labelled as SW11C and SW15C) was spiked with approximately 15 ppb of cyanide to evaluate the effectiveness of the proposed modified sampling methodology on eliminating any matrix interference and the accuracy of Hills Laboratories analysis.

The samples were sent under standard PDP chain of custody documentation to Hill Laboratories in Hamilton.

## 3.0 Results

### 3.1 Field screening results for sample preservation technique determination

Water samples were collected from the monitoring locations SW11 and SW15 on 3 November 2009 in accordance to the sampling methodology described in Section 2. To determine the most appropriate sample preservative techniques which should be used to minimise any potential cyanide losses or matrix interferences, a series of simple field tests were undertaken. Physiochemical measurements at both SW11 and SW15 indicated that the pH at these locations was very low and that the alkalinity in the samples would also be very low. On the basis of these results field staff determined that it was not necessary to add potassium hydroxide to the samples

Tests of the water samples with starch iodine paper revealed that no strong oxidising agents were present. The water samples were also tested using lead acetate paper which revealed that both samples had low concentrations of sulphide present. Therefore, it was determined that field filtering using a 0.45 $\mu$m filter and adjusting the sample pH (to be greater than pH 12) using sodium hydroxide as a preservative were the only sample preservation techniques required.

### 3.2 Analytical Results

Physiochemical and laboratory analytical results are present in Table 2 below. A calculation of anion/cation charge balance using the analytical results from the anion/cation profile indicated that a charge balance was not obtained in water sample SW11, as the number of anions measured in the water sample is larger than the number of cations. It is likely that the deficiency in reported cations in the water samples is due

to the fact that the water sample collected at SW11 contains high concentrations of various metal cations (such as Al, Fe, Mn and Zn) which will contribute to the overall cation charge, but metal cation concentrations were not measured as part of the cation profile. The fact that there was a significant difference in the number of anions compared to cations in the sample does not impact on the objectives of this study as the anion/cation profile was only selected as part of this study as the most cost-effective way to obtained the concentration of a number of potential matrix interferences (e.g. alkalinity, nitrate and nitrite) as well as to determine laboratory measurements of electrical conductivity and pH.

The laboratory pH and the field pH for SW15 (6.7 compared with 5.4 respectively) are considerably different (more than 1 pH unit). The field measurement of pH is considered to be representative of conditions found at the site because immediately after measurement was taken the accuracy of the pH meter was verified using a NITS tracable buffer solution. In addition, previous pH readings at the site have been generally between 5 and 6 pH units.

**Table 2. Physicochemical and cation/anion profiles**

| Sample Location | | SW11 | SW15 |
|---|---|---|---|
| Sample Name: | | SW11A | SW15A |
| Sampling date | | 3-Nov-09 | 3-Nov-09 |
| Lab Number: | | 740492.1 | 740492.2 |
| **Field:** | | | |
| Temperature (ºC) | | 13.22 | 13.71 |
| pH (pH units) | | 3.0 | 5.4 |
| Conductivity (ms/m) | | 72.6 | 16.8 |
| ORP (mV) | | 540.6 | 238 |
| Dissolved Oxygen | | 9.41 | 8.38 |
| Starch Iodine paper (presence of strong oxidizers) | | Negative | Negative |
| Lead Acetate Paper (high sulphide concentrations) | | Negative | Negative |
| | | | |
| **Laboratory** | | | |
| Total Cyanide | $g/m^3$ | 0.0024 | < 0.0010 |
| Total Sulphide | $g/m^3$ | < 0.0020 | < 0.0020 |
| Sum of Anions | meq/L | 9.5 | 1.4 |
| Sum of Cations | meq/L | 3.7 | 1.3 |
| pH | pH Units | 3.2 | 6.7 |
| Total Alkalinity | $g/m^3$ as $CaCO_3$ | < 1.0 | 16 |
| Bicarbonate | $g/m^3$ at 25°C | < 1.0 | 20 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 130 | 37 |
| Electrical Conductivity (EC) | mS/m | 78.3 | 14.9 |
| Dissolved Calcium | $g/m^3$ | 27 | 9.3 |
| Dissolved Magnesium | $g/m^3$ | 15 | 3.4 |
| Dissolved Potassium | $g/m^3$ | 1.6 | 0.6 |
| Dissolved Sodium | $g/m^3$ | 11 | 13 |
| Chloride | $g/m^3$ | 12 | 18 |
| Nitrite-N | $g/m^3$ | 0.0085 | < 0.0020 |
| Nitrate-N | $g/m^3$ | 0.16 | 0.048 |
| Nitrate-N + Nitrite-N | $g/m^3$ | 0.17 | 0.048 |
| Sulphate | $g/m^3$ | 440 | 28 |

The results for the cyanide analysis undertaken on the Hills laboratory are presented in Table 3.

- SW11A and SW15A water samples were collected using standard field sampling techniques and analysed within 5 days of being collected from the field.
- SW11B and SW15B water samples were collected using the modified field sampling technique described above and the samples were analysed within 48 hours of being collected.
- SW11C and SW15C were collected using the modified field sampling technique described above and the samples were analysed within 48 hours of being collected after being spiked with 15 ppb of cyanide.

It should be noted that SW11B was initially analysed by Hills laboratory within six hours of the sample being collected and then again 24 hours after the sample was collected. The first result was 0.0023 $g/m^3$ and the second result was 0.0043 $g/m^3$. The second result was used in the official laboratory report as sample SW11B was re-run at the same time as SW11C was analysed. The high relative percentage difference between the two results (61%) probably reflects the level of uncertainty in the measurement of cyanide near the method detection limit rather than any change in the actual concentration of cyanide in the sample between measurements.

**Table 3. Cyanide Monitoring data**

| Sample Location | | SW11 | | | SW15 | | |
|---|---|---|---|---|---|---|---|
| Sample Name: | | SW11A | SW11B | SW11C | SW15A | SW15B | SW15C |
| Sampling date | | 3-Nov-09 | 3-Nov-09 | 3-Nov-09 | 3-Nov-09 | 3-Nov-09 | 3-Nov-09 |
| Lab Number: | | 740492.1 | 740488.1 | 740488.3 | 740492.2 | 740488.2 | 740488.4 |
| Total Cyanide | $g/m^3$ | 0.0024±0.0012 | 0.0043±0.0019 | 0.017±0.0072 | < 0.0010 | < 0.0010 | 0.015 |

## 4.0 Discussion

The analysis of the water samples collected from monitoring locations SW11 and SW15 found no evidence of any appreciable concentrations of known analytical interference such as alkalinity, nitrite, oxidising agents (i.e. chlorine) or sulphide compounds. Spiked recoveries efficiency of the two samples were greater than 89%, which suggests that there are no significant analytical interference present in the sample collected from these two sites. If the first analytical results of sample SW11B is used to calculate recovery efficiencies, then the spiked recoveries efficiency of the two samples is approximately 100%.

The reported concentration in water sample SW11A and SW11B had a very high relative percentage difference (89%) (see Table 4). However, when considering the analytical uncertainty of measurements for these two results, the results were statistically indistinguishable. The high relative percentage difference exhibited by these samples is within the range typically expected for analysis near (less than 5x the method detection limit) the method detection limit. It should be noted that the relative percentage difference between the first measurement of SW11B and the second measurement (reported concentration) of SW11B is approximately 60% (see Table 5), which is similar to the variability observed between SW11A and SW11B. Therefore, it appears that the apparent high variability between the two sampling methodologies is due to analytical variability rather than any differences as a result of the two sampling methodologies.

| **Table 4. Relative percentage difference between two different sample methodologies and analysis for cyanide** | | | | |
|---|---|---|---|---|
| Sample Location | | SW11 | | |
| Sample Name: | | SW11A | SW11B | RPD |
| Sampling date | | 3-Nov-09 | 3-Nov-09 | |
| Lab Number: | | 740492.1 | 740488.1 | |
| Total Cyanide | $g/m^3$ | 0.0024±0.0012 | 0.0043±0.0019 | 58.8% |

| **Table 5. Relative Percentage Difference between two analysis of SW11B** | | | | |
|---|---|---|---|---|
| Sample Location | | SW11 | | |
| Sample Name: | | SW11B | SW11B | RPD |
| Sampling date | | 3-Nov-09 | 3-Nov-09 | |
| Lab Number: | | 740492.1 | 740488.1 | |
| Total Cyanide | $g/m^3$ | 0.0043±0.0019 | 0.0023±0.0019 | 60.6% |

Laboratory hold times did not appear to have a significant influence on the analytical results reported by the laboratory, as the concentrations of the cyanide measured in the sample within 6 hours of collection and 5 days later are almost numerically identical. On the basis of these results, the hold time for these samples for cyanide appears to be up to 5 days.

Standard field collection procedures appear to be satisfactory for collecting water samples at the site. This is demonstrated by the fact that the concentrations of cyanide within samples SW11A and SW11B are statistically indistinguishable and the excess concentration of cyanide in sample SW11C (approximately 0.002 $g/m^3$) is within the uncertainty of measurement of the results obtained from samples SW11A and SW11B.

## 5.0 Conclusion

Based upon this assessment the following conclusions can be drawn for these results:

1. On the basis of these results Hill Laboratories analysis appears to be accurate and reproducible.
2. Cyanide is present at low ppb concentrations at monitoring site SW11 and below the analytical detection limit (less than 1 ppb) at SW15.
3. Holding times for water sample collected from the Tui mine site which are undergoing analysis for cyanide is up to 5 days.

Although, there are no known analytical inferences within the water samples currently, addition of lime to the tailings and rehabilitation/re-construction of the tailing dam could result in the increase of several potential matrix inferences, such as high alkalinity, increased sulphide concentrations (especially particulate sulphides) and/or increased turbidity. Therefore, as a precautionary measure it is recommended that the following measures are implemented for any further water sampling undertaken for cyanide in waters discharged from the tailings dam.

1. That all field samples continued to be field filtered, this is in case remediation of the tailings dam results in the additional mobilisation of sulphide compounds or suspended solids.
2. That Potassium Iodine paper is continued to be used to confirm that strong oxidising agents are not present in the discharges.

It may also be prudent if cyanide monitoring is being undertaken as part of any post remedial monitoring programme to undertake an anion/cation analysis to verify that alkalinity is unlikely to be a significant analytical interference at SW11 and SW15.

## 6.0 Limitation

The report has been prepared for Environment Waikato according to their instructions, for the particular objectives described in the report. The information contained in the report should not be used by anyone else or for any other purposes.

Yours faithfully

**PATTLE DELAMORE PARTNERS LIMITED**

pp **Andrew Rumsby**

**Keith Delamore**

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 740492 | SUPv2 |
| **Contact:** | A Rumsby | **Date Registered:** | 03-Nov-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 11-Nov-2009 | |
| | PO Box 9528 | **Quote No:** | | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | A02277601 | |
| | | **Submitted By:** | A Rumsby | |

**Sample Type: Aqueous**

| | | Sample Name: | SW11a 03-Nov-2009 | SW15a 03-Nov-2009 | | |
|---|---|---|---|---|---|---|
| | | Lab Number: | 740492.1 | 740492.2 | | |
| Individual Tests | | | | | | |
| Total Cyanide | g/m³ | | 0.0024 ± 0.0012 | < 0.0010 ± 0.00067 | - | - |
| Total Sulphide | g/m³ | | < 0.002 ± 0.0014 | < 0.002 ± 0.0014 | - | - |
| Anion / Cation profile, dissolved metals trace level | | | | | | |
| Sum of Anions | meq/L | | 9.5 | 1.4 | - | - |
| Sum of Cations | meq/L | | 3.7 | 1.3 | - | - |
| pH | pH Units | | 3.2 ± 0.2 | 6.7 ± 0.2 | - | - |
| Total Alkalinity | g/m³ as $CaCO_3$ | | < 1.0 ± 0.67 | 16.2 ± 1.3 | - | - |
| Bicarbonate | g/m³ at 25°C | | < 1.0 ± -1.0 | 19.7 ± 1.8 | - | - |
| Total Hardness | g/m³ as $CaCO_3$ | | 129.9 ± 6.0 | 37.1 ± 1.8 | - | - |
| Electrical Conductivity (EC) | mS/m | | 78.3 ± 0.5 | 14.9 ± 0.2 | - | - |
| Dissolved Calcium | g/m³ | | 26.5 ± 1.7 | 9.29 ± 0.59 | - | - |
| Dissolved Magnesium | g/m³ | | 15.5 ± 1.1 | 3.38 ± 0.23 | - | - |
| Dissolved Potassium | g/m³ | | 1.62 ± 0.13 | 0.597 ± 0.055 | - | - |
| Dissolved Sodium | g/m³ | | 11.2 ± 1.2 | 12.9 ± 1.4 | - | - |
| Chloride | g/m³ | | 12.18 ± 0.97 | 17.8 ± 1.4 | - | - |
| Nitrite-N | g/m³ | | 0.0085 ± 0.0014 | < 0.002 ± 0.0014 | - | - |
| Nitrate-N | g/m³ | | 0.161 ± 0.018 | 0.0479 ± 0.0052 | - | - |
| Nitrate-N + Nitrite-N | g/m³ | | 0.170 ± 0.018 | 0.0479 ± 0.0050 | - | - |
| Sulphate | g/m³ | | 440 ± 30 | 28.0 ± 1.9 | - | - |

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

## Analyst's Comments

We note that the anion/cation does not balance for sample 740492.1 (SW11a). This may be due to the high levels of dissolved Al=13, Fe=16, Mn=6, Zn=23 $g.m^{-3}$).

# 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: Aqueous**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Anion / Cation profile, dissolved metals trace level | | - | 1-2 |
| Filtration, Unpreserved | Sample filtration through 0.45µm membrane filter. | - | 1-2 |

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-$CN^-$ C & E 21st ed. 2005. | - | 1-2 |
| Total anions for anion/cation balance check | Calculation: sum of anions as mEquiv/L. | 0.070 meq/L | 1-2 |
| Total cations for anion/cation balance check | Calculation: sum of cations as mEquiv/L. | 0.050 meq/L | 1-2 |
| pH | pH meter. APHA 4500-$H^+$ B 21st ed. 2005. | 0.1 pH Units | 1-2 |
| Total Alkalinity | Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 21st ed. 2005. | 1.0 $g/m^3$ as $CaCO_3$ | 1-2 |
| Bicarbonate | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-$CO_2$ D 21st ed. 2005. | 1.0 $g/m^3$ at 25°C | 1-2 |
| Total Hardness | Calculation from Calcium and Magnesium. | 1.0 $g/m^3$ as $CaCO_3$ | 1-2 |
| Electrical Conductivity (EC) | Conductivity meter, 25°C. APHA 2510 B 21st ed. 2005. | 0.1 mS/m | 1-2 |
| Filtration for dissolved metals analysis | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 21st ed. 2005. | - | 1-2 |
| Dissolved Calcium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 $g/m^3$ | 1-2 |
| Dissolved Magnesium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 $g/m^3$ | 1-2 |
| Dissolved Potassium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.050 $g/m^3$ | 1-2 |
| Dissolved Sodium | Filtered sample, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.020 $g/m^3$ | 1-2 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-$CN^-$ C & E 21st ed. 2005. | 0.0010 $g/m^3$ | 1-2 |
| Chloride | Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 $Cl^-$ E (modified from continuous flow analysis) 21st ed. 2005. | 0.50 $g/m^3$ | 1-2 |
| Nitrite-N | Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 $g/m^3$ | 1-2 |
| Nitrate-N | Calculation: (Nitrate-N + Nitrite-N) - NO2N. | 0.0020 $g/m^3$ | 1-2 |
| Nitrate-N + Nitrite-N | Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-$NO_3^-$ I (Proposed) 21st ed. 2005. | 0.0020 $g/m^3$ | 1-2 |
| Sulphide Microdistillation | Acid distillation of sample into alkaline trapping solution using Lachat MICRO DIST system. APHA 4500-$S^{2-}$ I 21st ed. 2005. | - | 1-2 |
| Total Sulphide | Sulphide microdistillation. Automated methylene blue colorimetry, flow injection analyser. APHA 4500-$S^{2-}$ I 21st ed. 2005. | 0.0020 $g/m^3$ | 1-2 |
| Sulphate | Filtered sample. Ion Chromatography. APHA 4110 B 21st ed. 2005. | 0.50 $g/m^3$ | 1-2 |

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

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

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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Pattle Delamore Partners Ltd | **Lab No:** | 740488 | SUPv3 |
| **Contact:** | A Rumsby | **Date Registered:** | 03-Nov-2009 | |
| | C/- Pattle Delamore Partners Ltd | **Date Reported:** | 11-Nov-2009 | |
| | PO Box 9528 | **Quote No:** | 38292 | |
| | Newmarket | **Order No:** | | |
| | AUCKLAND 1149 | **Client Reference:** | AO2277601 | |
| | | **Submitted By:** | A Rumsby | |

## Amended Report

This report replaces an earlier report issued on the 09 Nov 2009 at 11:33 am
A comment has been added to the cyanide result of sample 740488.1 at the request of the client.

**Sample Type: Aqueous**

| | | Sample Name: | SW11b 03-Nov-2009 10:30 am | SW15b 03-Nov-2009 10:30 am | SW11c (15ppb spike) 03-Nov-2009 | SW15c (15ppb spike) 03-Nov-2009 |
|---|---|---|---|---|---|---|
| | | Lab Number: | 740488.1 | 740488.2 | 740488.3 | 740488.4 |
| Total Cyanide | g/m³ | | 0.0043 ± 0.0019 #1 | < 0.0010 ± 0.00067 | 0.0170 ± 0.0072 | 0.0155 ± 0.0066 |

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

## Analyst's Comments

#1 It should be noted that this sample was analysed twice, the first within 6hrs of the sample being taken and the second approximately 24hr later. The first result was 0.0023g/m3 and the second was 0.0043g/m3 which was reported.

# 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: Aqueous**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| Total Cyanide Distillation | Distillation following the addition of sulphuric acid, alkaline trapping solution. APHA 4500-CN- C & E 21st ed. 2005. | - | 1-4 |
| Total Cyanide | Distillation, colorimetry. APHA 4500-CN- C & E 21st ed. 2005. | 0.0010 g/m³ | 1-4 |

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.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

# Appendix I

**Table I-1: Mass Flux Results for Tui Mine Baseline Monitoring**

| Sample Location | Level 4 Adit | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample No. | SW3 | ADIT4 | ADIT4 | ADIT4 | SW3 | SW3 | SW3 |
| Sampled By | URS | Sharplin | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | | 728224.1 | 734195.1 | 744474.1 |
| | | | | | | | |
| Flow rate ($m^3/s$) | 0.005 | 0.0003 | 0.0008 | 0.0006 | 0.0002 | 0.0021 | 0.0004 |
| | | | | | | | |
| Anion/cations (g/day) | | | | | | | |
| Calcium | 2467 | 240 | 610 | 347 | 142 | 1222 | 309 |
| Magnesium | 613 | 67 | 129 | 74 | 34 | 274 | 65 |
| Potassium | - | 11 | 29 | 20 | 7 | 75 | 15 |
| Sodium | - | 166 | 518 | 347 | 112 | 1240 | 228 |
| Chloride | - | 225 | 680 | 446 | 142 | 1824 | 309 |
| Nitrite-N | - | - | - | - | - | - | - |
| Nitrate-N | - | - | - | - | 2 | 31 | 5 |
| Nirate-N+Nitrite-N | - | - | - | - | 2 | 31 | 5 |
| Sulphate | 6134 | 577 | 1232 | 594 | 284 | 2188 | 873 |
| | | | | | | | |
| Metals (g/day) | | | | | | | |
| Dissolved Aluminium | - | - | - | - | - | 2.9 | - |
| Aluminium | - | - | - | - | 0.10 | 0.84 | - |
| Dissolved Antimony | - | - | - | - | - | - | - |
| Antimony | - | - | - | - | - | - | - |
| Dissolved Arsenic | - | - | - | - | - | - | - |
| Arsenic | - | - | 0.07 | - | - | - | - |
| Dissolved Barium | - | - | - | - | 0.10 | 0.80 | 0.2 |
| Barium | - | - | - | - | 0.10 | 0.86 | 0.2 |
| Dissolved Beryllium | - | - | - | - | - | - | - |
| Beryllium | - | - | - | - | - | - | - |
| Dissolved Boron | - | - | - | - | 0.17 | 2.0 | 0.4 |
| Boron | - | - | - | - | 0.16 | 1.8 | 0.3 |
| Dissolved Cadmium | 1.0 | 0.11 | 0.21 | 0.12 | 0.05 | 0.29 | 0.12 |
| Cadmium | 1.3 | 0.11 | 0.28 | 0.12 | 0.05 | 0.27 | 0.12 |
| Dissolved Calcium | - | - | - | - | 139 | 1222 | 309 |
| Calcium | - | - | - | - | 138 | 1204 | 302 |
| Dissolved Chromium | - | - | - | - | - | - | - |
| Chromium | - | - | - | - | - | - | - |
| Dissolved Copper | 1.9 | 0.09 | 0.07 | 0.04 | 0.03 | 0.18 | 0.04 |
| Copper | 54 | 0.09 | 2.66 | 0.05 | 0.04 | 0.22 | 0.50 |
| Dissoved Iron | - | 0.35 | 1.1 | 0.22 | - | - | - |
| Iron | 549 | 0.63 | 29 | 26 | - | - | - |
| Dissolved Lead | 0.26 | - | - | - | 0.01 | 0.09 | 0.03 |
| Lead | 30 | 0.07 | 0.56 | 0.27 | 0.02 | 0.15 | 0.03 |
| Dissolved Lithium | - | - | - | - | 0.03 | 0.31 | 0.06 |
| Lithium | - | - | - | - | 0.03 | 0.29 | 0.06 |
| Dissolved Magnesium | - | - | - | - | 33 | 292 | 68.6 |
| Magnesium | - | - | - | - | 33 | 274 | 62.3 |
| Dissolved Manganese | - | 0.07 | 0.04 | 0.02 | 0.03 | | 0.03 |
| Manganese | - | 0.07 | 0.42 | 0.04 | 0.03 | 0.13 | 0.02 |
| Dissolved Mercury | - | - | - | - | - | - | - |
| Mercury | - | - | - | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - | - | - | - |
| Molybdenum | - | - | - | - | - | - | - |
| Dissolved Nickel | - | - | - | - | - | - | - |
| Nickel | - | - | - | - | - | - | - |
| Dissolved Potassium | - | - | - | - | 6.5 | 75 | 13 |
| Potassium | - | - | - | - | 6.7 | 75 | 14 |
| Dissolved Selenium | - | - | - | - | - | - | - |
| Selenium | - | - | - | - | - | - | - |
| Dissolved Silver | - | - | - | - | - | - | - |
| Silver | - | - | - | - | - | - | 0.1 |
| Dissolved Sodium | - | - | - | - | 102 | 1204 | 228 |
| Sodium | - | - | - | - | 102 | 1149 | 234 |
| Dissolved Tin | - | - | - | - | - | - | - |
| Tin | - | - | - | - | - | - | - |
| Dissolved Uranium | - | - | - | - | - | - | - |
| Uranium | - | - | - | - | - | - | - |
| Dissolved Zinc | 109 | 13 | 21 | 9.2 | 5.8 | 33 | 13 |
| Zinc | 165 | 13 | 26 | 9.2 | 5.5 | 33 | 13 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| **Table I-2: Mass Flux Results for Tui Mine Baseline Monitoring** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Location | Level 5 Adit | | | | | | | |
| Sample No. | SW5 | AD5 | AD5 | AD5 | AD5 | SW5 | SW5 | SW5 |
| Sampled By | URS | Sharplin | Sharplin | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | | | 728224.3 | 734195.2 | 744474.2 |
| | | | | | | | | |
| Flow rate ($m^3/s$) | 0.01 | 0.010 | 0.007 | 0.012 | 0.014 | 0.0057 | 0.0102 | 0.0081 |
| | | | | | | | | |
| Anion/cations (g/day) | | | | | | | | |
| Calcium | 53136 | 69782 | 48478 | 85088 | - | 43338 | 56402 | 63685 |
| Magnesium | 10282 | 12758 | 9515 | 15565 | - | 8865 | 12338 | 12597 |
| Potassium | - | 1027 | 662 | 1453 | - | 640 | 820 | 910 |
| Sodium | - | 12415 | 8792 | 15046 | - | 7387 | 10575 | 10498 |
| Chloride | - | 8733 | 6143 | 10584 | - | 4925 | 9694 | 6998 |
| Nitrite-N | - | - | - | - | - | - | - | - |
| Nitrate-N | - | - | - | - | - | 12 | 55 | 23 |
| Nirate-N+Nitrite-N | - | - | - | - | - | 12 | 56 | 23 |
| Sulphate | 203040 | 238030 | 161392 | 286644 | 360772 | 132970 | 185069 | 195955 |
| | | | | | | | | |
| Metals (g/day) | | | | | | | | |
| Dissolved Aluminium | - | - | - | - | - | 2.3 | 7.3 | 3.1 |
| Aluminium | - | - | - | - | - | 128 | 388 | 182 |
| Dissolved Antimony | - | - | - | - | - | 0.31 | 0.33 | 0.43 |
| Antimony | - | - | - | - | - | 0.49 | 0.64 | 0.70 |
| Dissolved Arsenic | - | 0.86 | 0.48 | 1.4 | 1.9 | - | - | 0.98 |
| Arsenic | - | 3.4 | 1.8 | 4.1 | 6.4 | 2.6 | 3.3 | 3.4 |
| Dissolved Barium | - | - | - | - | - | 12 | 19 | 18 |
| Barium | - | - | - | - | - | 12 | 20 | 19 |
| Dissolved Beryllium | - | - | - | - | - | - | - | - |
| Beryllium | - | - | - | - | - | - | - | - |
| Dissolved Boron | - | - | - | - | - | 12 | 17 | 19 |
| Boron | - | - | - | - | - | 11 | 19 | 18 |
| Dissolved Cadmium | 115 | 28 | 62 | 166 | 148 | 64 | 167 | 84 |
| Cadmium | 124 | 92 | 69 | 149 | 161 | 74 | 185 | 98 |
| Dissolved Calcium | - | - | - | - | - | 42353 | 51114 | 58787 |
| Calcium | - | - | - | - | - | 41861 | 55521 | 62286 |
| Dissolved Chromium | - | - | - | - | - | - | - | - |
| Chromium | - | - | - | - | - | - | 0.51 | - |
| Dissolved Copper | 13 | 6.8 | 3.0 | 26 | 15 | 4.2 | 38 | 7 |
| Copper | 192 | 116 | 60 | 449 | 235 | 98 | 432 | 147 |
| Dissoved Iron | - | 27.0 | 7.2 | 474 | - | - | - | - |
| Iron | 2618 | 2106 | 1903 | 2827 | 4571 | 2315 | 3878 | 2939 |
| Dissolved Lead | 0.78 | 0.86 | - | - | 0.37 | 0.12 | 0.68 | 0.18 |
| Lead | 85 | 34 | 18 | 33 | 95 | 35 | 132 | 54 |
| Dissolved Lithium | - | - | - | - | - | 9.8 | 13 | 15 |
| Lithium | - | - | - | - | - | 9.4 | 13 | 14 |
| Dissolved Magnesium | - | - | - | - | - | 8865 | 11457 | 12597 |
| Magnesium | - | - | - | - | - | 8865 | 12338 | 13297 |
| Dissolved Manganese | - | 1301 | 927 | 378 | 1977 | 936 | 1322 | 1190 |
| Manganese | - | 1344 | 970 | 1440 | 1977 | 886 | 1410 | 1190 |
| Dissolved Mercury | - | - | - | - | - | - | - | - |
| Mercury | - | - | - | - | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - | - | 0.29 | 0.24 | 0.30 |
| Molybdenum | - | - | - | - | - | 0.29 | 0.32 | 0.32 |
| Dissolved Nickel | 16 | - | - | - | - | 12 | 19 | 16 |
| Nickel | 17 | - | - | - | - | 12 | 19 | 16 |
| Dissolved Potassium | - | - | - | - | - | 542 | 749 | 840 |
| Potassium | - | - | - | - | - | 542 | 828 | 770 |
| Dissolved Selenium | - | - | - | - | - | - | - | - |
| Selenium | - | - | - | - | - | - | 2.6 | - |
| Dissolved Silver | - | - | - | - | - | - | - | - |
| Silver | - | - | - | - | - | - | - | 0.21 |
| Dissolved Sodium | - | - | - | - | - | 6402 | 9694 | 10498 |
| Sodium | - | - | - | - | - | 6402 | 9694 | 9798 |
| Dissolved Tin | - | - | - | - | - | - | - | - |
| Tin | - | - | - | - | - | - | - | - |
| Dissolved Uranium | - | - | - | - | - | - | - | - |
| Uranium | - | - | - | - | - | - | - | - |
| Dissolved Zinc | 15034 | 14556 | 8792 | 25527 | 22239 | 9850 | 23795 | 13297 |
| Zinc | 16762 | 15669 | 10117 | 26537 | 24710 | 10835 | 26438 | 15396 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| **Table I-3: Mass Flux Results for Tui Mine Baseline Monitoring** | | | | | | |
|---|---|---|---|---|---|---|
| Sample Location | Tunakohoia North Branch, Downstream | | | | | |
| Sample No. | SW7 | TK2 | TK2 | SW7 | SW7 | SW7 |
| Sampled By | URS | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | 24/01/02 | 3/05/07 | 27/07/07 | 17/09/09 | 8/10/09 | 17/09/09 |
| Laboratory Number | | | | 728224.5 | 734195.3 | 744474.15 |
| | | | | | | |
| Flow rate ($m^3/s$) | 0.029 | 0.053 | 0.027 | 0.0179 | 0.1089 | 0.0198 |
| | | | | | | |
| Anion/cations (g/day) | | | | | | |
| Calcium | - | 168864 | 69984 | - | - | - |
| Magnesium | - | 50751 | 25661 | - | - | - |
| Potassium | - | 4199 | 2100 | - | - | - |
| Sodium | - | 51674 | 25661 | - | - | - |
| Chloride | - | 51213 | 25661 | - | - | - |
| Nitrite-N | - | - | - | - | - | - |
| Nitrate-N | - | - | - | - | - | - |
| Nirate-N+Nitrite-N | - | - | - | - | - | - |
| Sulphate | 330739 | - | 239625 | - | - | - |
| | | | | | | |
| Metals (g/day) | | | | | | |
| Dissolved Aluminium | - | - | - | 247 | 790 | 94 |
| Aluminium | - | - | - | 588 | 2729 | 582 |
| Dissolved Antimony | - | - | - | 0.34 | | 1.3 |
| Antimony | - | - | - | 0.42 | 2.5 | 2.2 |
| Dissolved Arsenic | - | - | 1.6 | - | - | - |
| Arsenic | - | - | 11 | - | 39 | |
| Dissolved Barium | - | - | - | 37 | 198 | 43 |
| Barium | - | - | - | 37 | 216 | 43 |
| Dissolved Beryllium | - | - | - | - | - | - |
| Beryllium | - | - | - | - | - | - |
| Dissolved Boron | - | - | - | 23 | 122 | 26 |
| Boron | - | - | - | 25 | 132 | 29 |
| Dissolved Cadmium | 86 | 125 | 105 | 71 | 263 | 84 |
| Cadmium | - | 125 | 107 | 74 | 273 | 84 |
| Dissolved Calcium | - | - | - | 55676 | 169361 | 61586 |
| Calcium | - | - | - | 57223 | 178770 | 61586 |
| Dissolved Chromium | - | - | - | - | - | - |
| Chromium | - | - | - | - | - | - |
| Dissolved Copper | 22 | 37 | 3.5 | 32 | 188 | 17 |
| Copper | - | 92 | 144 | 63 | 612 | 72 |
| Dissoved Iron | - | 92 | 76 | 247 | 348 | |
| Iron | - | 1380 | 1962 | 634 | 3858 | 941 |
| Dissolved Lead | 29 | 14 | 5.8 | 22 | 113 | 6 |
| Lead | | 46 | 70 | 51 | 941 | 62 |
| Dissolved Lithium | - | - | - | 15 | 44 | 16 |
| Lithium | - | - | - | 15 | 47 | 17 |
| Dissolved Magnesium | - | - | - | 17012 | 51749 | 17107 |
| Magnesium | - | - | - | 17012 | 52690 | 18818 |
| Dissolved Manganese | - | 2173 | 858 | 851 | 2164 | 941 |
| Manganese | - | 2035 | 851 | 882 | 2258 | 1078 |
| Dissolved Mercury | - | - | - | - | - | - |
| Mercury | - | - | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - | 42 | - |
| Molybdenum | - | - | - | - | 47 | 0.39 |
| Dissolved Nickel | 21 | - | - | 17 | 43 | 16 |
| Nickel | - | - | - | 17 | 47 | 17 |
| Dissolved Potassium | - | - | - | 1531 | 15054 | 1608 |
| Potassium | - | - | - | 1547 | 16936 | 1711 |
| Dissolved Selenium | - | - | - | - | - | - |
| Selenium | - | - | - | - | - | 2.05 |
| Dissolved Silver | - | - | - | - | - | - |
| Silver | - | - | - | - | - | - |
| Dissolved Sodium | - | - | - | 17012 | 89385 | 20529 |
| Sodium | - | - | - | 17012 | 90326 | 20529 |
| Dissolved Tin | - | - | - | - | - | - |
| Tin | - | - | - | - | - | 0.98 |
| Dissolved Uranium | - | - | - | - | - | - |
| Uranium | - | - | - | - | - | - |
| Dissolved Zinc | 11325 | 27775 | 14358 | 10207 | 36695 | 11633 |
| Zinc | - | 29113 | 14729 | 10826 | 38577 | 12317 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| Table I-4: Mass Flux Results for Tui Mine Baseline Monitoring | | | |
|---|---|---|---|
| Sample Location | Tunakohoia south Branch, Downstream | | |
| Sample No. | SW8 | SW8 | SW8 |
| Sampled By | PDP | PDP | PDP |
| Sampling date | 17/09/09 | 8/10/09 | 17/09/09 |
| Laboratory Number | 728224.7 | 734195.4 | 744474.16 |
| | | | |
| Flow rate ($m^3/s$) | 0.025 | 0.1237 | 0.0382 |
| | | | |
| Anion/cations (g/day) | | | |
| Calcium | - | - | - |
| Magnesium | - | - | - |
| Potassium | - | - | - |
| Sodium | - | - | - |
| Chloride | - | - | - |
| Nitrite-N | - | - | - |
| Nitrate-N | - | - | - |
| Nirate-N+Nitrite-N | - | - | - |
| Sulphate | - | - | - |
| | | | |
| Metals (g/day) | | | |
| Dissolved Aluminium | 35 | 545 | 99 |
| Aluminium | 65 | 791 | 158 |
| Dissolved Antimony | - | - | 0.9 |
| Antimony | - | - | 2.2 |
| Dissolved Arsenic | - | - | - |
| Arsenic | - | - | - |
| Dissolved Barium | 13 | 58 | 19 |
| Barium | 14 | 67 | 20 |
| Dissolved Beryllium | - | - | - |
| Beryllium | - | - | - |
| Dissolved Boron | 20 | 102 | 33 |
| Boron | 21 | 118 | 29 |
| Dissolved Cadmium | - | - | - |
| Cadmium | - | - | - |
| Dissolved Calcium | 14256 | 54507 | 21123 |
| Calcium | 14904 | 58782 | 19803 |
| Dissolved Chromium | - | - | - |
| Chromium | - | - | - |
| Dissolved Copper | - | - | 2.1 |
| Copper | - | 6.4 | 2.5 |
| Dissoved Iron | - | 278 | 96 |
| Iron | 54 | 385 | 172 |
| Dissolved Lead | - | - | - |
| Lead | - | 3.8 | - |
| Dissolved Lithium | 1.1 | 7.5 | 1.7 |
| Lithium | 1.3 | 8.4 | 1.9 |
| Dissolved Magnesium | 5616 | 21375 | 7591 |
| Magnesium | 5832 | 22444 | 6601 |
| Dissolved Manganese | - | 15 | 3.6 |
| Manganese | 3.0 | 30 | 6.3 |
| Dissolved Mercury | - | - | - |
| Mercury | - | - | - |
| Dissolved Molybdenum | - | - | - |
| Molybdenum | - | - | - |
| Dissolved Nickel | - | - | - |
| Nickel | - | - | - |
| Dissolved Potassium | 1102 | 4809 | 1518 |
| Potassium | 1145 | 5237 | 1485 |
| Dissolved Selenium | - | - | - |
| Selenium | - | - | - |
| Dissolved Silver | - | - | - |
| Silver | - | - | - |
| Dissolved Sodium | 17064 | 74814 | 25744 |
| Sodium | 17496 | 78020 | 23763 |
| Dissolved Tin | - | - | - |
| Tin | - | - | - |
| Dissolved Uranium | - | - | - |
| Uranium | - | - | - |
| Dissolved Zinc | 3.7 | 16 | - |
| Zinc | 2.8 | - | 7.9 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| Table I-5: Mass Flux Results for Tui Mine Baseline Monitoring | | | | |
|---|---|---|---|---|
| Sample Location | Taillings Drainage, Tui Tributary | | | |
| Sample No. | SW11 | SW11 | SW11 | SW11 |
| Sampled By | URS | PDP | PDP | PDP |
| Sampling date | 15/12/01 | 18/09/09 | 8/10/09 | 17/09/09 |
| Laboratory Number | | 728224.9 | 734195.5 | 744474.9 |
| | | | | |
| Flow rate ($m^3/s$) | 0.01 | 0.0012 | 0.0020 | 0.0011 |
| | | | | |
| Anion/cations (g/day) | | | | |
| Calcium | 18230 | - | - | - |
| Magnesium | 7465 | - | - | - |
| Potassium | - | - | - | - |
| Sodium | - | - | - | - |
| Chloride | - | - | - | - |
| Nitrite-N | - | - | - | - |
| Nitrate-N | - | - | - | - |
| Nirate-N+Nitrite-N | - | - | - | - |
| Sulphate | 132192 | - | - | - |
| | | | | |
| Metals (g/day) | | | | |
| Dissolved Aluminium | - | 1037 | 2419 | 959 |
| Aluminium | - | 1037 | 2419 | 1151 |
| Dissolved Antimony | - | 0.05 | 0.12 | 0.04 |
| Antimony | - | 0.06 | 0.13 | 0.04 |
| Dissolved Arsenic | - | 1.9 | 4.5 | 1.2 |
| Arsenic | 3.5 | 2.4 | 4.8 | 1.3 |
| Dissolved Barium | - | 3.1 | 5.4 | 3.2 |
| Barium | - | 3.2 | 5.2 | 3.0 |
| Dissolved Beryllium | - | 0.06 | 0.14 | 0.06 |
| Beryllium | - | 0.06 | 0.12 | 0.07 |
| Dissolved Boron | - | 1.2 | 2.1 | 1.2 |
| Boron | - | 1.1 | 1.9 | 1.3 |
| Dissolved Cadmium | 29 | 11 | 24 | 12 |
| Cadmium | 28 | 11 | 24 | 11 |
| Dissolved Calcium | - | 2696 | 4147 | 2398 |
| Calcium | - | 2592 | 3974 | 2494 |
| Dissolved Chromium | - | 0.29 | 0.64 | 0.29 |
| Chromium | - | 0.28 | 0.64 | 0.29 |
| Dissolved Copper | 212 | 100 | 294 | 93 |
| Copper | 218 | 104 | 276 | 95 |
| Dissoved Iron | 1486 | 2074 | 4493 | 1630 |
| Iron | 3223 | 2281 | 4493 | 1822 |
| Dissolved Lead | 162 | 74 | 154 | 83 |
| Lead | 189 | 80 | 157 | 83 |
| Dissolved Lithium | - | 1.8 | 3.8 | 2.0 |
| Lithium | - | 1.7 | 3.6 | 2.0 |
| Dissolved Magnesium | - | 1348 | 2592 | 1343 |
| Magnesium | - | 1348 | 2592 | 1439 |
| Dissolved Manganese | - | 560 | 1192 | 566 |
| Manganese | - | 570 | 1158 | 585 |
| Dissolved Mercury | - | - | - | - |
| Mercury | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - |
| Molybdenum | - | - | - | - |
| Dissolved Nickel | 15 | 5.6 | 11 | 5.1 |
| Nickel | 15 | 5.6 | 11 | 5.2 |
| Dissolved Potassium | - | 145 | 259 | 144 |
| Potassium | - | 145 | 242 | 144 |
| Dissolved Selenium | - | 0.23 | - | - |
| Selenium | - | 0.23 | - | 0.23 |
| Dissolved Silver | - | - | - | - |
| Silver | - | - | - | - |
| Dissolved Sodium | - | 964 | 1624 | 1055 |
| Sodium | - | 933 | 1538 | 1055 |
| Dissolved Tin | - | - | - | - |
| Tin | - | - | - | - |
| Dissolved Uranium | - | 0.02 | 0.04 | 0.02 |
| Uranium | - | 0.02 | 0.04 | 0.02 |
| Dissolved Zinc | 5685 | 1970 | 4320 | 1918 |
| Zinc | 5754 | 1970 | 4320 | 1918 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

**Table I-6: Mass Flux Results for Tui Mine Baseline Monitoring**

| Sample Location | Tui Stream, Downstream | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample No. | SW13 | TUI2 | TUI2 | TUI2 | TUI2 | SW13 | SW13 | SW13 |
| Sampled By | URS | Sharplin | Sharplin | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | 15/12/01 | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | | | | | | 728224.11 | 734195.11 | 744474.6 |
| | | | | | | | | |
| Flow rate ($m^3/s$) | 0.04 | 0.021 | 0.011 | 0.137 | 0.034 | 0.018 | 0.089 | 0.0229 |
| | | | | | | | | |
| Anion/cations (g/day) | | | | | | | | |
| Calcium | 35251 | 20192 | 10447 | 106298 | - | - | - | - |
| Magnesium | 13513 | 9848 | 3759 | 41338 | - | - | - | - |
| Potassium | - | 1382 | 771 | 8268 | - | - | - | - |
| Sodium | - | 16490 | 9314 | 112203 | - | - | - | - |
| Chloride | - | 19306 | 10447 | 124014 | - | - | - | - |
| Nitrite-N | - | - | - | - | - | - | - | - |
| Nitrate-N | - | - | - | - | - | - | - | - |
| Nirate-N+Nitrite-N | - | - | - | - | - | - | - | - |
| Sulphate | 144461 | 75099 | 38272 | 342516 | 107412 | - | - | - |
| | | | | | | | | |
| Metals (g/day) | | | | | | | | |
| Dissolved Aluminium | - | - | - | - | - | 103 | 390 | 196 |
| Aluminium | - | - | - | - | - | 754 | 2985 | 910 |
| Dissolved Antimony | - | - | - | - | - | - | - | - |
| Antimony | - | - | - | - | - | - | - | - |
| Dissolved Arsenic | - | - | - | - | - | - | - | - |
| Arsenic | - | - | - | 156 | 1.7 | - | - | - |
| Dissolved Barium | - | - | - | - | - | 14 | 57 | 19 |
| Barium | - | - | - | - | - | 15 | 62 | 19 |
| Dissolved Beryllium | - | - | - | - | - | - | - | - |
| Beryllium | - | - | - | - | - | - | - | - |
| Dissolved Boron | - | - | - | - | - | 18 | 92 | 26 |
| Boron | - | | | - | - | 17 | 84 | 26 |
| Dissolved Cadmium | 20 | 1.8 | 2 | 68 | 11 | 6.9 | 28 | 11 |
| Cadmium | 20 | 5.3 | 2 | 64 | 11 | 7.4 | 29 | 11 |
| Dissolved Calcium | - | - | - | - | - | 16917 | 59709 | 23743 |
| Calcium | - | - | - | - | - | 16917 | 59709 | 23743 |
| Dissolved Chromium | - | - | - | - | - | - | - | - |
| Chromium | - | - | - | - | - | - | - | - |
| Dissolved Copper | 28 | 1.8 | 2.9 | 100 | 16 | 12 | 57 | 22 |
| Copper | 118 | 11 | 6.83 | 1165 | 55 | 42 | 199 | 53 |
| Dissoved Iron | 207 | 16 | 15 | 261 | - | - | 168 | - |
| Iron | 1832 | 142 | 114 | 43535 | 842 | 323 | 1990 | - |
| Dissolved Lead | 8.6 | - | - | 25 | 4.1 | 5.8 | 18 | 12 |
| Lead | 107 | 28 | 4.9 | 2564 | 70 | 40 | 168 | 49 |
| Dissolved Lithium | - | - | - | - | - | 4.8 | 20 | 65 |
| Lithium | - | - | - | - | - | 4.9 | 18 | 7 |
| Dissolved Magnesium | - | - | - | - | - | 7228 | 26027 | 9299 |
| Magnesium | - | - | - | - | - | 7228 | 24496 | 9299 |
| Dissolved Manganese | - | 200 | 161 | 2232 | 668 | 323 | 1225 | 495 |
| Manganese | - | 190 | 176 | 2728 | 639 | 338 | 1225 | 495 |
| Dissolved Mercury | - | - | - | - | - | - | - | - |
| Mercury | - | - | - | - | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - | - | - | - | - |
| Molybdenum | - | - | - | - | - | - | - | - |
| Dissolved Nickel | 14 | - | - | - | - | 6.3 | 20 | 8 |
| Nickel | 14 | - | - | - | - | 6.5 | 22 | 8 |
| Dissolved Potassium | - | - | - | - | - | 1200 | 5359 | *1484* |
| Potassium | - | - | - | - | - | 1246 | 5512 | *1543* |
| Dissolved Selenium | - | - | - | - | - | - | - | - |
| Selenium | - | - | - | - | - | - | - | - |
| Dissolved Silver | - | - | - | - | - | - | - | - |
| Silver | - | - | - | - | - | - | - | - |
| Dissolved Sodium | - | - | - | - | - | 14610 | 62771 | 19786 |
| Sodium | - | - | - | - | - | 14610 | 64302 | 19786 |
| Dissolved Tin | - | - | - | - | - | - | - | - |
| Tin | - | - | - | - | - | - | - | - |
| Dissolved Uranium | - | - | - | - | - | - | - | - |
| Uranium | - | - | - | - | - | - | - | - |
| Dissolved Zinc | 3836 | 886 | 488 | 7913 | 2264 | 1200 | 4746 | 1820 |
| Zinc | 4078 | 997 | 550 | 11811 | 2351 | 1307 | 5129 | 1939 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| Table I-7: Mass Flux Results for Tui Mine Baseline Monitoring | | | |
|---|---|---|---|
| Sample Location | Tailings Drainage, Tunakohoia Tributary | | |
| Sample No. | SW15 | SW15 | SW15 |
| Sampled By | PDP | PDP | PDP |
| Sampling date | 18/09/09 | 8/10/09 | 0/01/00 |
| Laboratory Number | 728224.13 | 734195.7 | 744474.11 |
| | | | |
| Flow rate ($m^3/s$) | 0.0021 | 0.0103 | 0.0017 |
| | | | |
| Anion/cations (g/day) | | | |
| Calcium | - | - | - |
| Magnesium | - | - | - |
| Potassium | - | - | - |
| Sodium | - | - | - |
| Chloride | - | - | - |
| Nitrite-N | - | - | - |
| Nitrate-N | - | - | - |
| Nirate-N+Nitrite-N | - | - | - |
| Sulphate | - | - | - |
| | | | |
| Metals (g/day) | | | |
| Dissolved Aluminium | 5.5 | 151 | 2.8 |
| Aluminium | 5.9 | 204 | 2.8 |
| Dissolved Antimony | - | - | - |
| Antimony | - | 0.39 | - |
| Dissolved Arsenic | 0.72 | 19 | 0.32 |
| Arsenic | 0.85 | 21 | 0.44 |
| Dissolved Barium | 3.7 | 25 | 3.5 |
| Barium | 3.9 | 25 | 3.1 |
| Dissolved Beryllium | - | - | - |
| Beryllium | - | - | - |
| Dissolved Boron | 2.4 | 11 | 2.2 |
| Boron | 2.4 | 12 | 2.4 |
| Dissolved Cadmium | 1.7 | 16 | 1.8 |
| Cadmium | 1.7 | 16 | 1.5 |
| Dissolved Calcium | 3138 | 16837 | 2938 |
| Calcium | 3138 | 17723 | 2791 |
| Dissolved Chromium | - | - | - |
| Chromium | - | 0.66 | - |
| Dissolved Copper | 7.0 | 151 | 4.3 |
| Copper | 7.2 | 151 | 4.1 |
| Dissoved Iron | 41 | 975 | 18 |
| Iron | 42 | 975 | 18 |
| Dissolved Lead | 12 | 213 | 13 |
| Lead | 12 | 213 | 12 |
| Dissolved Lithium | 1.1 | 5.2 | 0.87 |
| Lithium | 1.1 | 5.2 | 0.91 |
| Dissolved Magnesium | 1218 | 6292 | 1043 |
| Magnesium | 1237 | 6292 | 1058 |
| Dissolved Manganese | 3.7 | 88 | 4.7 |
| Manganese | 3.7 | 83 | 4.8 |
| Dissolved Mercury | - | - | - |
| Mercury | - | - | - |
| Dissolved Molybdenum | - | 0.87 | - |
| Molybdenum | - | 0.89 | - |
| Dissolved Nickel | 0.41 | 2.8 | 0.35 |
| Nickel | 0.41 | 2.9 | 0.32 |
| Dissolved Potassium | 181 | 975 | 147 |
| Potassium | 179 | 975 | 147 |
| Dissolved Selenium | - | - | - |
| Selenium | - | 0.97 | - |
| Dissolved Silver | - | - | - |
| Silver | - | - | - |
| Dissolved Sodium | 1846 | 8773 | 1616 |
| Sodium | 2030 | 9748 | 1763 |
| Dissolved Tin | - | - | - |
| Tin | - | - | - |
| Dissolved Uranium | - | - | - |
| Uranium | - | - | - |
| Dissolved Zinc | 295 | 2481 | 264 |
| Zinc | 295 | 2481 | 250 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| **Table I-8: Mass Flux Results for Tui Mine Baseline Monitoring** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Location | Tunakohoia North Branch, Upstream | | | | | | |
| Sample No. | TK3 | TK3 | TK3 | TK3 | SW100 | SW100 | SW100 |
| Sampled By | Sharplin | Sharplin | Sharplin | Sharplin | PDP | PDP | PDP |
| Sampling date | 30/01/07 | 3/05/07 | 27/07/07 | 3/11/07 | 17/09/09 | 8/10/09 | 17/09/09 |
| Laboratory Number | | | | | 728224.16 | 734195.9 | 744474.3 |
| | | | | | | | |
| Flow rate ($m^3/s$) | 0.0080 | 0.0042 | 0.0330 | 0.0160 | 0.0057 | 0.0251 | 0.0134 |
| | | | | | | | |
| Anion/cations (g/day) | | | | | | | |
| Calcium | 38011 | 18238 | 143208 | - | 31519 | 58553 | 68308 |
| Magnesium | 8676 | 4153 | 31506 | - | 6402 | 15180 | 13893 |
| Potassium | 606 | 293 | 2864 | - | 542 | 1453 | 1146 |
| Sodium | 8126 | 4009 | 31506 | - | 6402 | 20602 | 13893 |
| Chloride | 7437 | 3720 | 28642 | - | 5417 | 23855 | 11578 |
| Nitrite-N | - | - | - | - | 1.97 | - | 6.02 |
| Nitrate-N | - | - | - | - | 24.1 | 282 | 70.6 |
| Nirate-N+Nitrite-N | - | - | - | - | 26.1 | 282 | 76.4 |
| Sulphate | 126015 | 58868 | 461588 | 282030 | 108346 | 238550 | 243130 |
| | | | | | | | |
| Metals (g/day) | | | | | | | |
| Dissolved Aluminium | - | - | - | - | - | 30 | - |
| Aluminium | - | - | - | - | 74 | 304 | 139 |
| Dissolved Antimony | - | - | - | - | 0.33 | | 0.57 |
| Antimony | - | - | - | - | 0.47 | 1.08 | 0.88 |
| Dissolved Arsenic | - | - | 1.5 | 0.70 | - | - | - |
| Arsenic | 0.69 | 0.36 | 5.6 | 3.1 | 1.38 | - | 2.32 |
| Dissolved Barium | - | - | - | - | 12.3 | 41 | 30.1 |
| Barium | - | - | - | - | 12.8 | 46 | 31.3 |
| Dissolved Beryllium | - | - | - | - | - | - | - |
| Beryllium | - | - | - | - | - | - | - |
| Dissolved Boron | - | - | - | - | 8.9 | 30 | 27.8 |
| Boron | - | - | - | - | 10.3 | 33 | 22.0 |
| Dissolved Cadmium | 61 | 21 | 295 | 122 | 48 | 167 | 102 |
| Cadmium | 69 | 21 | 292 | 132 | 54 | 180 | 115 |
| Dissolved Calcium | - | - | - | - | 30534 | 56385 | 70623 |
| Calcium | - | - | - | - | 32011 | 58553 | 69466 |
| Dissolved Chromium | - | - | - | - | - | - | - |
| Chromium | - | - | - | - | - | - | - |
| Dissolved Copper | 6.2 | 2.9 | 5.7 | 17 | 3.7 | 72 | 9.8 |
| Copper | 4.1 | 16 | 366 | 154 | 59 | 369 | 116 |
| Dissoved Iron | 680 | 3.6 | 18 | - | - | 72 | - |
| Iron | 854 | 376 | 4076 | 2385 | 1182 | 2602 | 2431 |
| Dissolved Lead | 6.9 | 0.36 | 5.0 | 7.7 | 2.07 | 10.8 | 3.24 |
| Lead | 43 | 4.3 | 93 | 81 | 26.6 | 163 | 61.4 |
| Dissolved Lithium | - | - | - | - | 6.9 | 16.0 | 17.4 |
| Lithium | - | - | - | - | 7.9 | 15 | 16.2 |
| Dissolved Magnesium | - | - | - | - | 6402 | 14096.16 | 16209 |
| Magnesium | - | - | - | - | 7387 | 14964 | 13893 |
| Dissolved Manganese | 481 | 257 | 1856 | 1277 | 542 | 1063 | 1274 |
| Manganese | 474 | 252 | 2099 | 1291 | 591 | 1128 | 1158 |
| Dissolved Mercury | - | - | - | - | - | - | - |
| Mercury | - | - | - | - | - | - | - |
| Dissolved Molybdenum | - | - | - | - | 0.16 | - | 0.37 |
| Molybdenum | - | - | - | - | 0.16 | - | 0.36 |
| Dissolved Nickel | - | - | - | - | 9.8 | 19.7 | 19.7 |
| Nickel | - | - | - | - | 9.4 | 19.7 | 18.5 |
| Dissolved Potassium | - | - | - | - | 453 | 1345 | 1123 |
| Potassium | - | - | - | - | 492 | 1453 | 1100 |
| Dissolved Selenium | - | - | - | - | - | - | - |
| Selenium | - | - | - | - | - | - | - |
| Dissolved Silver | - | - | - | - | - | - | - |
| Silver | - | - | - | - | - | - | - |
| Dissolved Sodium | - | - | - | - | 5910 | 18217 | 15051 |
| Sodium | - | - | - | - | 5910 | 18867 | 15051 |
| Dissolved Tin | - | - | - | - | - | - | - |
| Tin | - | - | - | - | - | - | - |
| Dissolved Uranium | - | - | - | - | - | - | - |
| Uranium | - | - | - | - | - | - | - |
| Dissolved Zinc | 7299 | 3377 | 38237 | 16838 | 6402 | 23855 | 15051 |
| Zinc | 7919 | 3601 | 40771 | 19644 | 7387 | 26024 | 16209 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not measured*

| Table I-9: Mass Flux Results for Tui Mine Baseline Monitoring | | | |
|---|---|---|---|
| Sample Location | Ruakaka Tributary | | |
| Sample No. | SW101 | SW101 | SW101 |
| Sampled By | PDP | PDP | PDP |
| Sampling date | 17/09/09 | 8/10/09 | 17/11/09 |
| Laboratory Number | 728224.17 | 734195.1 | 744474.4 |
| | | | |
| Flow rate ($m^3/s$) | 0.00072 | 0.025 | 0.00127 |
| | | | |
| Anion/cations (g/day) | | | |
| Calcium | 543 | 10407 | 832 |
| Magnesium | 168 | 3686 | 296 |
| Potassium | 46 | 1171 | 79 |
| Sodium | 530 | 15394 | 930 |
| Chloride | 748 | 26017 | 1313 |
| Nitrite-N | - | - | - |
| Nitrate-N | 10 | 542 | 15 |
| Nirate-N+Nitrite-N | 10 | 542 | 15 |
| Sulphate | 1871 | 34690 | 3502 |
| | | | |
| Metals (g/day) | | | |
| Dissolved Aluminium | 0.33 | 26 | 0.71 |
| Aluminium | 0.81 | 39 | 0.88 |
| Dissolved Antimony | 0.03 | - | 0.04 |
| Antimony | 0.03 | 0.78 | 0.05 |
| Dissolved Arsenic | - | - | - |
| Arsenic | - | - | - |
| Dissolved Barium | 1.1 | 33 | 1.9 |
| Barium | 1.2 | 33 | 2.0 |
| Dissolved Beryllium | - | - | - |
| Beryllium | - | - | - |
| Dissolved Boron | 0.75 | 26 | 1.4 |
| Boron | 0.75 | 28 | 1.3 |
| Dissolved Cadmium | 0.94 | 30 | 1.8 |
| Cadmium | 1.00 | 30 | 1.9 |
| Dissolved Calcium | 499 | 12141 | 832 |
| Calcium | 511 | 11925 | 799 |
| Dissolved Chromium | - | - | - |
| Chromium | - | - | - |
| Dissolved Copper | 0.29 | 16 | 0.62 |
| Copper | 0.32 | 16 | 0.62 |
| Dissoved Iron | - | - | - |
| Iron | - | - | - |
| Dissolved Lead | 12 | 347 | 23 |
| Lead | 14 | 369 | 25 |
| Dissolved Lithium | 0.14 | 3.3 | 0.24 |
| Lithium | 0.14 | 3.3 | 0.23 |
| Dissolved Magnesium | 187 | 4553 | 296 |
| Magnesium | 193 | 4770 | 274 |
| Dissolved Manganese | 0.11 | 6.5 | 0.15 |
| Manganese | 0.13 | 7.6 | 0.14 |
| Dissolved Mercury | - | - | - |
| Mercury | - | - | - |
| Dissolved Molybdenu | - | - | - |
| Molybdenum | - | - | - |
| Dissolved Nickel | 0.09 | 2.4 | 0.13 |
| Nickel | 0.09 | 2.6 | 0.12 |
| Dissolved Potassium | 42 | 1323 | 73 |
| Potassium | 44 | 1301 | 74 |
| Dissolved Selenium | - | - | - |
| Selenium | - | - | - |
| Dissolved Silver | - | - | - |
| Silver | - | - | - |
| Dissolved Sodium | 499 | 16478 | 919 |
| Sodium | 511 | 16695 | 941 |
| Dissolved Tin | - | - | - |
| Tin | - | - | - |
| Dissolved Uranium | - | - | - |
| Uranium | - | - | - |
| Dissolved Zinc | 106 | 3469 | 197 |
| Zinc | 106 | 3469 | 186 |

*Note: "-" denotes the concentration was either below analytical detection limit or parameter was not me*

# Appendix J

## Statistical Analysis of the data

Statistical summaries of the data for the various monitoring sites are presented in Tables J-1 to J-9. An arithmetic mean was used for estimating the central tendency of the data, rather than the geometric mean or harmonic mean because this is the approach preferred by the US EPA in estimating exposure. The arithmetic mean is always greater or equal to the value calculated for either the geometric mean or harmonic mean.

In calculating site statistics, where the concentration of an analyte was below the detection limit, a value of half the detection limit was used for that sample in the calculation. However, it should be noted that care should be taken where more than 20% of the data is below the detection limit. Substituting half the detection limit for the value below the detection limit could change the population distribution and, therefore, result in an incorrect estimate of the mean. In such cases, the medium might be a better indicator of the central tendency rather than the arithmetic mean. The medium has been reported to be less than half the detection limit where more than 50% of the data is below the detection limit.

### Data Suitability for Statistical Analysis

To undertake a meaningful statistical analysis using a t-test to detect any difference before and after the remediation of Tui Mine site it is usually recommended that at least six discrete (i.e. above detection limits) data points are obtained.

Generally, in most datasets there were only a sufficient number of discrete (above detection limit) observations to conduct statistical analysis on pH, electrical conductivity, dissolved and total cadmium, copper, lead, manganese, nickel and zinc. At monitoring sites SW15 (Upper Tailing dam) and SW101 (Ruakaka adits tributaries) no datasets were of a sufficient size to allow them to be used for statistical analysis.

It should be noted that not all the above parameters are normally distributed and despite the fact that the data may be of sufficient size to undertake a t-test it may not be valid to do so. A Kolmogorov-Smirnov normality test was used to test if the data was normally distributed or not. The results of the Kolmogorov-Smirnov normality test suggest that only the following data sets are normally distributed (and have more than six discrete observations)

- SW3 - alkalinity, bicarbonate, electrical conductivity, calcium, magnesium, potassium, nitrate, cadmium (dissolved and total), copper (dissolved), iron (total), lead (dissolved and total), manganese (dissolved), nickel (dissolved and total) and zinc (dissolved and total).
- SW5- pH, alkalinity, bicarbonate, electrical conductivity, calcium, magnesium, potassium, nitrate, sulphate, arsenic (total), cadmium (dissolved and total), copper (dissolved and total), iron (total),

manganese (dissolved and total), nickel (dissolved and total) and zinc (dissolved and total).

- SW7 – pH, electrical conductivity, cadmium (dissolved and total), copper (dissolved and total), iron (total), lead (dissolved and total), manganese (dissolved and total), nickel (dissolved) and zinc (dissolved and total).
- SW8 - pH, electrical conductivity, copper (dissolved and total).
- SW11 – pH, electrical conductivity, arsenic (dissolved and total), cadmium (dissolved and total), copper (dissolved and total), iron (dissolved and total), lead (dissolved and total), manganese (dissolved and total), nickel (dissolved and total) and zinc (dissolved and total).
- SW13 – pH, electrical conductivity cadmium (dissolved and total), copper (dissolved), lead (dissolved) manganese (dissolved and total), nickel (dissolved) and zinc (dissolved and total).
- SW100 - pH, alkalinity, bicarbonate, electrical conductivity, calcium, magnesium, sodium, potassium, nitrate, sulphate, arsenic (total), cadmium (dissolved and total), copper (dissolved and total), iron (total), lead (dissolved and total), manganese (dissolved and total), nickel (dissolved and total) and zinc (dissolved and total).

It may be possible on some of the other suitably sized other datasets to use data transformation techniques (such as log transformation or log-log transformation) to transform the data into a normally distributed dataset for statistical analysis. It should be noted that all of the current datasets are too small to consider using non-parametric statistical tests.

For datasets which are either too small or not normally distributed, it may be possible to evaluate if there has been a significant change in concentrations by either graphical methods (such as box and whisker plots) or by reviewing the data if the change in concentration is large enough (i.e. more than one or two orders of magnitude). Figures K-1 to K-10 provide graphical representations of the current and historical data.

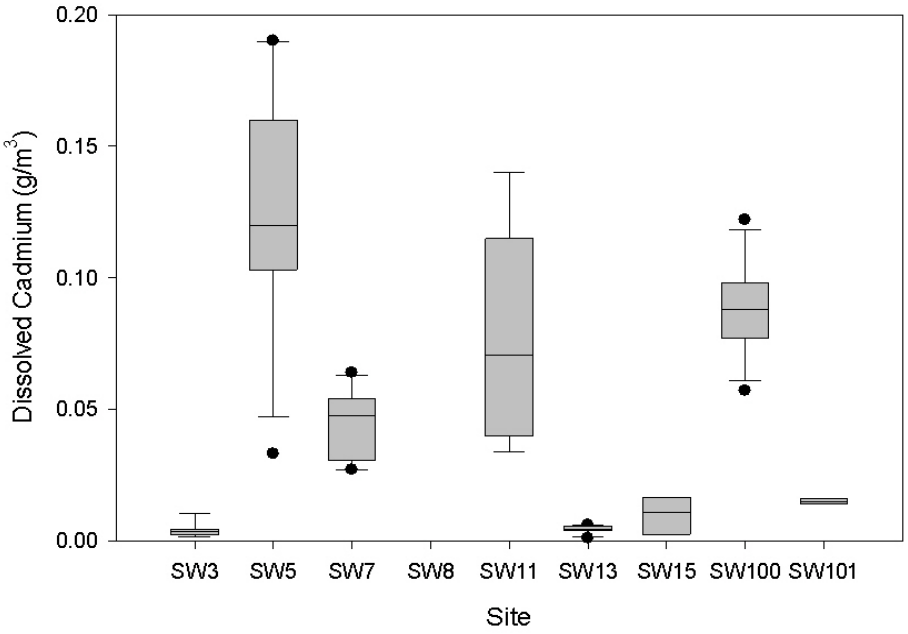


**Figure J-1: Dissolved cadmium concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value)**

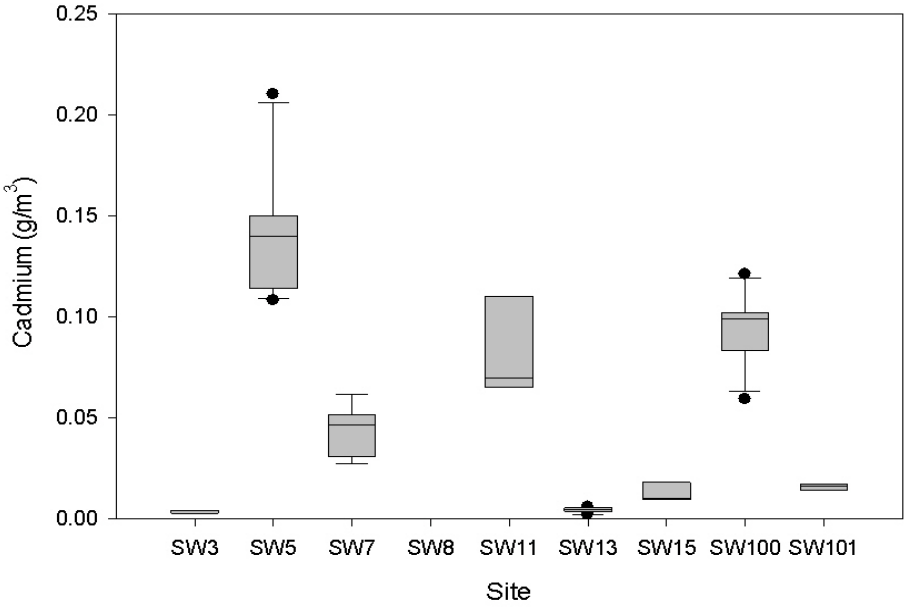


**Figure J-2: Total cadmium concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

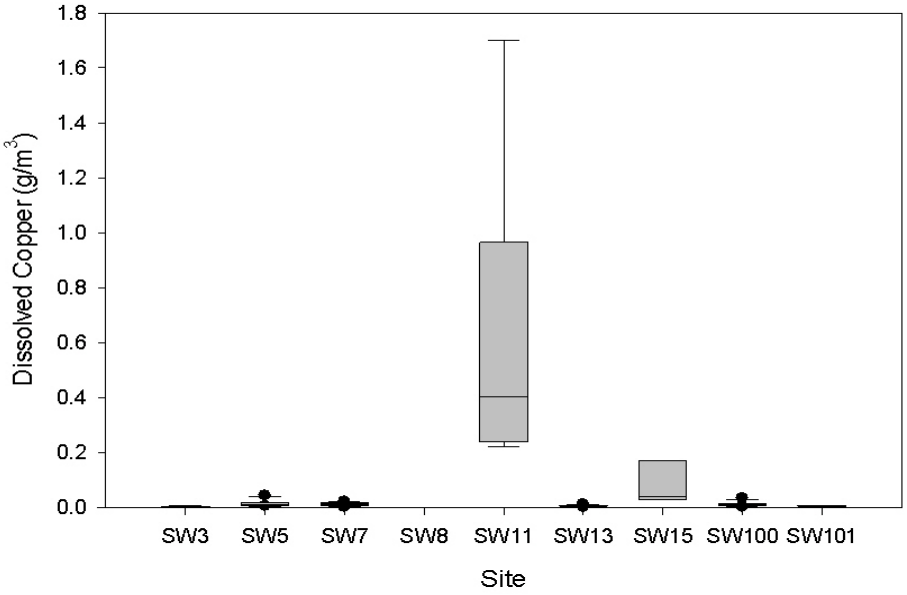


**Figure J-3: Dissolved copper concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

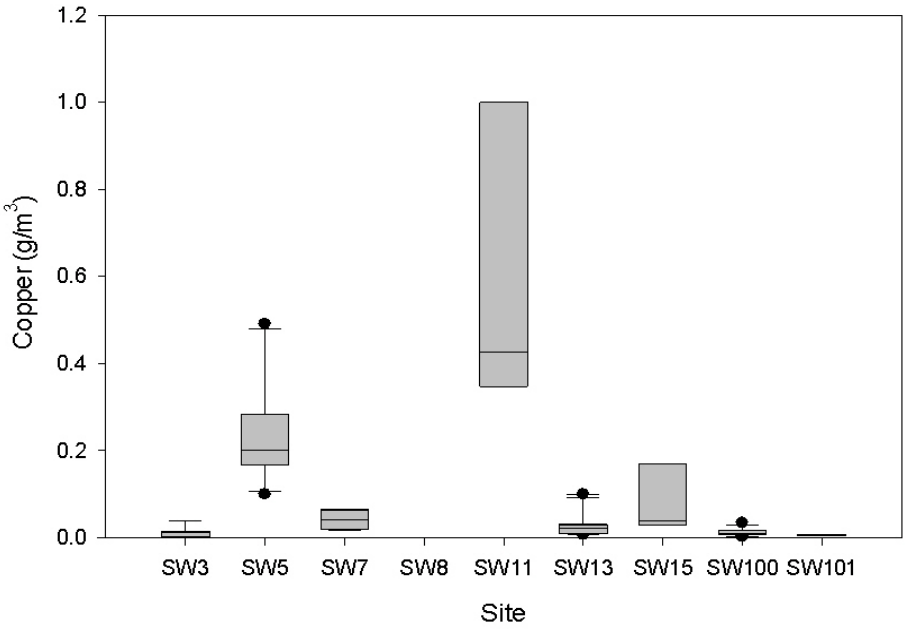


**Figure J-4: Total copper concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

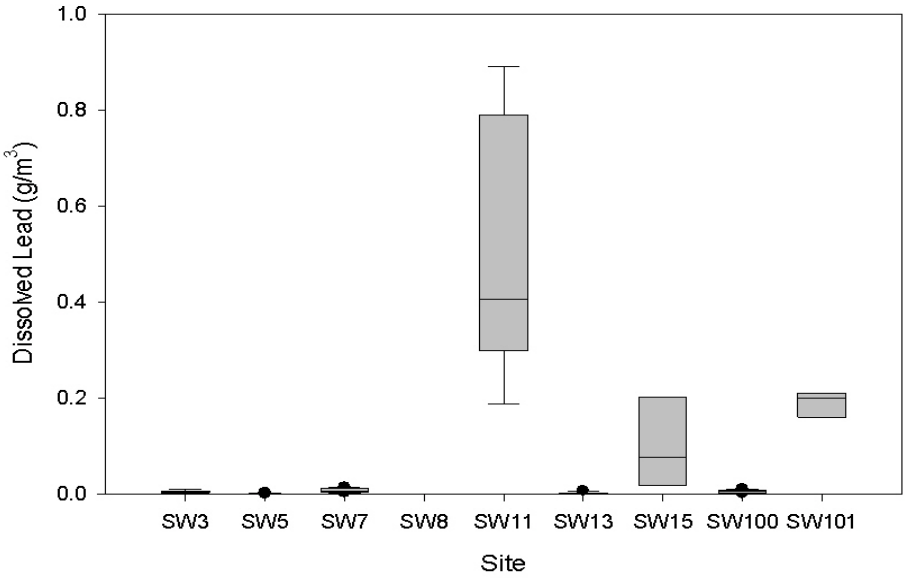


**Figure J-5: Dissolved lead concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

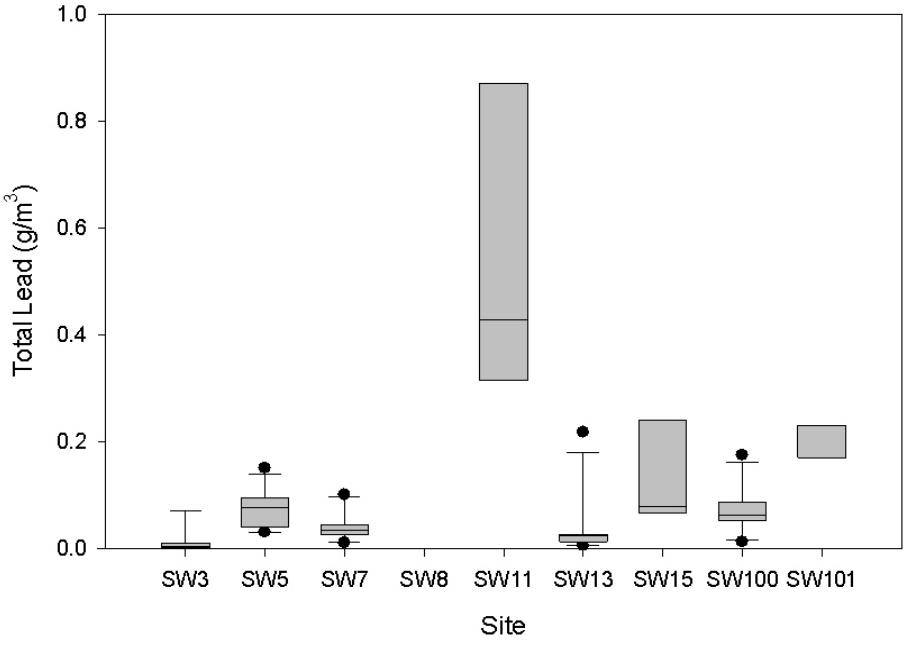


**Figure J-6: Total lead concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value). Note no data indicates concentrations of lead were all below detection limit.**

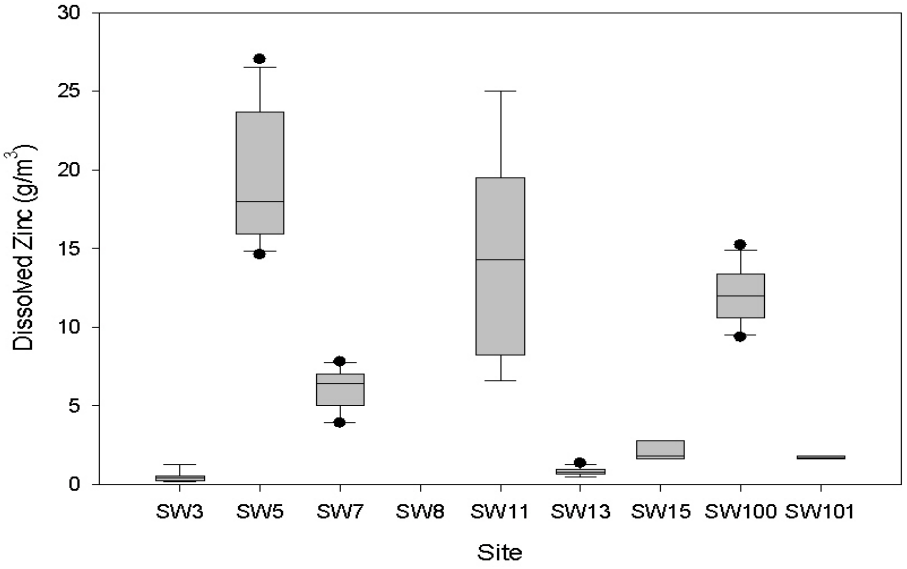


**Figure J-7: Dissolved zinc concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

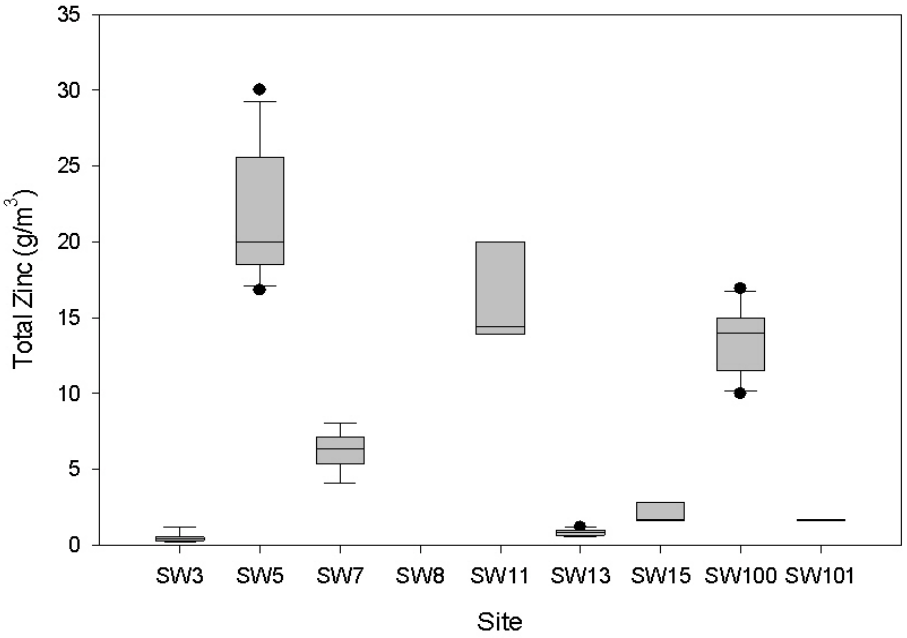


**Figure J-8: Total zinc concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

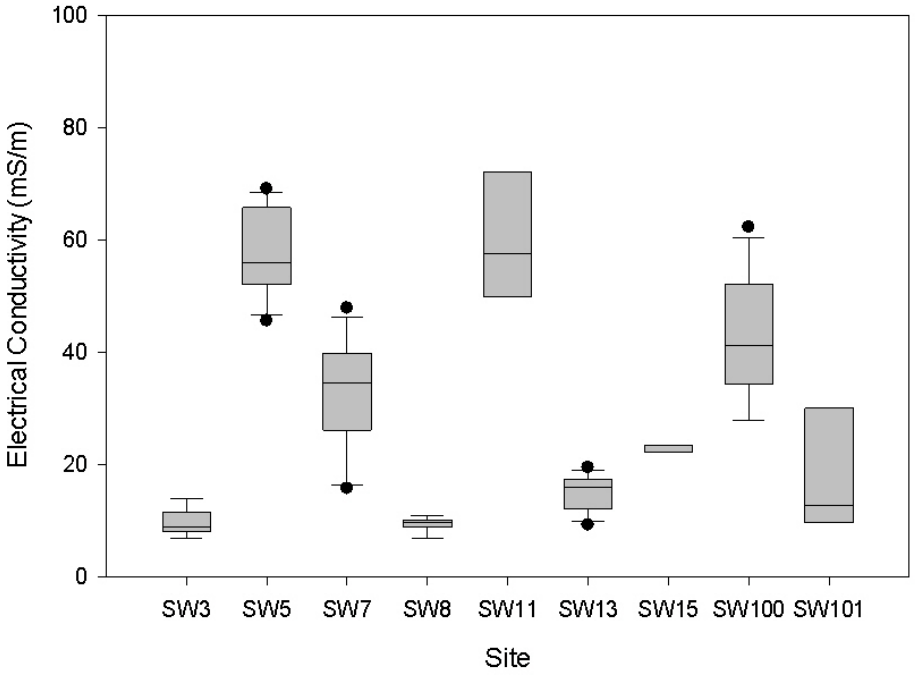


**Figure J-9: Electrical conductivity (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, and line represents medium value).**

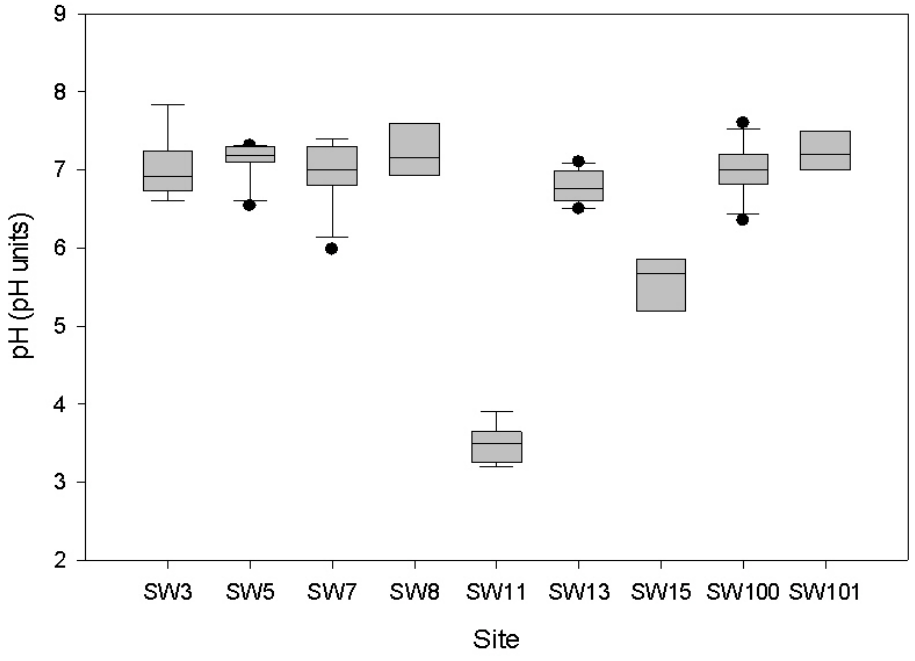


**Figure J-10: pH concentrations (box represents 25 and 75 percentile data, whisker represent 5% and 95% data, line represents medium value).**

**Table J-1: Descriptive Statistics for Sampling Site SW3 (Adit 4 discharge)**

| Column | Units | Size | Number of Observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 11 | 5 | 6 | Failed | 6.96 | 0.493 | 0.22 | 0.612 | 1.2 | 7.8 | 6.6 | 6.7 | 6.675 | 7.2 |
| Total Suspended Solids | $g/m^3$ | 11 | 6 | 5 | -- | 2.083 | 1.429 | 0.583 | 1.5 | 3.5 | 5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Total Dissolved Silica | $g/m^3$ | 11 | 3 | 8 | -- | 12.333 | 0.577 | 0.333 | 1.434 | 1 | 13 | 12 | 12 | 12 | 12.75 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 11 | 6 | 5 | Passed | 15.167 | 4.579 | 1.869 | 4.805 | 12 | 23 | 11 | 14.5 | 11 | 17 |
| Bicarbonate | $g/m^3$ at 25°C | 11 | 6 | 5 | Passed | 18.55 | 5.047 | 2.06 | 5.296 | 14.1 | 26.3 | 12.2 | 18.9 | 14 | 21 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 11 | 3 | 8 | Passed | 30.667 | 6.807 | 3.93 | 16.909 | 13 | 36 | 23 | 33 | 25.5 | 35.25 |
| Conductivity | mS/m | 11 | 5 | 6 | Passed | 11.16 | 1.978 | 0.885 | 2.456 | 5.4 | 14 | 8.6 | 11.2 | 9.875 | 12.275 |
| Calcium | $g/m^3$ | 11 | 9 | 2 | Passed | 8.741 | 2.103 | 0.701 | 1.617 | 6.19 | 11.9 | 5.71 | 8.72 | 6.925 | 10.25 |
| Magnesium | $g/m^3$ | 11 | 9 | 2 | Passed | 2.041 | 0.566 | 0.189 | 0.435 | 1.66 | 3.08 | 1.42 | 1.92 | 1.5 | 2.453 |
| Potassium | $g/m^3$ | 11 | 8 | 3 | Passed | 0.49 | 0.0818 | 0.0289 | 0.0684 | 0.21 | 0.61 | 0.4 | 0.485 | 0.415 | 0.555 |
| Sodium | $g/m^3$ | 11 | 8 | 3 | Failed | 7.267 | 0.363 | 0.128 | 0.304 | 1.1 | 7.9 | 6.8 | 7.225 | 6.99 | 7.505 |
| Chloride | $g/m^3$ | 11 | 8 | 3 | Failed | 9.94 | 0.436 | 0.154 | 0.364 | 1.3 | 10.3 | 9 | 10 | 9.81 | 10.3 |
| Nitrite-N | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Nitrate-N | $g/m^3$ | 11 | 5 | 6 | Passed | 0.15 | 0.019 | 0.00851 | 0.0236 | 0.048 | 0.17 | 0.122 | 0.158 | 0.136 | 0.163 |
| Nirate-N+Nitrite-N | $g/m^3$ | 11 | 3 | 8 | Passed | 0.157 | 0.0153 | 0.00882 | 0.0379 | 0.03 | 0.17 | 0.14 | 0.16 | 0.145 | 0.168 |
| Sulphate | $g/m^3$ | 11 | 9 | 2 | Failed | 19.278 | 6.512 | 2.171 | 5.005 | 16 | 28 | 12 | 17.6 | 13.65 | 26.65 |
| dissolved Aluminium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0064 | 0.00831 | 0.0048 | 0.0207 | 0.0144 | 0.016 | <0.0032 | 0.0016 | 0.0016 | 0.0124 |
| Aluminium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00447 | 0.0028 | 0.00162 | 0.00696 | 0.0056 | 0.0072 | <0.0032 | 0.0046 | 0.00235 | 0.00655 |
| dissolved Barium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00583 | 0.00127 | 0.00073 | 0.00315 | 0.0024 | 0.0068 | 0.0044 | 0.0063 | 0.00488 | 0.00668 |
| Barium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00617 | 0.00129 | 0.00074 | 0.00319 | 0.0024 | 0.0071 | 0.0047 | 0.0067 | 0.0052 | 0.007 |
| dissolved Boron | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0117 | 0.000577 | 0.00033 | 0.00143 | 0.001 | 0.012 | 0.011 | 0.012 | 0.0113 | 0.012 |
| Boron | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0106 | 0.000635 | 0.00037 | 0.00158 | 0.0011 | 0.011 | 0.0099 | 0.011 | 0.0102 | 0.011 |
| dissolved Cadmium | $g/m^3$ | 11 | 9 | 2 | Passed | 0.00403 | 0.00256 | 0.00085 | 0.00197 | 0.0087 | 0.0103 | 0.0016 | 0.0036 | 0.00247 | 0.00432 |
| Cadmium | $g/m^3$ | 11 | 9 | 2 | Passed | 0.0043 | 0.00258 | 0.00086 | 0.00198 | 0.0091 | 0.0106 | 0.0015 | 0.004 | 0.00295 | 0.0044 |
| dissolved Calcium | $g/m^3$ | 11 | 4 | 7 | Passed | 8.027 | 2.143 | 1.072 | 3.41 | 4.19 | 9.9 | 5.71 | 8.25 | 6.205 | 9.85 |
| Calcium | $g/m^3$ | 11 | 3 | 8 | Passed | 8.667 | 1.79 | 1.033 | 4.446 | 3.1 | 9.7 | 6.6 | 9.7 | 7.375 | 9.7 |
| dissolved Chromium | $g/m^3$ | 11 | 9 | 2 | Passed | 0.00283 | 0.00201 | 0.00067 | 0.00155 | 0.00501 | 0.0059 | <0.00053 | 0.0019 | 0.00099 | 0.00453 |
| Chromium | $g/m^3$ | 11 | 9 | 2 | Failed | 0.011 | 0.0115 | 0.00385 | 0.00887 | 0.0369 | 0.038 | <0.00053 | 0.0115 | 0.00247 | 0.0133 |
| dissolved Copper | $g/m^3$ | 11 | 9 | 2 | Failed | 0.0107 | 0.0035 | 0.00117 | 0.00269 | 0.0115 | 0.016 | 0.00446 | 0.01 | 0.01 | 0.0115 |
| Copper | $g/m^3$ | 11 | 9 | 2 | Passed | 0.285 | 0.417 | 0.139 | 0.32 | 1.26 | 1.27 | 0.01 | 0.07 | 0.01 | 0.444 |
| dissolved Lead | $g/m^3$ | 11 | 6 | 5 | Passed | 0.000817 | 0.000313 | 0.00013 | 0.00033 | 0.00081 | 0.0013 | 0.00049 | 0.00077 | 0.00058 | 0.001 |
| Lead | $g/m^3$ | 11 | 9 | 2 | Passed | 0.0117 | 0.0221 | 0.00735 | 0.017 | 0.0689 | 0.0697 | 0.0008 | 0.0037 | 0.00125 | 0.009 |
| dissolved Lithium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00187 | 0.000153 | 8.8E-05 | 0.00038 | 0.0003 | 0.002 | 0.0017 | 0.0019 | 0.00175 | 0.00198 |
| Lithium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00187 | 0.000252 | 0.00015 | 0.00063 | 0.0005 | 0.0021 | 0.0016 | 0.0019 | 0.00168 | 0.00205 |
| dissolved Magnesium | $g/m^3$ | 11 | 4 | 7 | Passed | 1.88 | 0.435 | 0.218 | 0.693 | 0.88 | 2.3 | 1.42 | 1.9 | 1.51 | 2.25 |
| Magnesium | $g/m^3$ | 11 | 3 | 8 | Passed | 1.933 | 0.404 | 0.233 | 1.004 | 0.8 | 2.3 | 1.5 | 2 | 1.625 | 2.225 |
| dissolved Manganese | $g/m^3$ | 11 | 6 | 5 | Passed | 0.00126 | 0.00115 | 0.00047 | 0.00121 | 0.00274 | 0.003 | <0.00053 | 0.00073 | 0.00041 | 0.0024 |
| Manganese | $g/m^3$ | 11 | 6 | 5 | Failed | 0.00227 | 0.00207 | 0.00085 | 0.00217 | 0.0053 | 0.006 | 0.0007 | 0.00158 | 0.00077 | 0.003 |
| dissolved Potassium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.433 | 0.0252 | 0.0145 | 0.0625 | 0.05 | 0.46 | 0.41 | 0.43 | 0.415 | 0.453 |
| Potassium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.44 | 0.03 | 0.0173 | 0.0745 | 0.06 | 0.47 | 0.41 | 0.44 | 0.418 | 0.462 |
| Silver | $g/m^3$ | 11 | 1 | 10 | -- | 0.0047 | -- | -- | -- | 0 | 0.0047 | <0.0011 | 0.0047 | 0.0047 | 0.0047 |
| dissolved Sodium | $g/m^3$ | 11 | 3 | 8 | Passed | 7.033 | 0.379 | 0.219 | 0.94 | 0.7 | 7.3 | 6.6 | 7.2 | 6.75 | 7.275 |
| Sodium | $g/m^3$ | 11 | 3 | 8 | Passed | 7 | 0.624 | 0.361 | 1.551 | 1.2 | 7.5 | 6.3 | 7.2 | 6.525 | 7.425 |
| dissolved Zinc | $g/m^3$ | 11 | 9 | 2 | Passed | 0.457 | 0.332 | 0.111 | 0.255 | 1.08 | 1.26 | 0.18 | 0.41 | 0.236 | 0.519 |
| Zinc | $g/m^3$ | 11 | 9 | 2 | Passed | 0.469 | 0.303 | 0.101 | 0.233 | 1.02 | 1.2 | 0.18 | 0.39 | 0.328 | 0.532 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-2: Descriptive Statistics for Sampling Site SW5 (Adit 5 discharge)**

| Column | Units | Size | Number of Observations | Missing | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 11 | 11 | 0 | 6.54 | 7.18 | 7.1 | 7.3 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 11 | 7 | 4 | 43 | 64 | 51 | 68 |
| Bicarbonate | $g/m^3$ at 25°C | 11 | 6 | 5 | 52 | 79 | 65.3 | 81.7 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 11 | 3 | 8 | 220 | 290 | 237.5 | 297.5 |
| Conductivity | mS/m | 11 | 11 | 0 | 45.5 | 56 | 52.125 | 64.975 |
| Calcium | $g/m^3$ | 11 | 10 | 1 | 61.5 | 81.75 | 80.4 | 88 |
| Dissolved calcium | $g/m^3$ | 11 | 10 | 1 | 11.9 | 16.1 | 14.9 | 17.9 |
| Potassium | $g/m^3$ | 11 | 9 | 2 | 0.93 | 1.23 | 1.175 | 1.3 |
| Sodium | $g/m^3$ | 11 | 9 | 2 | 12 | 14.6 | 14.475 | 14.85 |
| Chloride | $g/m^3$ | 11 | 9 | 2 | 10 | 10.2 | 10.15 | 10.9 |
| Nitrite-N | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| Nitrate-N | $g/m^3$ | 11 | 6 | 5 | 0.019 | 0.0315 | 0.024 | 0.036 |
| Nirate-N+Nitrite-N | $g/m^3$ | 11 | 3 | 8 | 0.025 | 0.033 | 0.027 | 0.0555 |
| Sulphate | $g/m^3$ | 11 | 11 | 0 | 210 | 276 | 268 | 280 |
| dissolved Aluminium | $g/m^3$ | 11 | 3 | 8 | 0.0044 | 0.0046 | 0.00445 | 0.00737 |
| Aluminium | $g/m^3$ | 11 | 3 | 8 | 0.26 | 0.26 | 0.26 | 0.395 |
| dissolved Antimony | $g/m^3$ | 11 | 3 | 8 | 0.00037 | 0.00061 | 0.00043 | 0.00063 |
| Antimony | $g/m^3$ | 11 | 3 | 8 | 0.00073 | 0.001 | 0.0008 | 0.001 |
| dissolved Arsenic | $g/m^3$ | 11 | 10 | 1 | <0.0021 | 0.001 | 0.001 | 0.0014 |
| Arsenic | $g/m^3$ | 11 | 10 | 1 | 0.003 | 0.0049 | 0.00398 | 0.0052 |
| dissolved Barium | $g/m^3$ | 11 | 3 | 8 | 0.022 | 0.024 | 0.0225 | 0.0255 |
| Barium | $g/m^3$ | 11 | 3 | 8 | 0.023 | 0.024 | 0.0233 | 0.0262 |
| dissolved Beryllium | $g/m^3$ | 11 | 0 | 11 | <0.00011 | <0.00011 | -- | -- |
| Beryllium | $g/m^3$ | 11 | 0 | 11 | <0.00011 | <0.00011 | -- | -- |
| dissolved Boron | $g/m^3$ | 11 | 3 | 8 | 0.019 | 0.024 | 0.0203 | 0.0262 |
| Boron | $g/m^3$ | 11 | 3 | 8 | 0.022 | 0.023 | 0.0223 | 0.0252 |
| dissolved Cadmium | $g/m^3$ | 11 | 11 | 0 | 0.033 | 0.12 | 0.104 | 0.153 |
| Cadmium | $g/m^3$ | 11 | 11 | 0 | 0.108 | 0.14 | 0.115 | 0.148 |
| dissolved Calcium | $g/m^3$ | 11 | 4 | 7 | 58 | 72.75 | 59.75 | 85 |
| Calcium | $g/m^3$ | 11 | 3 | 8 | 63 | 85 | 68.5 | 88 |
| dissolved Chromium | $g/m^3$ | 11 | 0 | 11 | <0.00053 | <0.00053 | -- | -- |
| Chromium | $g/m^3$ | 11 | 3 | 8 | <0.00053 | <0.00053 | 0.00026 | 0.0005 |
| dissolved Copper | $g/m^3$ | 11 | 11 | 0 | 0.005 | 0.0093 | 0.0068 | 0.0158 |
| Copper | $g/m^3$ | 11 | 11 | 0 | 0.099 | 0.2 | 0.169 | 0.268 |
| dissolved Iron | $g/m^3$ | 11 | 11 | 0 | <0.0021 | 0.01 | 0.01 | 0.01 |
| Iron | $g/m^3$ | 11 | 11 | 0 | 2.46 | 3.7 | 3.063 | 4.355 |
| dissolved Lead | $g/m^3$ | 11 | 11 | 0 | 0.00025 | 0.00077 | 0.00035 | 0.001 |
| Lead | $g/m^3$ | 11 | 11 | 0 | 0.03 | 0.077 | 0.048 | 0.0934 |
| dissolved Lithium | $g/m^3$ | 11 | 3 | 8 | 0.015 | 0.02 | 0.0163 | 0.0208 |
| Lithium | $g/m^3$ | 11 | 3 | 8 | 0.015 | 0.019 | 0.016 | 0.0198 |
| dissolved Magnesium | $g/m^3$ | 11 | 4 | 7 | 11.9 | 15.5 | 12.45 | 18 |
| Magnesium | $g/m^3$ | 11 | 3 | 8 | 14 | 18 | 15 | 18.75 |
| dissolved Manganese | $g/m^3$ | 11 | 7 | 4 | 0.364 | 1.54 | 1.505 | 1.675 |
| Manganese | $g/m^3$ | 11 | 7 | 4 | 1.388 | 1.6 | 1.578 | 1.678 |
| dissolved Mercury | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| Mercury | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| dissolved Molybdenum | $g/m^3$ | 11 | 3 | 8 | 0.00027 | 0.00043 | 0.00031 | 0.00054 |
| Molybdenum | $g/m^3$ | 11 | 3 | 8 | 0.00036 | 0.00046 | 0.00039 | 0.00056 |
| dissolved Nickel | $g/m^3$ | 11 | 7 | 4 | 0.0186 | 0.0223 | 0.021 | 0.0232 |
| Nickel | $g/m^3$ | 11 | 7 | 4 | 0.0195 | 0.0217 | 0.0211 | 0.0234 |
| dissolved Potassium | $g/m^3$ | 11 | 3 | 8 | 0.85 | 1.1 | 0.913 | 1.175 |
| Potassium | $g/m^3$ | 11 | 3 | 8 | 0.94 | 1.1 | 0.98 | 1.1 |
| dissolved Selenium | $g/m^3$ | 11 | 2 | 9 | 0.0005 | 0.00075 | 0.0005 | 0.001 |
| Selenium | $g/m^3$ | 11 | 3 | 8 | 0.001 | 0.001 | 0.001 | 0.00242 |
| dissolved Silver | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| Silver | $g/m^3$ | 11 | 1 | 10 | <0.0021 | 0.0003 | 0.0003 | 0.0003 |
| dissolved Sodium | $g/m^3$ | 11 | 3 | 8 | 11 | 13 | 11.5 | 14.5 |
| Sodium | $g/m^3$ | 11 | 3 | 8 | 11 | 13 | 11.5 | 13.75 |
| dissolved Tin | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| Tin | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| dissolved Uranium | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| Uranium | $g/m^3$ | 11 | 0 | 11 | -- | -- | -- | -- |
| dissolved Zinc | $g/m^3$ | 11 | 11 | 0 | 14.6 | 18 | 16.175 | 22.775 |
| Zinc | $g/m^3$ | 11 | 11 | 0 | 16.8 | 20 | 18.55 | 24.68 |

*Notes:*

*1.* "--" *Insufficient data to undertake statistical analysis*

**Table J-6: Descriptive Statistics for Sampling Site SW13 (Tui Stream)**

| Column | Units | Size | Number of Observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mea | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 13 | 13 | 0 | Passed | 6.715 | 0.183 | 0.0507 | 0.11 | 0.6 | 7.1 | 6.5 | 6.7 | 6.555 | 6.825 |
| Electrical Conductivity | mS/m | 13 | 12 | 1 | Passed | 14.305 | 3.449 | 0.996 | 2.192 | 10.44 | 19.4 | 8.96 | 14.55 | 11.8 | 17.35 |
| dissolved Aluminium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0399 | 0.0341 | 0.0197 | 0.0847 | 0.0654 | 0.067 | 0.0016 | 0.051 | 0.014 | 0.063 |
| Aluminium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.294 | 0.258 | 0.149 | 0.641 | 0.488 | 0.49 | 0.0016 | 0.39 | 0.0987 | 0.465 |
| dissolved Antimony | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Antimony | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Arsenic | g/m$^3$ | 13 | 1 | 12 | Failed | <0.0011 | -- | -- | -- | 0 | 0.001 | <0.0011 | <0.0011 | <0.0011 | <0.0011 |
| Arsenic | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00526 | 0.0069 | 0.00398 | 0.0171 | 0.0126 | 0.0132 | <0.0011 | 0.002 | 0.00095 | 0.0104 |
| dissolved Barium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00767 | 0.00146 | 0.00084 | 0.00362 | 0.0029 | 0.0092 | 0.0063 | 0.0075 | 0.0066 | 0.00877 |
| Barium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0082 | 0.00155 | 0.0009 | 0.00386 | 0.0031 | 0.0098 | 0.0067 | 0.0081 | 0.00705 | 0.00937 |
| dissolved Beryllium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | g/m$^3$ | 13 | 3 | 10 | Failed | 0.012 | 0 | 0 | 0 | 0 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 |
| Boron | g/m$^3$ | 13 | 3 | 10 | Failed | 0.011 | 0 | 0 | 0 | 0 | 0.011 | 0.011 | 0.011 | 0.011 | 0.011 |
| dissolved Cadmium | g/m$^3$ | 13 | 13 | 0 | Passed | 0.00415 | 0.00141 | 0.00039 | 0.00085 | 0.0049 | 0.0059 | 0.001 | 0.00432 | 0.00378 | 0.00509 |
| Cadmium | g/m$^3$ | 13 | 10 | 3 | Passed | 0.00415 | 0.00112 | 0.00035 | 0.0008 | 0.00373 | 0.00573 | 0.002 | 0.004 | 0.0038 | 0.00488 |
| dissolved Calcium | g/m$^3$ | 13 | 3 | 10 | Passed | 9.567 | 1.626 | 0.939 | 4.039 | 3.2 | 11 | 7.8 | 9.9 | 8.325 | 10.725 |
| Calcium | g/m$^3$ | 13 | 3 | 10 | Passed | 9.5 | 1.609 | 0.929 | 3.998 | 3.2 | 11 | 7.8 | 9.7 | 8.275 | 10.675 |
| dissolved Chromium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Copper | g/m$^3$ | 13 | 13 | 0 | Passed | 0.0057 | 0.00259 | 0.00072 | 0.00157 | 0.00745 | 0.00845 | 0.001 | 0.0067 | 0.00398 | 0.0077 |
| Copper | g/m$^3$ | 13 | 10 | 3 | Failed | 0.0263 | 0.0269 | 0.00852 | 0.0193 | 0.0926 | 0.0987 | 0.006 | 0.0187 | 0.0113 | 0.027 |
| dissolved Iron | g/m$^3$ | 13 | 13 | 0 | Failed | 0.0183 | 0.014 | 0.0039 | 0.00849 | 0.051 | 0.06 | 0.009 | 0.01 | 0.01 | 0.0228 |
| Iron | g/m$^3$ | 13 | 10 | 3 | Failed | 0.535 | 1.117 | 0.353 | 0.799 | 3.676 | 3.686 | 0.01 | 0.164 | 0.08 | 0.29 |
| dissolved Lead | g/m$^3$ | 13 | 13 | 0 | Passed | 0.0022 | 0.00071 | 0.0002 | 0.00043 | 0.00287 | 0.0038 | 0.00093 | 0.0023 | 0.00183 | 0.0025 |
| Lead | g/m$^3$ | 13 | 10 | 3 | Failed | 0.0365 | 0.0641 | 0.0203 | 0.0459 | 0.216 | 0.217 | 0.0011 | 0.019 | 0.0107 | 0.026 |
| dissolved Lithium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00253 | 0.0006 | 0.00035 | 0.0015 | 0.0012 | 0.0031 | 0.0019 | 0.0026 | 0.00208 | 0.00297 |
| Lithium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0025 | 0.00066 | 0.00038 | 0.00163 | 0.0013 | 0.0032 | 0.0019 | 0.0024 | 0.00202 | 0.003 |
| dissolved Magnesium | g/m$^3$ | 13 | 3 | 10 | Passed | 3.433 | 1.25 | 0.722 | 3.106 | 2.5 | 4.7 | 2.2 | 3.4 | 2.5 | 4.375 |
| Magnesium | g/m$^3$ | 13 | 3 | 10 | Passed | 3.3 | 1.353 | 0.781 | 3.36 | 2.7 | 4.7 | 2 | 3.2 | 2.3 | 4.325 |
| dissolved Manganese | g/m$^3$ | 13 | 7 | 6 | Passed | 0.153 | 0.0768 | 0.029 | 0.0711 | 0.229 | 0.23 | 0.00086 | 0.165 | 0.125 | 0.205 |
| Manganese | g/m$^3$ | 13 | 7 | 6 | Passed | 0.16 | 0.0825 | 0.0312 | 0.0763 | 0.23 | 0.231 | 0.00077 | 0.18 | 0.12 | 0.22 |
| dissolved Mercury | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Molybdenum | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Nickel | g/m$^3$ | 13 | 7 | 6 | Passed | 0.00337 | 0.00151 | 0.00057 | 0.00139 | 0.00424 | 0.0045 | 0.00027 | 0.004 | 0.00288 | 0.00432 |
| Nickel | g/m$^3$ | 13 | 6 | 7 | Passed | 0.00331 | 0.00161 | 0.00066 | 0.00169 | 0.00444 | 0.0047 | 0.00027 | 0.0039 | 0.0029 | 0.0042 |
| dissolved Potassium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.637 | 0.183 | 0.106 | 0.456 | 0.35 | 0.78 | 0.43 | 0.7 | 0.498 | 0.76 |
| Potassium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.657 | 0.193 | 0.111 | 0.479 | 0.37 | 0.81 | 0.44 | 0.72 | 0.51 | 0.787 |
| dissolved Selenium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Silver | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | g/m$^3$ | 13 | 1 | 12 | Failed | 0.0047 | -- | -- | -- | 0 | 0.0047 | 0.0047 | 0.0047 | 0.0047 | 0.0047 |
| dissolved Sodium | g/m$^3$ | 13 | 3 | 10 | Passed | 8.333 | 1.106 | 0.639 | 2.748 | 2.2 | 9.5 | 7.3 | 8.2 | 7.525 | 9.175 |
| Sodium | g/m$^3$ | 13 | 3 | 10 | Passed | 8.467 | 1.002 | 0.578 | 2.488 | 2 | 9.5 | 7.5 | 8.4 | 7.725 | 9.225 |
| dissolved Tin | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | g/m$^3$ | 13 | 13 | 0 | Passed | 0.774 | 0.256 | 0.0711 | 0.155 | 0.91 | 1.34 | 0.43 | 0.76 | 0.59 | 0.871 |
| Zinc | g/m$^3$ | 13 | 10 | 3 | Passed | 0.769 | 0.224 | 0.0708 | 0.16 | 0.76 | 1.18 | 0.42 | 0.812 | 0.563 | 0.85 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-3: Descriptive Statistics for Sampling Site SW7 (Tunakohoia Stream north branch)**

| Column | Units | Size | Number of observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 13 | 11 | 2 | Passed | 6.815 | 0.389 | 0.117 | 0.261 | 1.42 | 7.4 | 5.98 | 6.9 | 6.627 | 6.992 |
| Electrical Conductivity | mS/m | 13 | 10 | 3 | Failed | 73.705 | 87.024 | 27.519 | 62.253 | 260.32 | 276 | 15.68 | 37.75 | 30.07 | 47.8 |
| dissolved Aluminium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0997 | 0.0542 | 0.0313 | 0.135 | 0.105 | 0.16 | 0.055 | 0.084 | 0.0623 | 0.141 |
| Aluminium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.337 | 0.0451 | 0.026 | 0.112 | 0.09 | 0.38 | 0.29 | 0.34 | 0.302 | 0.37 |
| dissolved Antimony | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00036 | 0.00034 | 0.00019 | 0.00084 | 0.00063 | 0.00074 | <0.00021 | 0.00022 | 0.00014 | 0.00061 |
| Antimony | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00061 | 0.0006 | 0.00034 | 0.00148 | 0.00103 | 0.0013 | 0.00027 | 0.00027 | 0.00027 | 0.00104 |
| dissolved Arsenic | g/m$^3$ | 13 | 1 | 12 | Failed | 0.00068 | -- | -- | -- | 0 | 0.00068 | <0.0011 | 0.00068 | 0.00068 | 0.00068 |
| Arsenic | g/m$^3$ | 13 | 7 | 6 | Failed | 0.00161 | 0.00189 | 0.00072 | 0.00175 | 0.00414 | 0.00464 | 0.0005 | 0.0005 | 0.0005 | 0.0032 |
| dissolved Barium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0233 | 0.00208 | 0.0012 | 0.00517 | 0.004 | 0.025 | 0.021 | 0.024 | 0.0218 | 0.0248 |
| Barium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.024 | 0.001 | 0.00058 | 0.00248 | 0.002 | 0.025 | 0.023 | 0.024 | 0.0233 | 0.0248 |
| dissolved Beryllium | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0143 | 0.00115 | 0.00067 | 0.00287 | 0.002 | 0.015 | 0.013 | 0.015 | 0.0135 | 0.015 |
| Boron | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0157 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.017 | 0.014 | 0.016 | 0.0145 | 0.0168 |
| dissolved Cadmium | g/m$^3$ | 13 | 10 | 3 | Passed | 0.0452 | 0.0125 | 0.00396 | 0.00896 | 0.0369 | 0.0639 | 0.027 | 0.0475 | 0.0313 | 0.0532 |
| Cadmium | g/m$^3$ | 13 | 9 | 4 | Passed | 0.0437 | 0.0117 | 0.00389 | 0.00898 | 0.0344 | 0.0614 | 0.027 | 0.0461 | 0.0319 | 0.0503 |
| dissolved Calcium | g/m$^3$ | 13 | 3 | 10 | Passed | 30 | 10.392 | 6 | 25.816 | 18 | 36 | 18 | 36 | 22.5 | 36 |
| Calcium | g/m$^3$ | 13 | 3 | 10 | Passed | 30.667 | 10.116 | 5.84 | 25.13 | 18 | 37 | 19 | 36 | 23.25 | 36.75 |
| dissolved Chromium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Copper | g/m$^3$ | 13 | 10 | 3 | Passed | 0.0109 | 0.00578 | 0.00183 | 0.00413 | 0.0195 | 0.021 | 0.0015 | 0.00975 | 0.008 | 0.0123 |
| Copper | g/m$^3$ | 13 | 9 | 4 | Passed | 0.04 | 0.0201 | 0.00668 | 0.0154 | 0.0475 | 0.0651 | 0.0176 | 0.041 | 0.0197 | 0.0626 |
| dissolved Iron | g/m$^3$ | 13 | 10 | 3 | Failed | 0.034 | 0.0454 | 0.0144 | 0.0325 | 0.15 | 0.16 | 0.01 | 0.0225 | 0.01 | 0.0327 |
| Iron | g/m$^3$ | 13 | 9 | 4 | Passed | 0.416 | 0.28 | 0.0932 | 0.215 | 0.731 | 0.841 | 0.11 | 0.41 | 0.158 | 0.62 |
| dissolved Lead | g/m$^3$ | 13 | 10 | 3 | Failed | 0.00708 | 0.00439 | 0.00139 | 0.00314 | 0.0115 | 0.014 | 0.00249 | 0.0057 | 0.0033 | 0.0115 |
| Lead | g/m$^3$ | 13 | 9 | 4 | Failed | 0.0403 | 0.0273 | 0.0091 | 0.021 | 0.09 | 0.1 | 0.01 | 0.033 | 0.0252 | 0.0442 |
| dissolved Lithium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.0078 | 0.00269 | 0.00155 | 0.00668 | 0.0048 | 0.0095 | 0.0047 | 0.0092 | 0.00583 | 0.00942 |
| Lithium | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00817 | 0.00274 | 0.00158 | 0.00681 | 0.0048 | 0.0098 | 0.005 | 0.0097 | 0.00617 | 0.00977 |
| dissolved Magnesium | g/m$^3$ | 13 | 3 | 10 | Passed | 8.833 | 2.93 | 1.691 | 7.278 | 5.5 | 11 | 5.5 | 10 | 6.625 | 10.75 |
| Magnesium | g/m$^3$ | 13 | 3 | 10 | Passed | 9.2 | 3.118 | 1.8 | 7.745 | 5.4 | 11 | 5.6 | 11 | 6.95 | 11 |
| dissolved Manganese | g/m$^3$ | 13 | 5 | 8 | Passed | 0.434 | 0.136 | 0.0609 | 0.169 | 0.32 | 0.55 | 0.23 | 0.471 | 0.334 | 0.55 |
| Manganese | g/m$^3$ | 13 | 5 | 8 | Passed | 0.449 | 0.157 | 0.0701 | 0.195 | 0.39 | 0.63 | 0.24 | 0.441 | 0.334 | 0.585 |
| dissolved Mercury | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00157 | 0.00254 | 0.00147 | 0.00631 | 0.0044 | 0.0045 | <0.00021 | 0.0001 | 0.0001 | 0.0034 |
| Molybdenum | g/m$^3$ | 13 | 3 | 10 | Passed | 0.00178 | 0.00279 | 0.00161 | 0.00694 | 0.0049 | 0.005 | 0.0001 | 0.00023 | 0.00013 | 0.00381 |
| dissolved Nickel | g/m$^3$ | 13 | 6 | 7 | Passed | 0.0089 | 0.00282 | 0.00115 | 0.00296 | 0.0077 | 0.0123 | 0.0046 | 0.0094 | 0.0067 | 0.011 |
| Nickel | g/m$^3$ | 13 | 7 | 6 | Passed | 0.00944 | 0.0026 | 0.00098 | 0.0024 | 0.0076 | 0.0126 | 0.005 | 0.01 | 0.00768 | 0.0109 |
| dissolved Potassium | g/m$^3$ | 13 | 3 | 10 | Passed | 1.177 | 0.367 | 0.212 | 0.913 | 0.66 | 1.6 | 0.94 | 0.99 | 0.953 | 1.448 |
| Potassium | g/m$^3$ | 13 | 3 | 10 | Passed | 1.267 | 0.462 | 0.267 | 1.147 | 0.8 | 1.8 | 1 | 1 | 1 | 1.6 |
| dissolved Selenium | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | g/m$^3$ | 13 | 1 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Silver | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | g/m$^3$ | 13 | 0 | 13 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Sodium | g/m$^3$ | 13 | 3 | 10 | Passed | 10.833 | 1.258 | 0.726 | 3.126 | 2.5 | 12 | 9.5 | 11 | 9.875 | 11.75 |
| Sodium | g/m$^3$ | 13 | 3 | 10 | Passed | 10.867 | 1.206 | 0.696 | 2.995 | 2.4 | 12 | 9.6 | 11 | 9.95 | 11.75 |
| dissolved Tin | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | g/m$^3$ | 13 | 1 | 12 | -- | 0.00057 | -- | -- | -- | 0 | 0.00057 | <0.00053 | 0.00057 | 0.00057 | 0.00057 |
| dissolved Uranium | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | g/m$^3$ | 13 | 0 | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | g/m$^3$ | 13 | 10 | 3 | Passed | 6.079 | 1.282 | 0.405 | 0.917 | 3.89 | 7.79 | 3.9 | 6.377 | 5.29 | 6.99 |
| Zinc | g/m$^3$ | 13 | 9 | 4 | Passed | 6.304 | 1.278 | 0.426 | 0.983 | 3.94 | 8.04 | 4.1 | 6.314 | 5.833 | 7.065 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-4: Descriptive Statistics for Sampling Site SW8 (Tunakohoia Stream South branch - Town Water Supply)**

| Column | Units | Size | Number of observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 10 | 8 | 2 | Passed | 7.213 | 0.34 | 0.12 | 0.284 | 0.9 | 7.7 | 6.8 | 7.15 | 6.95 | 7.5 |
| Electrical Conductivity | mS/m | 10 | 8 | 2 | Passed | 9.65 | 0.795 | 0.281 | 0.664 | 2.6 | 10.9 | 8.3 | 9.65 | 9.2 | 10.15 |
| dissolved Aluminium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.0323 | 0.0176 | 0.0102 | 0.0438 | 0.035 | 0.051 | 0.016 | 0.03 | 0.0195 | 0.0457 |
| Aluminium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.0507 | 0.0221 | 0.0128 | 0.055 | 0.044 | 0.074 | 0.03 | 0.048 | 0.0345 | 0.0675 |
| dissolved Antimony | $g/m^3$ | 10 | 3 | 7 | Failed | 0.00016 | 9.8E-05 | 5.7E-05 | 0.00024 | 0.00017 | 0.00027 | <0.00021 | 0.0001 | 0.0001 | 0.00023 |
| Antimony | $g/m^3$ | 10 | 3 | 7 | Failed | 0.00029 | 0.00032 | 0.00019 | 0.0008 | 0.00056 | 0.00066 | <0.00021 | 0.0001 | 0.0001 | 0.00052 |
| dissolved Arsenic | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Arsenic | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Barium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00577 | 0.00035 | 0.0002 | 0.00087 | 0.0007 | 0.0061 | 0.0054 | 0.0058 | 0.0055 | 0.00603 |
| Barium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00623 | 0.00012 | 6.7E-05 | 0.00029 | 0.0002 | 0.0063 | 0.0061 | 0.0063 | 0.00615 | 0.0063 |
| dissolved Beryllium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00963 | 0.00032 | 0.00019 | 0.0008 | 0.0006 | 0.01 | 0.0094 | 0.0095 | 0.00943 | 0.00988 |
| Boron | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00987 | 0.00115 | 0.00066 | 0.00286 | 0.0023 | 0.011 | 0.0087 | 0.0099 | 0.009 | 0.0107 |
| dissolved Cadmium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00011 | 0.00011 | 6.3E-05 | 0.00027 | 0.00019 | 0.00024 | 0.00005 | 0.00005 | 0.00005 | 0.00019 |
| Cadmium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Calcium | $g/m^3$ | 10 | 4 | 6 | Passed | 5.793 | 0.821 | 0.411 | 1.307 | 1.53 | 6.6 | 5.07 | 5.75 | 5.085 | 6.5 |
| Calcium | $g/m^3$ | 10 | 3 | 7 | Passed | 6.133 | 0.709 | 0.41 | 1.762 | 1.4 | 6.9 | 5.5 | 6 | 5.625 | 6.675 |
| dissolved Chromium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Copper | $g/m^3$ | 10 | 6 | 4 | Passed | 0.00074 | 0.00021 | 8.7E-05 | 0.00022 | 0.0006 | 0.0011 | 0.0005 | 0.00072 | 0.0006 | 0.0008 |
| Copper | $g/m^3$ | 10 | 7 | 3 | Passed | 0.00064 | 0.00035 | 0.00013 | 0.00032 | 0.00117 | 0.0012 | 2.6E-05 | 0.0006 | 0.0006 | 0.00075 |
| dissolved Iron | $g/m^3$ | 10 | 8 | 2 | Passed | 0.0106 | 0.0126 | 0.00445 | 0.0105 | 0.029 | 0.029 | 2.5E-05 | 0.00503 | 3.8E-05 | 0.023 |
| Iron | $g/m^3$ | 10 | 7 | 3 | Passed | 0.0247 | 0.0256 | 0.00969 | 0.0237 | 0.06 | 0.06 | 2.5E-05 | 0.025 | 2.5E-05 | 0.048 |
| dissolved Lead | $g/m^3$ | 10 | 8 | 2 | Failed | 0.00044 | 0.00033 | 0.00012 | 0.00027 | 0.001 | 0.0011 | <0.00011 | 0.0005 | 0.00015 | 0.0005 |
| Lead | $g/m^3$ | 10 | 7 | 3 | Failed | 0.0006 | 0.00067 | 0.00025 | 0.00062 | 0.0019 | 0.0021 | 0.0002 | 0.00036 | 0.0003 | 0.00048 |
| dissolved Lithium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00057 | 0.00011 | 6.5E-05 | 0.00028 | 0.0002 | 0.0007 | 0.0005 | 0.00051 | 0.0005 | 0.00065 |
| Lithium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00066 | 0.00012 | 6.7E-05 | 0.00029 | 0.0002 | 0.00079 | 0.00059 | 0.00059 | 0.00059 | 0.00074 |
| dissolved Magnesium | $g/m^3$ | 10 | 4 | 6 | Passed | 2.197 | 0.319 | 0.16 | 0.508 | 0.71 | 2.6 | 1.89 | 2.15 | 1.945 | 2.45 |
| Magnesium | $g/m^3$ | 10 | 3 | 7 | Passed | 2.267 | 0.379 | 0.219 | 0.94 | 0.7 | 2.7 | 2 | 2.1 | 2.025 | 2.55 |
| dissolved Manganese | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00084 | 0.00072 | 0.00042 | 0.0018 | 0.00137 | 0.0014 | <0.00053 | 0.0011 | 0.00029 | 0.00133 |
| Manganese | $g/m^3$ | 10 | 3 | 7 | Passed | 0.00203 | 0.00071 | 0.00041 | 0.00176 | 0.0014 | 0.0028 | 0.0014 | 0.0019 | 0.00153 | 0.00258 |
| dissolved Mercury | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Molybdenum | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Nickel | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Nickel | $g/m^3$ | 10 | 1 | 9 | Failed | 0.0009 | -- | -- | -- | 0 | 0.0009 | 0.0009 | 0.0009 | 0.0009 | 0.0009 |
| dissolved Potassium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.473 | 0.0321 | 0.0186 | 0.0799 | 0.06 | 0.51 | 0.45 | 0.46 | 0.453 | 0.498 |
| Potassium | $g/m^3$ | 10 | 3 | 7 | Passed | 0.49 | 0.04 | 0.0231 | 0.0994 | 0.08 | 0.53 | 0.45 | 0.49 | 0.46 | 0.52 |
| dissolved Selenium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Silver | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Sodium | $g/m^3$ | 10 | 3 | 7 | Passed | 7.567 | 0.493 | 0.285 | 1.225 | 0.9 | 7.9 | 7 | 7.8 | 7.2 | 7.875 |
| Sodium | $g/m^3$ | 10 | 3 | 7 | Passed | 7.533 | 0.493 | 0.285 | 1.225 | 0.9 | 8.1 | 7.2 | 7.3 | 7.225 | 7.9 |
| dissolved Tin | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | $g/m^3$ | 10 | 0 | 10 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | $g/m^3$ | 10 | 8 | 2 | Failed | 0.00784 | 0.00725 | 0.00256 | 0.00606 | 0.0165 | 0.017 | <0.0011 | 0.0055 | 0.0016 | 0.0155 |
| Zinc | $g/m^3$ | 10 | 7 | 3 | Failed | 0.00289 | 0.00325 | 0.00123 | 0.00301 | 0.0095 | 0.01 | 0.0005 | 0.002 | 0.00108 | 0.00285 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-5: Descriptive Statistics for Sampling Site SW11 (Discharge of Tailings dam into Tui Stream)**

| Column | Units | Size | Number of Observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 12 | 12 | 0 | Failed | 3.5 | 0.235 | 0.0782 | 0.18 | 0.7 | 3.9 | 3.2 | 3.5 | 3.275 | 3.625 |
| Electrical Conductivity | mS/m | 12 | 12 | 0 | Failed | 128.917 | 159.015 | 45.904 | 101.033 | 525.4 | 562 | 36.6 | 57.45 | 50.5 | 130.65 |
| dissolved Aluminium | g/m$^3$ | 12 | 3 | 9 | Passed | 11.333 | 2.309 | 1.333 | 5.737 | 4 | 14 | 10 | 10 | 10 | 13 |
| Aluminium | g/m$^3$ | 12 | 3 | 9 | Passed | 12 | 2 | 1.155 | 4.968 | 4 | 14 | 10 | 12 | 10.5 | 13.5 |
| dissolved Antimony | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00052 | 0.00018 | 0.0001 | 0.000442 | 0.00033 | 0.00072 | 0.00039 | 0.00044 | 0.0004 | 0.00065 |
| Antimony | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00058 | 0.00018 | 0.00011 | 0.000451 | 0.00036 | 0.00077 | 0.00041 | 0.00055 | 0.00045 | 0.00072 |
| dissolved Arsenic | g/m$^3$ | 12 | 8 | 4 | Passed | 0.0103 | 0.00843 | 0.00298 | 0.00705 | 0.025 | 0.026 | 0.001 | 0.00868 | 0.004 | 0.015 |
| Arsenic | g/m$^3$ | 12 | 10 | 2 | Passed | 0.0148 | 0.0118 | 0.00374 | 0.00847 | 0.031 | 0.033 | 0.002 | 0.0141 | 0.003 | 0.025 |
| dissolved Barium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.0313 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.033 | 0.03 | 0.031 | 0.0302 | 0.0325 |
| Barium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.0307 | 0.00058 | 0.00033 | 0.00143 | 0.001 | 0.031 | 0.03 | 0.031 | 0.0302 | 0.031 |
| dissolved Beryllium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.0007 | 9.3E-05 | 5.4E-05 | 0.000231 | 0.00018 | 0.0008 | 0.00062 | 0.00067 | 0.00063 | 0.00077 |
| Beryllium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00067 | 7.6E-05 | 4.4E-05 | 0.000188 | 0.00014 | 0.00072 | 0.00058 | 0.0007 | 0.00061 | 0.00072 |
| dissolved Boron | g/m$^3$ | 12 | 3 | 9 | Passed | 0.0123 | 0.00058 | 0.00033 | 0.00143 | 0.001 | 0.013 | 0.012 | 0.012 | 0.012 | 0.0127 |
| Boron | g/m$^3$ | 12 | 3 | 9 | Passed | 0.012 | 0.00173 | 0.001 | 0.0043 | 0.003 | 0.014 | 0.011 | 0.011 | 0.011 | 0.0133 |
| dissolved Cadmium | g/m$^3$ | 12 | 12 | 0 | Passed | 0.0652 | 0.0394 | 0.0114 | 0.025 | 0.122 | 0.14 | 0.0179 | 0.056 | 0.0353 | 0.0905 |
| Cadmium | g/m$^3$ | 12 | 10 | 2 | Passed | 0.0679 | 0.0408 | 0.0129 | 0.0292 | 0.123 | 0.14 | 0.0175 | 0.0668 | 0.0325 | 0.11 |
| dissolved Calcium | g/m$^3$ | 12 | 4 | 8 | Passed | 24.025 | 2.114 | 1.057 | 3.364 | 4.9 | 26 | 21.1 | 24.5 | 22.55 | 25.5 |
| Calcium | g/m$^3$ | 12 | 3 | 9 | Passed | 24.667 | 1.528 | 0.882 | 3.795 | 3 | 26 | 23 | 25 | 23.5 | 25.75 |
| dissolved Chromium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00317 | 0.00047 | 0.00027 | 0.00117 | 0.0009 | 0.0037 | 0.0028 | 0.003 | 0.00285 | 0.00352 |
| Chromium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00313 | 0.00051 | 0.0003 | 0.00127 | 0.001 | 0.0037 | 0.0027 | 0.003 | 0.00278 | 0.00352 |
| dissolved Copper | g/m$^3$ | 12 | 12 | 0 | Failed | 0.524 | 0.463 | 0.134 | 0.294 | 1.58 | 1.7 | 0.12 | 0.373 | 0.228 | 0.717 |
| Copper | g/m$^3$ | 12 | 10 | 2 | Failed | 0.653 | 0.458 | 0.145 | 0.327 | 1.466 | 1.6 | 0.134 | 0.432 | 0.347 | 0.99 |
| dissolved Iron | g/m$^3$ | 12 | 12 | 0 | Failed | 11.408 | 12.271 | 3.542 | 7.797 | 29.6 | 30.6 | 1 | 2.743 | 1.845 | 23 |
| Iron | g/m$^3$ | 12 | 10 | 2 | Failed | 15.131 | 13.846 | 4.378 | 9.905 | 33.63 | 35.3 | 1.67 | 11.365 | 3.11 | 26 |
| dissolved Lead | g/m$^3$ | 12 | 12 | 0 | Passed | 0.383 | 0.299 | 0.0862 | 0.19 | 0.865 | 0.89 | 0.025 | 0.328 | 0.129 | 0.564 |
| Lead | g/m$^3$ | 12 | 10 | 2 | Passed | 0.481 | 0.313 | 0.0989 | 0.224 | 0.892 | 0.91 | 0.018 | 0.417 | 0.219 | 0.77 |
| dissolved Lithium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.02 | 0.00265 | 0.00153 | 0.00657 | 0.005 | 0.022 | 0.017 | 0.021 | 0.018 | 0.0217 |
| Lithium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.0193 | 0.00289 | 0.00167 | 0.00717 | 0.005 | 0.021 | 0.016 | 0.021 | 0.0173 | 0.021 |
| dissolved Magnesium | g/m$^3$ | 12 | 4 | 8 | Passed | 12.66 | 2.802 | 1.401 | 4.458 | 6.36 | 15 | 8.64 | 13.5 | 10.82 | 14.5 |
| Magnesium | g/m$^3$ | 12 | 3 | 9 | Passed | 14.333 | 1.155 | 0.667 | 2.868 | 2 | 15 | 13 | 15 | 13.5 | 15 |
| dissolved Manganese | g/m$^3$ | 12 | 6 | 6 | Passed | 3.881 | 2.544 | 1.039 | 2.67 | 6.495 | 6.9 | 0.405 | 3.93 | 2.22 | 5.9 |
| Manganese | g/m$^3$ | 12 | 6 | 6 | Passed | 3.915 | 2.531 | 1.033 | 2.656 | 6.288 | 6.7 | 0.412 | 4.04 | 2.2 | 6.1 |
| dissolved Mercury | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Molybdenum | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Nickel | g/m$^3$ | 12 | 7 | 5 | Passed | 0.0468 | 0.0148 | 0.00561 | 0.0137 | 0.0484 | 0.066 | 0.0176 | 0.0478 | 0.0446 | 0.0537 |
| Nickel | g/m$^3$ | 12 | 7 | 5 | Passed | 0.0468 | 0.0146 | 0.00554 | 0.0135 | 0.0472 | 0.065 | 0.0178 | 0.0473 | 0.0443 | 0.054 |
| dissolved Potassium | g/m$^3$ | 12 | 3 | 9 | Passed | 1.467 | 0.0577 | 0.0333 | 0.143 | 0.1 | 1.5 | 1.4 | 1.5 | 1.425 | 1.5 |
| Potassium | g/m$^3$ | 12 | 3 | 9 | Passed | 1.433 | 0.0577 | 0.0333 | 0.143 | 0.1 | 1.5 | 1.4 | 1.4 | 1.4 | 1.475 |
| dissolved Selenium | g/m$^3$ | 12 | 1 | 11 | Failed | 0.0022 | -- | -- | -- | 0 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 |
| Selenium | g/m$^3$ | 12 | 2 | 10 | Failed | 0.0023 | 0.00014 | 0.0001 | 0.00127 | 0.0002 | 0.0024 | 0.0022 | 0.0023 | 0.0022 | 0.0024 |
| dissolved Silver | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | g/m$^3$ | 12 | 1 | 11 | Failed | 0.0001 | -- | -- | -- | 0 | 0.0001 | <0.0021 | 0.0001 | 0.0001 | 0.0001 |
| dissolved Sodium | g/m$^3$ | 12 | 3 | 9 | Failed | 9.9 | 0.954 | 0.551 | 2.37 | 1.7 | 11 | 9.3 | 9.4 | 9.325 | 10.6 |
| Sodium | g/m$^3$ | 12 | 3 | 9 | Passed | 9.633 | 1.185 | 0.684 | 2.943 | 2.1 | 11 | 8.9 | 9 | 8.925 | 10.5 |
| dissolved Tin | g/m$^3$ | 12 | 1 | 11 | Failed | 0.00079 | -- | -- | -- | 0 | 0.00079 | 0.00079 | 0.00079 | 0.00079 | 0.00079 |
| Tin | g/m$^3$ | 12 | 0 | 12 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00021 | 2.9E-05 | 1.7E-05 | 0.0000717 | 0.00005 | 0.00023 | 0.00018 | 0.00023 | 0.00019 | 0.00023 |
| Uranium | g/m$^3$ | 12 | 3 | 9 | Passed | 0.00022 | 0.00002 | 1.2E-05 | 0.0000497 | 0.00004 | 0.00024 | 0.0002 | 0.00022 | 0.00021 | 0.00024 |
| dissolved Zinc | g/m$^3$ | 12 | 12 | 0 | Passed | 12.323 | 6.604 | 1.906 | 4.196 | 22.36 | 25 | 2.64 | 11.61 | 7.1 | 16.85 |
| Zinc | g/m$^3$ | 12 | 10 | 2 | Passed | 13.171 | 6.973 | 2.205 | 4.988 | 22.8 | 25 | 2.2 | 14.1 | 8.04 | 19 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-7: Descriptive Statistics for Sampling Site SW15 (Tailing dam dischrge into Tunakohoia Stream)**

| Column | Units | Size | Number of observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH Units | 3 | 3 | 0 | Passed | 5.573 | 0.345 | 0.199 | 0.858 | 0.67 | 5.86 | 5.19 | 5.67 | 5.31 | 5.813 |
| Electrical Conductivity | mS/m | 3 | 3 | 0 | Passed | 9.37 | 8.099 | 4.676 | 20.12 | 16 | 18.1 | 2.1 | 7.91 | 3.553 | 15.552 |
| dissolved Aluminium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.073 | 0.0842 | 0.0486 | 0.209 | 0.151 | 0.17 | 0.019 | 0.03 | 0.0217 | 0.135 |
| Aluminium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0937 | 0.118 | 0.0683 | 0.294 | 0.211 | 0.23 | 0.019 | 0.032 | 0.0222 | 0.18 |
| dissolved Antimony | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Antimony | g/m$^3$ | 3 | 1 | 2 | Failed | <0.00021 | -- | -- | -- | 0 | 0.00044 | <0.00021 | <0.00021 | <0.00021 | <0.00021 |
| dissolved Arsenic | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00903 | 0.0104 | 0.006 | 0.0258 | 0.0188 | 0.021 | 0.0022 | 0.0039 | 0.00263 | 0.0167 |
| Arsenic | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0105 | 0.0117 | 0.00675 | 0.029 | 0.021 | 0.024 | 0.003 | 0.0046 | 0.0034 | 0.0191 |
| dissolved Barium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.024 | 0.004 | 0.00231 | 0.00994 | 0.008 | 0.028 | 0.02 | 0.024 | 0.021 | 0.027 |
| Barium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0233 | 0.00404 | 0.00233 | 0.01 | 0.007 | 0.028 | 0.021 | 0.021 | 0.021 | 0.0262 |
| dissolved Beryllium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0133 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.015 | 0.012 | 0.013 | 0.0123 | 0.0145 |
| Boron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0143 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.016 | 0.013 | 0.014 | 0.0133 | 0.0155 |
| dissolved Cadmium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0131 | 0.00441 | 0.00255 | 0.011 | 0.0086 | 0.018 | 0.0094 | 0.012 | 0.0101 | 0.0165 |
| Cadmium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0124 | 0.00483 | 0.00279 | 0.012 | 0.0087 | 0.018 | 0.0093 | 0.01 | 0.00948 | 0.016 |
| dissolved Calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 18.667 | 1.528 | 0.882 | 3.795 | 3 | 20 | 17 | 19 | 17.5 | 19.75 |
| Calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 18.667 | 1.528 | 0.882 | 3.795 | 3 | 20 | 17 | 19 | 17.5 | 19.75 |
| dissolved Chromium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | g/m$^3$ | 3 | 1 | 2 | Failed | <0.00053 | -- | -- | -- | 0 | 0.00075 | <0.00053 | <0.00053 | <0.00053 | <0.00053 |
| dissolved Copper | g/m$^3$ | 3 | 3 | 0 | Passed | 0.079 | 0.0789 | 0.0456 | 0.196 | 0.141 | 0.17 | 0.029 | 0.038 | 0.0313 | 0.137 |
| Copper | g/m$^3$ | 3 | 3 | 0 | Passed | 0.079 | 0.079 | 0.0456 | 0.196 | 0.142 | 0.17 | 0.028 | 0.039 | 0.0308 | 0.137 |
| dissolved Iron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.48 | 0.539 | 0.311 | 1.34 | 0.98 | 1.1 | 0.12 | 0.22 | 0.145 | 0.88 |
| Iron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.483 | 0.537 | 0.31 | 1.334 | 0.98 | 1.1 | 0.12 | 0.23 | 0.148 | 0.882 |
| dissolved Lead | g/m$^3$ | 3 | 3 | 0 | Passed | 0.131 | 0.0949 | 0.0548 | 0.236 | 0.175 | 0.24 | 0.065 | 0.089 | 0.071 | 0.202 |
| Lead | g/m$^3$ | 3 | 3 | 0 | Passed | 0.129 | 0.0966 | 0.0558 | 0.24 | 0.173 | 0.24 | 0.067 | 0.079 | 0.07 | 0.2 |
| dissolved Lithium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00583 | 0.00012 | 6.7E-05 | 0.00029 | 0.0002 | 0.0059 | 0.0057 | 0.0059 | 0.00575 | 0.0059 |
| Lithium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00593 | 0.00025 | 0.00015 | 0.00063 | 0.0005 | 0.0062 | 0.0057 | 0.0059 | 0.00575 | 0.00613 |
| dissolved Magnesium | g/m$^3$ | 3 | 3 | 0 | Passed | 6.933 | 0.289 | 0.167 | 0.717 | 0.5 | 7.1 | 6.6 | 7.1 | 6.725 | 7.1 |
| Magnesium | g/m$^3$ | 3 | 3 | 0 | Passed | 7 | 0.265 | 0.153 | 0.657 | 0.5 | 7.2 | 6.7 | 7.1 | 6.8 | 7.175 |
| dissolved Manganese | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0503 | 0.0426 | 0.0246 | 0.106 | 0.079 | 0.099 | 0.02 | 0.032 | 0.023 | 0.0822 |
| Manganese | g/m$^3$ | 3 | 3 | 0 | Passed | 0.049 | 0.0395 | 0.0228 | 0.0981 | 0.074 | 0.094 | 0.02 | 0.033 | 0.0233 | 0.0787 |
| dissolved Mercury | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | g/m$^3$ | 3 | 1 | 2 | Failed | 0.00098 | -- | -- | -- | 0 | 0.00098 | 0.00098 | 0.00098 | 0.00098 | 0.00098 |
| Molybdenum | g/m$^3$ | 3 | 1 | 2 | Failed | 0.001 | -- | -- | -- | 0 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| dissolved Nickel | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0026 | 0.00053 | 0.00031 | 0.00131 | 0.001 | 0.0032 | 0.0022 | 0.0024 | 0.00225 | 0.003 |
| Nickel | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00257 | 0.00064 | 0.00037 | 0.00158 | 0.0011 | 0.0033 | 0.0022 | 0.0022 | 0.0022 | 0.00302 |
| dissolved Potassium | g/m$^3$ | 3 | 3 | 0 | Passed | 1.027 | 0.0643 | 0.0371 | 0.16 | 0.12 | 1.1 | 0.98 | 1 | 0.985 | 1.075 |
| Potassium | g/m$^3$ | 3 | 3 | 0 | Passed | 1.023 | 0.0681 | 0.0393 | 0.169 | 0.13 | 1.1 | 0.97 | 1 | 0.978 | 1.075 |
| dissolved Selenium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | g/m$^3$ | 3 | 1 | 2 | Failed | <0.0011 | -- | -- | -- | 0 | 0.0011 | <0.0011 | <0.0011 | <0.0011 | <0.0011 |
| dissolved Silver | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Sodium | g/m$^3$ | 3 | 3 | 0 | Passed | 10.3 | 0.608 | 0.351 | 1.511 | 1.1 | 11 | 9.9 | 10 | 9.925 | 10.75 |
| Sodium | g/m$^3$ | 3 | 3 | 0 | Passed | 11.333 | 0.577 | 0.333 | 1.434 | 1 | 12 | 11 | 11 | 11 | 11.75 |
| dissolved Tin | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | g/m$^3$ | 3 | 3 | 0 | Passed | 2.067 | 0.643 | 0.371 | 1.597 | 1.2 | 2.8 | 1.6 | 1.8 | 1.65 | 2.55 |
| Zinc | g/m$^3$ | 3 | 3 | 0 | Passed | 2.033 | 0.666 | 0.384 | 1.654 | 1.2 | 2.8 | 1.6 | 1.7 | 1.625 | 2.525 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-8: Descriptive Statistics for Sampling Site SW100 (Tunakohoia Stream North Branch downstream of SW3 and SW5 discharges)**

| Column | Units | Size | number of observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH units | 11 | 11 | 0 | Passed | 7.015 | 0.314 | 0.0946 | 0.211 | 1.25 | 7.6 | 6.35 | 7 | 6.84 | 7.19 |
| Alkalinity | $g/m^3$ as $CaCO_3$ | 11 | 7 | 4 | Passed | 41.429 | 14.374 | 5.433 | 13.294 | 42 | 62 | 20 | 44 | 29.75 | 49.75 |
| Bicarbonate | $g/m^3$ at 25°C | 11 | 6 | 5 | Passed | 46.983 | 13.035 | 5.321 | 13.679 | 35 | 59 | 24 | 52.1 | 39.7 | 55 |
| Total Hardness | $g/m^3$ as $CaCO_3$ | 11 | 3 | 8 | Passed | 172 | 66.573 | 38.436 | 165.377 | 124 | 220 | 96 | 200 | 122 | 215 |
| Conductivity | mS/m | 11 | 11 | 0 | Passed | 42.736 | 10.777 | 3.249 | 7.24 | 34.3 | 62.2 | 27.9 | 41.1 | 34.9 | 51.175 |
| Calcium | $g/m^3$ | 11 | 10 | 1 | Passed | 53.95 | 14.537 | 4.597 | 10.399 | 52 | 79 | 27 | 54.15 | 50 | 64 |
| Dissolved calcium | $g/m^3$ | 11 | 10 | 1 | Passed | 11.642 | 2.719 | 0.86 | 1.945 | 9.5 | 16.5 | 7 | 11.75 | 11 | 13 |
| Potassium | $g/m^3$ | 11 | 9 | 2 | Passed | 0.961 | 0.155 | 0.0516 | 0.119 | 0.51 | 1.18 | 0.67 | 0.99 | 0.863 | 1.063 |
| Sodium | $g/m^3$ | 11 | 9 | 2 | Passed | 11.789 | 1.234 | 0.411 | 0.949 | 4.3 | 13.8 | 9.5 | 11.8 | 11.075 | 12.475 |
| Chloride | $g/m^3$ | 11 | 9 | 2 | Passed | 10.489 | 0.44 | 0.147 | 0.338 | 1 | 11 | 10 | 10.4 | 10 | 10.925 |
| Nitrite-N | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0034 | 0.00216 | 0.00125 | 0.00537 | 0.0042 | 0.0052 | 0.001 | 0.004 | 0.00175 | 0.0052 |
| Nitrate-N | $g/m^3$ | 11 | 6 | 5 | Passed | 0.07 | 0.0334 | 0.0136 | 0.035 | 0.094 | 0.13 | 0.036 | 0.0605 | 0.049 | 0.084 |
| Nirate-N+Nitrite-N | $g/m^3$ | 11 | 3 | 8 | Passed | 0.083 | 0.0412 | 0.0238 | 0.102 | 0.077 | 0.13 | 0.053 | 0.066 | 0.0563 | 0.114 |
| Sulphate | $g/m^3$ | 11 | 11 | 0 | Passed | 184.378 | 39.886 | 12.026 | 26.796 | 142 | 252 | 110 | 183 | 161.62 | 209.75 |
| dissolved Aluminium | $g/m^3$ | 11 | 1 | 10 | Failed | -- | -- | -- | -- | -- | 0.014 | <0.00032 | -- | -- | -- |
| Aluminium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.137 | 0.0153 | 0.00882 | 0.0379 | 0.03 | 0.15 | 0.12 | 0.14 | 0.125 | 0.147 |
| dissolved Antimony | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00042 | 0.0003 | 0.00017 | 0.00074 | 0.00058 | 0.00068 | <0.00021 | 0.00049 | 0.0002 | 0.00068 |
| Antimony | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00074 | 0.00023 | 0.00013 | 0.00057 | 0.00046 | 0.00096 | 0.0005 | 0.00076 | 0.00057 | 0.00091 |
| dissolved Arsenic | $g/m^3$ | 11 | 2 | 9 | Passed | 0.00051 | 1.1E-05 | 8E-06 | 0.0001 | 1.6E-05 | 0.00052 | 0.0005 | 0.00051 | 0.0005 | 0.00052 |
| Arsenic | $g/m^3$ | 11 | 10 | 1 | Passed | 0.0026 | 0.0017 | 0.00054 | 0.00122 | 0.005 | 0.006 | 0.001 | 0.0021 | 0.001 | 0.0035 |
| dissolved Barium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0233 | 0.00379 | 0.00219 | 0.0094 | 0.007 | 0.026 | 0.019 | 0.025 | 0.0205 | 0.0257 |
| Barium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0247 | 0.00321 | 0.00186 | 0.00799 | 0.006 | 0.027 | 0.021 | 0.026 | 0.0223 | 0.0267 |
| dissolved Beryllium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0187 | 0.00503 | 0.00291 | 0.0125 | 0.01 | 0.024 | 0.014 | 0.018 | 0.015 | 0.0225 |
| Boron | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0183 | 0.00306 | 0.00176 | 0.00759 | 0.006 | 0.021 | 0.015 | 0.019 | 0.016 | 0.0205 |
| dissolved Cadmium | $g/m^3$ | 11 | 11 | 0 | Passed | 0.0885 | 0.0166 | 0.005 | 0.0111 | 0.065 | 0.122 | 0.057 | 0.088 | 0.0784 | 0.0969 |
| Cadmium | $g/m^3$ | 11 | 11 | 0 | Passed | 0.0947 | 0.0165 | 0.00499 | 0.0111 | 0.062 | 0.121 | 0.059 | 0.099 | 0.0853 | 0.102 |
| dissolved Calcium | $g/m^3$ | 11 | 3 | 8 | Passed | 49.667 | 20.502 | 11.837 | 50.93 | 36 | 62 | 26 | 61 | 34.75 | 61.75 |
| Calcium | $g/m^3$ | 11 | 3 | 8 | Passed | 50.667 | 20.648 | 11.921 | 51.292 | 38 | 65 | 27 | 60 | 35.25 | 63.75 |
| dissolved Chromium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Copper | $g/m^3$ | 11 | 11 | 0 | Passed | 0.0118 | 0.00802 | 0.00242 | 0.00539 | 0.031 | 0.033 | 0.00199 | 0.009 | 0.00813 | 0.0148 |
| Copper | $g/m^3$ | 11 | 11 | 0 | Passed | 0.12 | 0.0564 | 0.017 | 0.0379 | 0.192 | 0.198 | 0.006 | 0.12 | 0.103 | 0.164 |
| dissolved Iron | $g/m^3$ | 11 | 4 | 7 | Failed | 0.259 | 0.485 | 0.243 | 0.772 | 0.981 | 0.987 | 0.00617 | 0.0215 | 0.00809 | 0.51 |
| Iron | $g/m^3$ | 11 | 11 | 0 | Passed | 1.982 | 0.92 | 0.278 | 0.618 | 2.69 | 3.73 | 1.04 | 1.7 | 1.286 | 2.325 |
| dissolved Lead | $g/m^3$ | 11 | 11 | 0 | Passed | 0.00498 | 0.00278 | 0.00084 | 0.00187 | 0.009 | 0.01 | 0.001 | 0.005 | 0.00285 | 0.00708 |
| Lead | $g/m^3$ | 11 | 11 | 0 | Passed | 0.0722 | 0.0424 | 0.0128 | 0.0285 | 0.162 | 0.174 | 0.012 | 0.062 | 0.0532 | 0.0856 |
| dissolved Lithium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0121 | 0.00413 | 0.00238 | 0.0103 | 0.0076 | 0.015 | 0.0074 | 0.014 | 0.00905 | 0.0147 |
| Lithium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0123 | 0.00478 | 0.00276 | 0.0119 | 0.0091 | 0.016 | 0.0069 | 0.014 | 0.00868 | 0.0155 |
| dissolved Magnesium | $g/m^3$ | 11 | 3 | 8 | Passed | 11.167 | 4.072 | 2.351 | 10.116 | 7.5 | 14 | 6.5 | 13 | 8.125 | 13.75 |
| Magnesium | $g/m^3$ | 11 | 3 | 8 | Passed | 11.3 | 4.095 | 2.364 | 10.173 | 8.1 | 15 | 6.9 | 12 | 8.175 | 14.25 |
| dissolved Manganese | $g/m^3$ | 11 | 7 | 4 | Passed | 0.82 | 0.227 | 0.0856 | 0.21 | 0.61 | 1.1 | 0.49 | 0.733 | 0.702 | 1.053 |
| Manganese | $g/m^3$ | 11 | 7 | 4 | Passed | 0.811 | 0.237 | 0.0897 | 0.219 | 0.68 | 1.2 | 0.52 | 0.699 | 0.658 | 0.98 |
| dissolved Mercury | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00025 | 0.00013 | 7.5E-05 | 0.00032 | 0.00023 | 0.00033 | <0.00021 | 0.00032 | 0.00016 | 0.00033 |
| Molybdenum | $g/m^3$ | 11 | 3 | 8 | Passed | 0.00025 | 0.00013 | 7.4E-05 | 0.00032 | 0.00023 | 0.00033 | 0.0001 | 0.00031 | 0.00015 | 0.00033 |
| dissolved Nickel | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0154 | 0.00563 | 0.00325 | 0.014 | 0.0109 | 0.02 | 0.0091 | 0.017 | 0.0111 | 0.0193 |
| Nickel | $g/m^3$ | 11 | 3 | 8 | Passed | 0.0147 | 0.00508 | 0.00293 | 0.0126 | 0.0099 | 0.019 | 0.0091 | 0.016 | 0.0108 | 0.0182 |
| dissolved Potassium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.837 | 0.189 | 0.109 | 0.47 | 0.35 | 0.97 | 0.62 | 0.92 | 0.695 | 0.958 |
| Potassium | $g/m^3$ | 11 | 3 | 8 | Passed | 0.873 | 0.178 | 0.103 | 0.442 | 0.33 | 1 | 0.67 | 0.95 | 0.74 | 0.988 |
| dissolved Selenium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Silver | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Sodium | $g/m^3$ | 11 | 3 | 8 | Passed | 11.133 | 2.419 | 1.397 | 6.01 | 4.6 | 13 | 8.4 | 12 | 9.3 | 12.75 |
| Sodium | $g/m^3$ | 11 | 3 | 8 | Passed | 11.233 | 2.25 | 1.299 | 5.59 | 4.3 | 13 | 8.7 | 12 | 9.525 | 12.75 |
| dissolved Tin | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | $g/m^3$ | 11 | 0 | 11 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | $g/m^3$ | 11 | 11 | 0 | Passed | 12.073 | 1.753 | 0.529 | 1.178 | 5.85 | 15.2 | 9.35 | 12 | 10.7 | 13.262 |
| Zinc | $g/m^3$ | 11 | 11 | 0 | Passed | 13.546 | 2.204 | 0.665 | 1.481 | 6.93 | 16.9 | 9.97 | 14 | 11.625 | 14.875 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*

**Table J-9: Descriptive Statistics for Sampling Site SW101 (Ruakaka Adits Tributary downstream of Ruakaka Adits discharges)**

| Column | Units | Size | Number of observations | Missing | Normality Test (K-S) | Mean | Std Dev | Std. Error | C.I. of Mean | Range | Max | Min | Median | 25% | 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | pH units | 3 | 3 | 0 | Passed | 7.233 | 0.252 | 0.145 | 0.625 | 0.5 | 7.5 | 7 | 7.2 | 7.05 | 7.425 |
| Alkalinity | g/m$^3$ as $CaCO_3$ | 3 | 3 | 0 | Passed | 9.933 | 0.115 | 0.0667 | 0.287 | 0.2 | 10 | 9.8 | 10 | 9.85 | 10 |
| Bicarbonate | g/m$^3$ at 25°C | 3 | 3 | 0 | Failed | 12 | 0 | 0 | 0 | 0 | 12 | 12 | 12 | 12 | 12 |
| Total Hardness | g/m$^3$ as $CaCO_3$ | 3 | 3 | 0 | Passed | 27.333 | 7.371 | 4.256 | 18.311 | 14 | 33 | 19 | 30 | 21.75 | 32.25 |
| Conductivity | mS/m | 3 | 3 | 0 | Passed | 11.3 | 1.572 | 0.907 | 3.904 | 3.1 | 12.7 | 9.6 | 11.6 | 10.1 | 12.425 |
| Calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 7.033 | 2.011 | 1.161 | 4.995 | 3.9 | 8.7 | 4.8 | 7.6 | 5.5 | 8.425 |
| Dissolved calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 2.367 | 0.577 | 0.333 | 1.434 | 1 | 2.7 | 1.7 | 2.7 | 1.95 | 2.7 |
| Potassium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.663 | 0.107 | 0.0617 | 0.266 | 0.19 | 0.73 | 0.54 | 0.72 | 0.585 | 0.728 |
| Sodium | g/m$^3$ | 3 | 3 | 0 | Passed | 8.033 | 0.808 | 0.467 | 2.008 | 1.4 | 8.5 | 7.1 | 8.5 | 7.45 | 8.5 |
| Chloride | g/m$^3$ | 3 | 3 | 0 | Failed | 12 | 0 | 0 | 0 | 0 | 12 | 12 | 12 | 12 | 12 |
| Nitrite-N | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Nitrate-N | g/m$^3$ | 3 | 3 | 0 | Passed | 0.183 | 0.0586 | 0.0338 | 0.146 | 0.11 | 0.25 | 0.14 | 0.16 | 0.145 | 0.227 |
| Nirate-N+Nitrite-N | g/m$^3$ | 3 | 3 | 0 | Passed | 0.183 | 0.0586 | 0.0338 | 0.146 | 0.11 | 0.25 | 0.14 | 0.16 | 0.145 | 0.227 |
| Sulphate | g/m$^3$ | 3 | 3 | 0 | Passed | 26 | 8.718 | 5.033 | 21.656 | 16 | 32 | 16 | 30 | 19.5 | 31.5 |
| dissolved Aluminium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00793 | 0.00357 | 0.00206 | 0.00887 | 0.0067 | 0.012 | 0.0053 | 0.0065 | 0.0056 | 0.0106 |
| Aluminium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.013 | 0.005 | 0.00289 | 0.0124 | 0.01 | 0.018 | 0.008 | 0.013 | 0.00925 | 0.0167 |
| dissolved Antimony | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00031 | 0.00019 | 0.00011 | 0.00047 | 0.00036 | 0.00046 | <0.00021 | 0.00037 | 0.00017 | 0.00044 |
| Antimony | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00045 | 7.8E-05 | 4.5E-05 | 0.00019 | 0.00015 | 0.00051 | 0.00036 | 0.00047 | 0.00039 | 0.0005 |
| dissolved Arsenic | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Arsenic | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Barium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0167 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.018 | 0.015 | 0.017 | 0.0155 | 0.0177 |
| Barium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0173 | 0.00208 | 0.0012 | 0.00517 | 0.004 | 0.019 | 0.015 | 0.018 | 0.0158 | 0.0187 |
| dissolved Beryllium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Beryllium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Boron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0123 | 0.00058 | 0.00033 | 0.00143 | 0.001 | 0.013 | 0.012 | 0.012 | 0.012 | 0.0127 |
| Boron | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0123 | 0.00058 | 0.00033 | 0.00143 | 0.001 | 0.013 | 0.012 | 0.012 | 0.012 | 0.0127 |
| dissolved Cadmium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.015 | 0.001 | 0.00058 | 0.00248 | 0.002 | 0.016 | 0.014 | 0.015 | 0.0143 | 0.0158 |
| Cadmium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0157 | 0.00153 | 0.00088 | 0.00379 | 0.003 | 0.017 | 0.014 | 0.016 | 0.0145 | 0.0168 |
| dissolved Calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 7.067 | 1.286 | 0.742 | 3.194 | 2.4 | 8 | 5.6 | 7.6 | 6.1 | 7.9 |
| Calcium | g/m$^3$ | 3 | 3 | 0 | Passed | 7 | 1.375 | 0.794 | 3.415 | 2.7 | 8.2 | 5.5 | 7.3 | 5.95 | 7.975 |
| dissolved Chromium | g/m$^3$ | 3 | 0 | 3 | Passed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | g/m$^3$ | 3 | 0 | 3 | Passed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Copper | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00587 | 0.00136 | 0.00078 | 0.00337 | 0.0027 | 0.0073 | 0.0046 | 0.0057 | 0.00488 | 0.0069 |
| Copper | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00603 | 0.00114 | 0.00066 | 0.00283 | 0.0022 | 0.0073 | 0.0051 | 0.0057 | 0.00525 | 0.0069 |
| dissolved Iron | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Iron | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Lead | g/m$^3$ | 3 | 3 | 0 | Passed | 0.19 | 0.0265 | 0.0153 | 0.0657 | 0.05 | 0.21 | 0.16 | 0.2 | 0.17 | 0.207 |
| Lead | g/m$^3$ | 3 | 3 | 0 | Passed | 0.21 | 0.0346 | 0.02 | 0.0861 | 0.06 | 0.23 | 0.17 | 0.23 | 0.185 | 0.23 |
| dissolved Lithium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00197 | 0.0004 | 0.00023 | 0.001 | 0.0007 | 0.0022 | 0.0015 | 0.0022 | 0.00168 | 0.0022 |
| Lithium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00197 | 0.00042 | 0.00024 | 0.00103 | 0.0008 | 0.0023 | 0.0015 | 0.0021 | 0.00165 | 0.00225 |
| dissolved Magnesium | g/m$^3$ | 3 | 3 | 0 | Passed | 2.6 | 0.458 | 0.265 | 1.138 | 0.9 | 3 | 2.1 | 2.7 | 2.25 | 2.925 |
| Magnesium | g/m$^3$ | 3 | 3 | 0 | Passed | 2.6 | 0.458 | 0.265 | 1.138 | 0.9 | 3.1 | 2.2 | 2.5 | 2.275 | 2.95 |
| dissolved Manganese | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00207 | 0.00083 | 0.00048 | 0.00207 | 0.0016 | 0.003 | 0.0014 | 0.0018 | 0.0015 | 0.0027 |
| Manganese | g/m$^3$ | 3 | 3 | 0 | Passed | 0.0023 | 0.00111 | 0.00064 | 0.00277 | 0.0022 | 0.0035 | 0.0013 | 0.0021 | 0.0015 | 0.00315 |
| dissolved Mercury | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mercury | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Molybdenum | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Molybdenum | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Nickel | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00123 | 0.00015 | 8.8E-05 | 0.00038 | 0.0003 | 0.0014 | 0.0011 | 0.0012 | 0.00113 | 0.00135 |
| Nickel | g/m$^3$ | 3 | 3 | 0 | Passed | 0.00127 | 0.00021 | 0.00012 | 0.00052 | 0.0004 | 0.0015 | 0.0011 | 0.0012 | 0.00113 | 0.00143 |
| dissolved Potassium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.653 | 0.0379 | 0.0219 | 0.094 | 0.07 | 0.68 | 0.61 | 0.67 | 0.625 | 0.677 |
| Potassium | g/m$^3$ | 3 | 3 | 0 | Passed | 0.66 | 0.0529 | 0.0306 | 0.131 | 0.1 | 0.7 | 0.6 | 0.68 | 0.62 | 0.695 |
| dissolved Selenium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Silver | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Sodium | g/m$^3$ | 3 | 3 | 0 | Passed | 8 | 0.4 | 0.231 | 0.994 | 0.8 | 8.4 | 7.6 | 8 | 7.7 | 8.3 |
| Sodium | g/m$^3$ | 3 | 3 | 0 | Passed | 8.167 | 0.451 | 0.26 | 1.12 | 0.9 | 8.6 | 7.7 | 8.2 | 7.825 | 8.5 |
| dissolved Tin | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tin | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Uranium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | g/m$^3$ | 3 | 0 | 3 | Failed | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| dissolved Zinc | g/m$^3$ | 3 | 3 | 0 | Passed | 1.7 | 0.1 | 0.0577 | 0.248 | 0.2 | 1.8 | 1.6 | 1.7 | 1.625 | 1.775 |
| Zinc | g/m$^3$ | 3 | 3 | 0 | Passed | 1.667 | 0.0577 | 0.0333 | 0.143 | 0.1 | 1.7 | 1.6 | 1.7 | 1.625 | 1.7 |

*Notes:*

*1. "--" Insufficient data to undertake statistical analysis*