Report

Red Hill Mining Lease

Surface Water Quality Technical Report

4 OCTOBER 2013

Prepared for

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Table of Contents

Table of Contents

Tables

Figures

Table of Contents

Appendices

Abbreviations

Abbreviation	Description
AEP	Annual Exceedence Period
ANZECC	Australia and New Zealand Environment and Conservation Council
ARI	Annual Recurrence Interval
AS	Australian Standard
BMA	BHP Billiton Mitsubishi Alliance
BoM	Bureau of Meteorology
BRM	Broadmeadow underground mine
CHPP	Coal Handling and Preparation Plant
DERM	Department of Environment and Resource Management (now EHP)
EA	Environmental Authority
EC	Electrical Conductivity
EFO	Environmental Flow Objectives
EHP	Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority (now EHP)
EPP (Water)	Environmental Protection (Water) Policy 2009
GMS	Goonyella Middle Seam
GRB	Goonyella Riverside Broadmeadow
GRM	Goonyella Riverside Mine
IMG	incidental mine gas
ML	mine lease
MLA	mine lease application
MIA	mine industrial area
NRM	Department of Natural Resources and Mines
NTU	Nephelometric Turbidity Units
QWQG	Queensland Water Quality Guidelines 2009
REMP	receiving environment monitoring program
RHM	Red Hill Mine
ROM	run of mine
ROP	Resource Operations Plan
TDS	Total Dissolved Salts
TSS	Total Suspended Solids
URS	URS Australia Pty Ltd
Water Act	Water Act 2000
WQO	Water Quality Objective
WRP	Water Resource Plan

Executive Summary

The Red Hill Mining Lease is located adjacent to the existing Goonyella, Riverside and Broadmeadow (GRB) mine complex in the Bowen Basin, approximately 20 kilometres (km) north of Moranbah and 135 km south-west of Mackay, Queensland.

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to convert the existing Red Hill Mining Lease Application (MLA70421) to a mining lease to enable the continuation of existing mining operations associated with the GRB mine complex. Specifically, the mining lease conversion will allow for:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine.
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM).
- A future Red Hill Mine underground expansion option located to the east of the GRM.

The three project elements described above are collectively referred to as 'the project'.

This Surface Water Quality Technical Report provides an assessment of the surface water resources for the proposed project in the context of environmental values defined by the *Environmental Protection (Water) Policy 2009* (EPP (Water)). The assessment contained within the report is based on the mine footprint proposed as of 2011.

The project is located within the headwaters of the Isaac-Connors sub catchment of the Fitzroy Basin. Six watercourses have been defined within or adjacent to the EIS study area. These are the Isaac River and its various tributaries, including Goonyella Creek, Eureka Creek, 12 Mile Gully, Fisher Creek, and Platypus Creek. All other streams located in the EIS study area are tributaries of these watercourses. The Isaac River, the primary watercourse within the EIS study area, flows south through the project site and converges with the Connors River before flowing into the Mackenzie River.

Environmental values for receiving waters in the EIS study area were specified in Schedule 1 of EPP (Water) in September 2011 for the Isaac River sub-basin of the Fitzroy Basin with some locally derived values to account for naturally high levels of some toxicants. They were defined in September 2011, and are still current. The local watercourses represent a slightly to moderately disturbed aquatic habitat, are suitable for visual and primary and secondary contact recreation, have cultural and spiritual values, and support industrial use and agricultural activities including stock watering, farm use and irrigation. Regionally the Isaac/Connors River System also provides a potable water supply (after treatment), supports aquaculture and aquatic food for human consumption.

Relevant water quality objectives for the EIS study area were identified from the EPP (Water), local reference data and the Water Quality Guidelines (ANZECC 2000). Water quality data, covering the period 2010 – 2011, shows that water quality exceeded relevant quality objectives for a number of parameters at both upstream and downstream sites. The water quality data indicates that aluminium, iron, copper, chromium, nickel, vanadium and zinc are present at elevated concentrations relative to the water quality objectives. The data also indicates that the vast majority of these metals are adsorbed to suspended particles and would not be expected to have an adverse effect on aquatic organisms. Notwithstanding that some metals are naturally present at high concentrations, the levels of these metals in at soluble form are within guideline values.

Historical electrical conductivity data shows that all sites meet the water quality objectives.

Without proper management and impact mitigation programs the project has the potential to adversely impact on ephemeral surface water resources during construction, operation, and decommissioning. During construction the main areas of potential impact are activities associated with the construction of mine infrastructure, construction of access roads and stream crossings, and earth moving activities. These activities may lead to increased potential for erosion and sediment mobilisation to surface waterways. In addition, these activities increase the potential for water quality deterioration through chemical and fuel spills.

During operations, all mine water produced from the project activities will be transferred to the adjacent GRB mine complex for reuse and management within the existing mine water management system. The water supply for the project underground operations coal handling and preparation plant, potable uses and stockpile management will be drawn from the GRB mine water management system. Modelling of the combined water management system indicates that the addition of water from the project does not affect the ability of the GRB mine complex operation to achieve compliance with its existing environmental authority in relation to mine water management and discharges.

Potential adverse impacts may, however, arise during the operational phase of the coal mine due to water management system infrastructure malfunctions (storages, pipes, embankments and levees), flooding of the mine area, chemical and fuel spills, and ponding of water within subsided areas.

During decommissioning the main areas of potential impact arise from transfer system failures during dewatering activities and increased erosion and sediment mobilisation potential during earthworks activities to establish a final landform for the sites.

Management and mitigation measures are recommended to reduce or eliminate potential impacts identified in this study. The main mitigation measures required to address surface water quality involve development and implementation of erosion and sediment control measures and spill prevention, and by having response procedures documented and managed as part of the project's environmental authorities.

Proposed augmentation of the on-going water quality monitoring program is detailed within this report, designed to measure the effectiveness of the impact mitigation measures implemented during the project. Based on the implementation of recommended management and mitigation measures, and validation through monitoring programs, the residual risk of the project having adverse impacts on receiving surface waters is expected to be minor.

1 Introduction

1.1 Project Overview

The Red Hill Mining Lease is located adjacent to the existing Goonyella, Riverside and Broadmeadow (GRB) mine complex in the Bowen Basin, approximately 20 kilometres (km) north of Moranbah and 135 km by road south-west from Mackay, Queensland (Figure 1-1).

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to convert the existing Red Hill Mining Lease Application (MLA) 70421 to enable the continuation of existing mining operations associated with the GRB mine complex. Specifically, the mining lease conversion will allow for:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM) into MLA70421, with development work commencing in Financial Year 2016. Key elements include:
  - No new mining infrastructure is proposed other than infrastructure required for drainage of incidental mine gas (IMG) to enable safe and efficient mining.
  - Management of waste and water produced from drainage of IMG will be integrated with the existing BRM waste and water management systems.
  - The mining of the Broadmeadow extension is to sustain existing production rates of the BRM mine and will extend the life of mine by approximately one year.
  - The existing BRM workforce will complete all work associated with the extensions.
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM), including:
  - underground mining associated with the RHM underground expansion option to target the Goonyella Middle Seam (GMS) on mine lease (ML) 1763;
  - a new mine industrial area (MIA);
  - a coal handling and preparation plant (CHPP) adjacent to the Riverside MIA on MLA1764 and ML1900 − the Red Hill CHPP will consist of up to three 1,200 tonne per hour modules;
  - construction of a drift for mine access;
  - a conveyor system linking RHM to the Red Hill CHPP;
  - associated coal handling infrastructure and stockpiles;
  - a new conveyor linking product coal stockpiles to a new rail load-out facility located on ML1900; and
  - means for providing flood protection to the mine access and MIA, potentially requiring a levee along the west bank of the Isaac River.
- A future Red Hill Mine (RHM) underground mine expansion option to the east of the GRB mine complex, to target the GMS on MLA70421. This includes development of key infrastructure:
  - the proposed mine layout consists of a main drive extending approximately west to east with longwall panels ranging to the north and south;
  - a network of bores and associated surface infrastructure over the underground mine footprint for mine gas pre-drainage (IMG) and management of goaf methane drainage to enable the safe extraction of coal;
  - a ventilation system for the underground workings;
  - a bridge across the Isaac River for all-weather access. This will be located above the main headings, and will also provide a crossing point for other mine related infrastructure including water pipelines and power supply;

- a new accommodation village (Red Hill accommodation village) for the up to 100 per cent remote construction and operational workforces with capacity for up to 3,000 workers; and
- potential production capacity of 14mtpa of high quality hard coking coal over a life of 20 to 25 years.

The three main project elements described above are collectively referred to as 'the project'.

Mine water from the proposed project activities will be transferred to the existing GRB mine water management system. The water supply for the proposed underground operations, CHPP, potable uses and stockpile management will be drawn from the existing GRB mine complex.

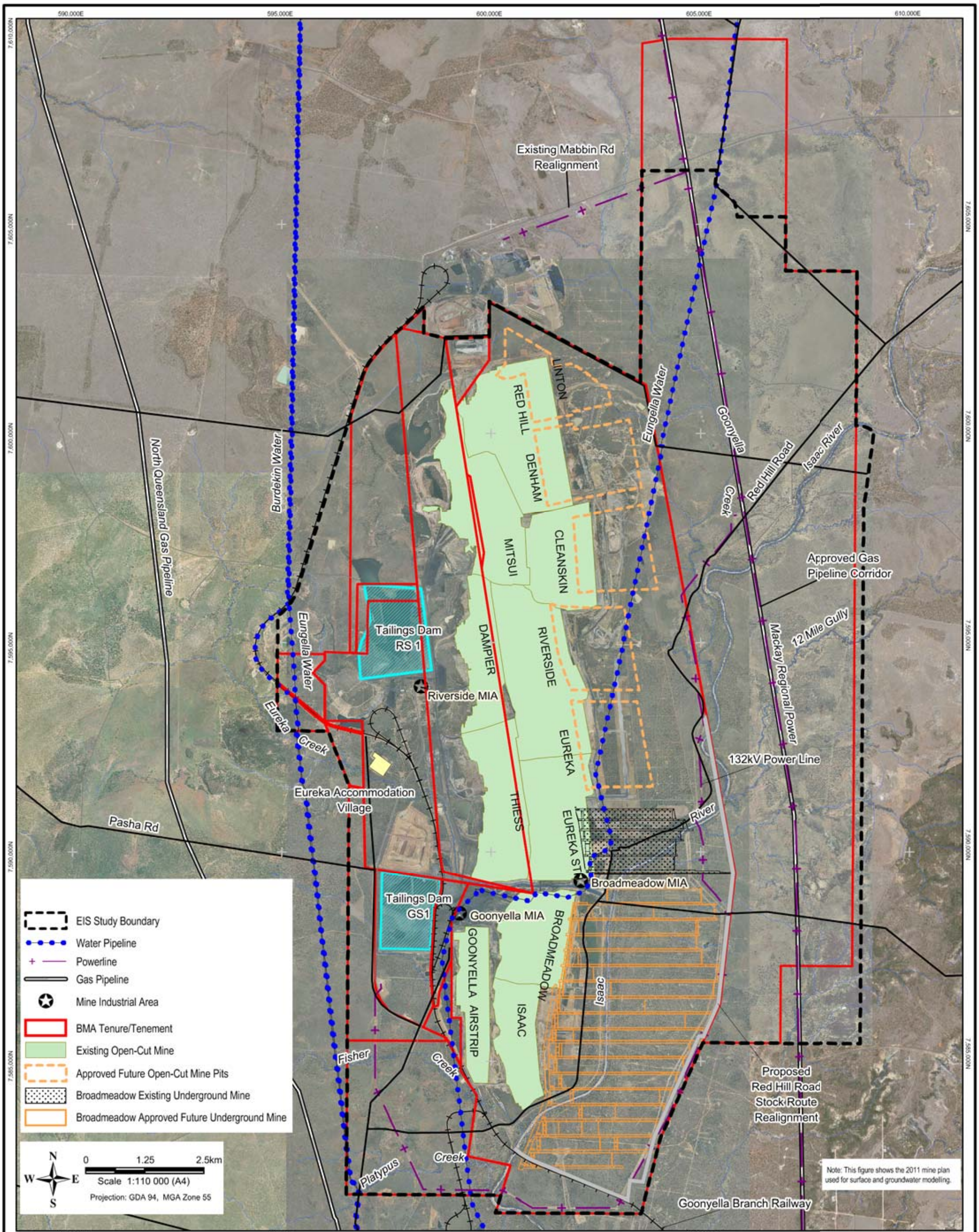
Surface water quality predictions were modelled on the October 2011 mine plan sequence. A new mining sequence has since been developed for the RHM, Broadmeadow extension and the existing approved BRM. Further, both the BRM and the proposed Broadmeadow extension footprints have been revised. This has the potential to alter surface water quality modelling over the life of mine. However, the mine plan and revised schedule are indicative only and sequencing of production and annual production rates may vary. Regardless of this, the changes are not anticipated to have a significant impact on modelling predictions. Surface water modelling results from 2011 have been retained, and are incorporated into this report.

1.2 Methodology

This report provides an assessment of the surface water resources within the vicinity of the proposed project in the context of environmental values defined by the Environmental Protection (Water) Policy 2009 (EPP (Water)). The value of these resources to the environment and for human uses are discussed in terms of current legislation, water quality, regional hydrology and the existing condition of watercourses within the environmental impact statement (EIS) study area (as shown in Figure 1-1).

A description of the current hydrological conditions using available data is also provided. A water quality assessment using available data for the site was undertaken through the comparison with relevant water quality objectives (WQO) from the EPP (Water). Water balance modelling was undertaken in 2011 to predict the effect of proposed mine affected water discharges, via the GRB mine complex, from the proposed mine on water quality downstream of the release (refer to Red Hill Mining Lease EIS Appendix I3).

Potential impacts from the project on the environmental values are identified and details of preventative and mitigation measures to demonstrate that the project will not result in degradation of water quality related values are provided.



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RED HILL MINING LEASE
SURFACE WATER QUALITY TECHNICAL REPORT

RED HILL PROJECT LOCATION

SURFACE WATER

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Figure: **1-1** Rev.**A** A4

Environmental Values

2.1 Environmental Protection (Water) Policy 2009

The EPP (Water) seeks to protect and/or enhance the suitability of Queensland's waters for various beneficial uses. The policy identifies environmental values for waters in Queensland and guides the setting of WQOs to protect the environmental values of any water resource.

2.2 Existing Environmental Values

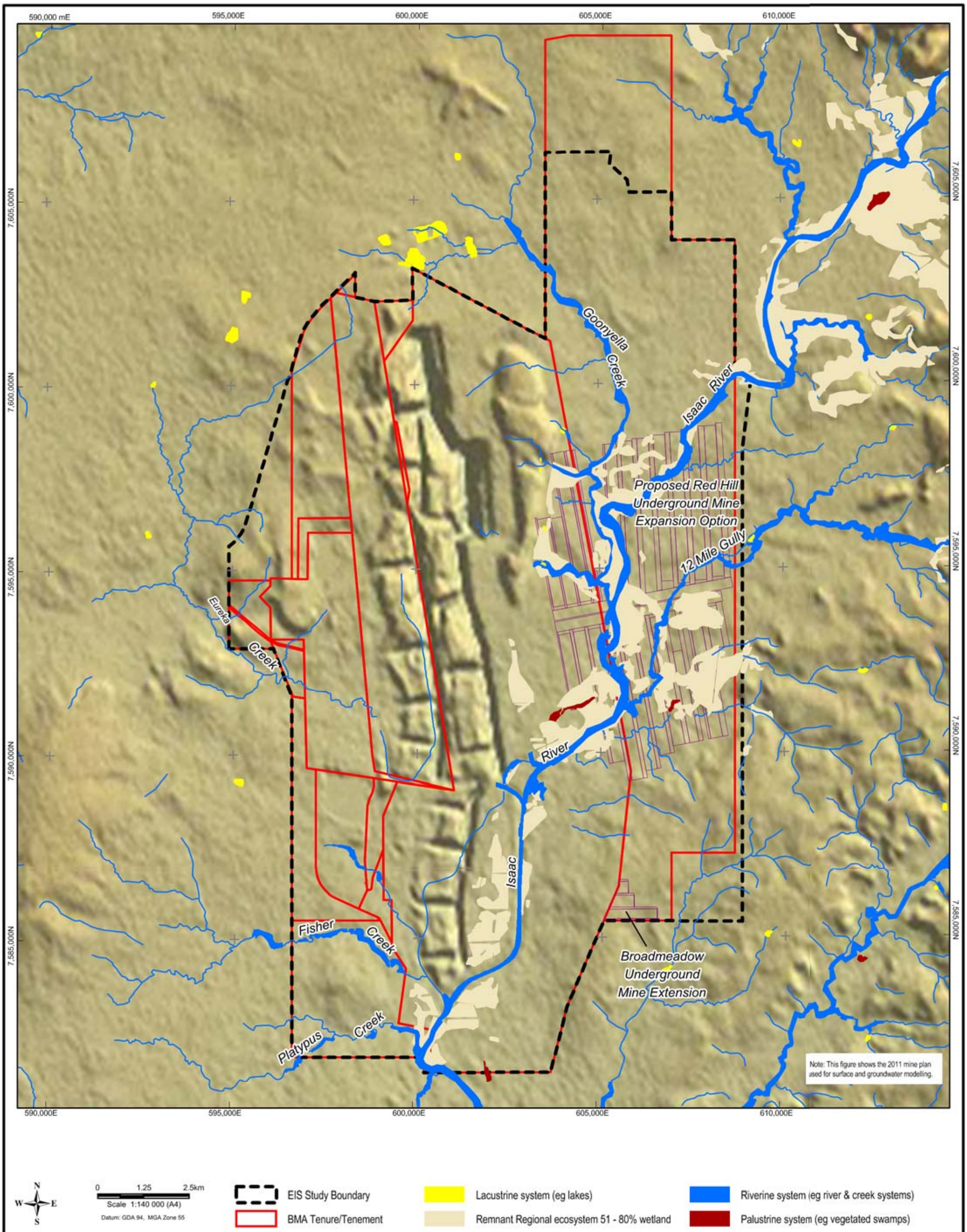
Environmental values for the EIS study area (Isaac River sub-basin of the Fitzroy Basin) were included within Schedule 1 of the EPP (Water) in September 2011.

The EIS study area is located within the Isaac-Connors sub-catchment, of the greater Fitzroy Basin. In the greater regional catchment context, the EIS study area shown on Figure 1-1 is in the far upstream headwaters of the Fitzroy Basin, and relatively high in the headwaters of the Isaac River sub catchment.

The project activities will occur completely within the broader Isaac River catchment, and span across the tributary catchments of Goonyella Creek and 12 Mile Gully. Other nearby tributaries including Eureka Creek, Fisher Creek, and Platypus Creek are also located within the EIS study area as shown in Figure 2-1.

All streams within or adjacent to the EIS study area were identified as upland freshwater streams, which are defined as (freshwater) streams or stream sections above 150 m in elevation (ANZECC 2000). The EPP (Water) designates waters within the EIS study area as Isaac River main channel and Isaac northern tributaries.

Environmental values that have been identified for the EIS study area are provided in Table 2-1.



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RED HILL MINING LEASE
SURFACE WATER QUALITY TECHNICAL REPORT

WETLAND FEATURES WITHIN RED HILL PROJECT MINE LEASE

URS

SURFACE WATER

Figure: **2-1**

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2 Environmental Values

Table 2-1 Environmental Values for the Receiving Environment

Environmental Values	Local Scale	Isaac River main channel	Isaac Northern tributaries – developed areas
Aquatic Ecosystem Environmental Values			
Protection of high ecological value aquatic habitat	X	X	X
Protection of slightly to moderately disturbed aquatic habitat	✓	✓	✓
Protection of highly disturbed aquatic habitat	X	X	X
Human Use Environmental Values			
Suitability for crop irrigation	X	X	✓
Suitability for farm use	X	✓	✓
Suitability for stock watering	✓	✓	✓
Suitability for aquaculture	X	X	X
Suitability for human consumers of aquatic food	X	X	✓
Suitability for primary contact recreation (e.g. swimming)	X	✓	✓
Suitability for secondary contact recreation (e.g. boating)	X	✓	✓
Suitability for visual (no contact) recreation	✓	✓	✓
Suitability for drinking water supply	X	X	✓
Suitability for industrial use (including manufacturing plants, power generation)	X	✓	✓
Protection of cultural and spiritual values	✓	✓	✓

2.2.1 Water Resource Management

The use of water for human activities such as irrigation, stock water, drinking water and industrial use is regulated under the Water Act 2000. The *Water Act 2000* (Water Act) provides a basis for the planning and allocation of Queensland water resources, which in turn must make allowances for the provision of water purely for the support of the natural processes that underpin the ecological health of natural river systems, that is, environmental flows. The watercourses potentially affected by the project are subject to protection under the Water Act, which regulates the extraction of water from these watercourses and works that might disturb bed and banks of each watercourse.

The Water Act prescribes the process for preparing Water Resource Plans (WRP) and Resource Operation Plans (ROP) which are specific for catchments within Queensland. Under this process, the WRP identifies a balance between waterway health and community needs and are applied on a catchment scale. The WRP establishes Environmental Flow Objectives (EFO) that are of importance for waterway health, and sets Water Allocation Security Objectives which are important to maintain water availability for community needs. The ROP provides the operational details on how this balance can be achieved. The WRP and ROP determine conditions for granting water allocation licences, permits and other authorities, as well as rules for water trading and sharing. Further discussion on potential impacts of the project on flows is provided in Section 7 and Appendix I4 of the Red Hill Mining Lease EIS. The WRP and ROP applicable to the Project are detailed below.

Fitzroy Basin Water Resource Plan

The proposed project is located within the Fitzroy Basin. The Water Resource (Fitzroy Basin) Plan was finalised in 1999, but was amended in 2005 to address overland flow water management and was again updated in 2011 (Queensland Government 2011a).

Fitzroy Basin Resource Operations Plan

The Fitzroy Basin ROP came into force in January 2004, and was amended in October 2011 (Revision 3) (Queensland Government 2011b). It details how the objectives of the Water Resource (Fitzroy Basin) Plan will be met on an operational level, and defines strategies to support the WRP's overall goals for water entitlement security and ecological health.

In general it provides the basis and rules for trading of water allocations, allows for unallocated water to be identified and allocated and also details operating rules for the use of water management infrastructure such as weirs and dams. The Nogoa Mackenzie, Lower Fitzroy, and Fitzroy Barrage Supplemented Water Supply Schemes operate within the wider Fitzroy Basin catchment. Of these, the Nogoa Mackenzie Water Supply Scheme is the nearest to the site but is in a separate catchment.

Table 2-2 below identifies water users located within 100 km downstream of the EIS study area, along the Isaac River. There were no external users identified within the immediate EIS study area. Users were identified via a search of water licence allocations within the Isaac-Connors sub catchment of the Fitzroy Basin, using the Department of Natural Resources and Mines (NRM) Water Entitlements System.

2.2.2 Aquatic Ecosystem Values

The watercourses within the EIS study area are ephemeral in nature and provide seasonal habitat for aquatic fauna and flora.

The aquatic ecosystems are considered to be slightly to moderately disturbed from current mining and grazing activities and are classified accordingly in the EPP (Water). The stream health for the various rivers and creeks within the EIS study area is assessed in Section 10 of the Red Hill Mining Lease EIS. The impact of the Burton Gorge Dam on low flow hydrology in the Isaac River is another factor influencing the disturbed status of aquatic habit values in the Isaac River.

2.2.3 Human Use Environmental Values

Existing Land Use

The dominant land use upstream of the proposed mine site is beef cattle grazing. Tree clearing has occurred over time to improve pastures. There is also some mining activity upstream of the proposed mine and the Isaac River has been dammed upstream through the construction of Burton Gorge Dam. The catchments are therefore not in pristine condition and are susceptible to the impacts from existing land use activities.

Existing land uses downstream of the EIS study area include mining, grazing (modified pastures) and dryland cropping.

Existing Water Use

The existing licensed water users downstream of the proposed mine are shown in Table 2-2.

2 Environmental Values

Table 2-2 Water Licences Downstream of the Red Hill Mine (Source: NRM Water Entitlements System, 2011)

License Number	Permit Type	Status	Authorised Purpose	Licensee	Nominal Megalitres (ML)	Location (Coordinates or Property Plan Number)	Distance in relation to existing GRM footprint
178493	Interfere by diversion (of surface water)	Under renewal	Divert the course of flow	Anglo Coal (Moranbah North Management) Pty Limited	Not recorded	1/RP904445 1/SP126833	Immediately downstream; extends for approximately 5 km across both banks of Isaac River.
43173WL	Take water (surface water)	Issued	Water harvesting	Private user	Not recorded	18/SP113322	Approximately 52 km downstream; adjacent to left bank of Isaac River.
44161U	Take water (groundwater)	Issued	Domestic supply, irrigation, stock	Private user	65	11/KL135 1/KL159 Lat -22.23833 Long 148.4303	Approximately 52 km downstream; adjacent to left bank of Isaac River.
16103F	Interfere by impounding – embankment or wall	Issued	Impound water	Namrog Investments Pty Limited	Not recorded	9/CNS98	Approximately 70 km downstream; on right bank of Isaac River.
400859	Take water (surface water)	Under replacement	Stock	Private user	10	6/CNS53 7/CNS53	Approximately 85 km downstream on Isaac River.

Hydrology

3.1 Hydrological Overview of the EIS Study Area

The project is located within the headwaters of the Isaac-Connors sub-catchment of the Fitzroy Basin. The Isaac River flows through the site in a southerly direction and is in the headwaters of the greater Fitzroy catchment. The Isaac River converges with the Connors River before flowing into the Mackenzie River. The Mackenzie River is joined by the Dawson River to form the Fitzroy River, which flows initially north and then east towards the east coast of Queensland. The Fitzroy River discharges into the Coral Sea at Rockhampton (adjacent to Casuarina Island).

The total catchment area of the Isaac River upstream of the MLA70421 boundary is approximately 1200 square kilometres (km^2). The Burton Gorge Dam is located 23 km upstream of the mine and captures a sub-catchment area of approximately 600 km^2. Burton Gorge Dam is often only part full and (anecdotally) overflows typically occur approximately once every four years.

The Isaac River tributaries in the immediate vicinity of the project are 12 Mile Gully, which flows from the eastern side of the mine through the lease, Goonyella Creek to the north east, Eureka Creek which flows through the existing GRB mine complex to the west, and Fisher and Platypus Creeks which flow from the west around the southern end of the existing GRB mine complex before joining the Isaac River downstream of the railway (refer to Figure 4–1 in Section 4 of this report).

Approximately 8 km of the Isaac River channel has been diverted east of its original path, around the GRB mine complex (south of the proposed RHM) in the mid-1980s. At the same time Eureka Creek was diverted (to its present day position), and Fisher Creek was diverted (known as Fisher Diversion) south to Platypus Creek.

The Isaac River and tributaries in and around the EIS study area are ephemeral. Flow mainly occurs for a short period during and immediately after rainfall events.

3.2 Climate Data

3.2.1 Rainfall and Evaporation

Historic climate data was sourced from the Bureau of Meteorology (BoM) SILO data drill using 122 years of records (1889 to 2011). The data drill is produced by accessing grids of data derived from interpolating the BoM records from individual weather recording stations. This type of analysis is particularly helpful when there are no long term climate stations installed within the immediate vicinity of the study location, as is the case for this project. The interpolations are calculated using splining and kriging techniques and the resulting data drill consists of fully synthetic data. Figure 3-1 shows annual water year totals for the site and Figure 3-2 shows mean monthly rainfall and evaporation.

From Figure 3-1 it can be seen that annual rainfall at the GRM site is highly variable and subject to prolonged periods of above and below average rainfall. The mean monthly rainfall shows a distinct seasonal distribution (refer to Figure 3-2). Monthly rainfall totals are greatest in the wet season, extending from November through March, and peak in January at just over 100 millimetres (mm). Mean monthly evaporation is in excess of mean monthly rainfall throughout the year, except for January and February, and peaks in December at almost 245 mm.

3 Hydrology

Figure 3-1 Annual Rainfall Totals at Goonyella (SILO Data Drill 1890-2010)

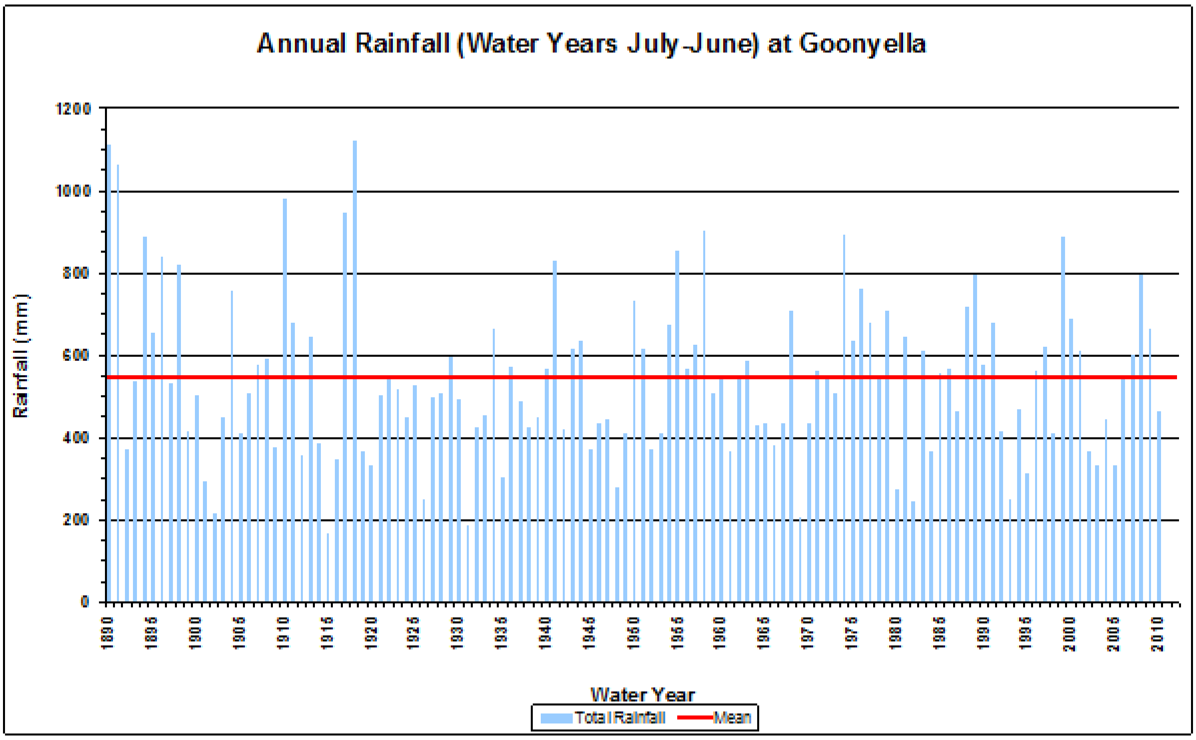
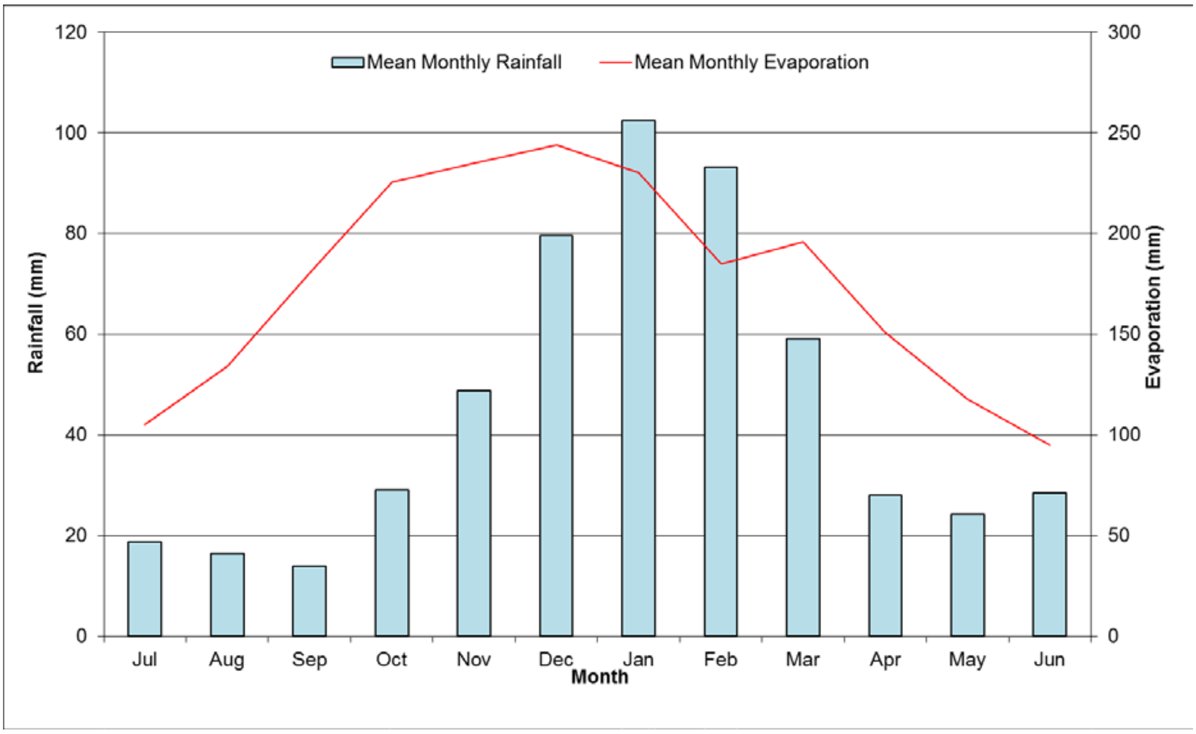


Figure 3-2 Mean Monthly Rainfall and Evaporation at Goonyella (SILO Data Drill 1889-2011)

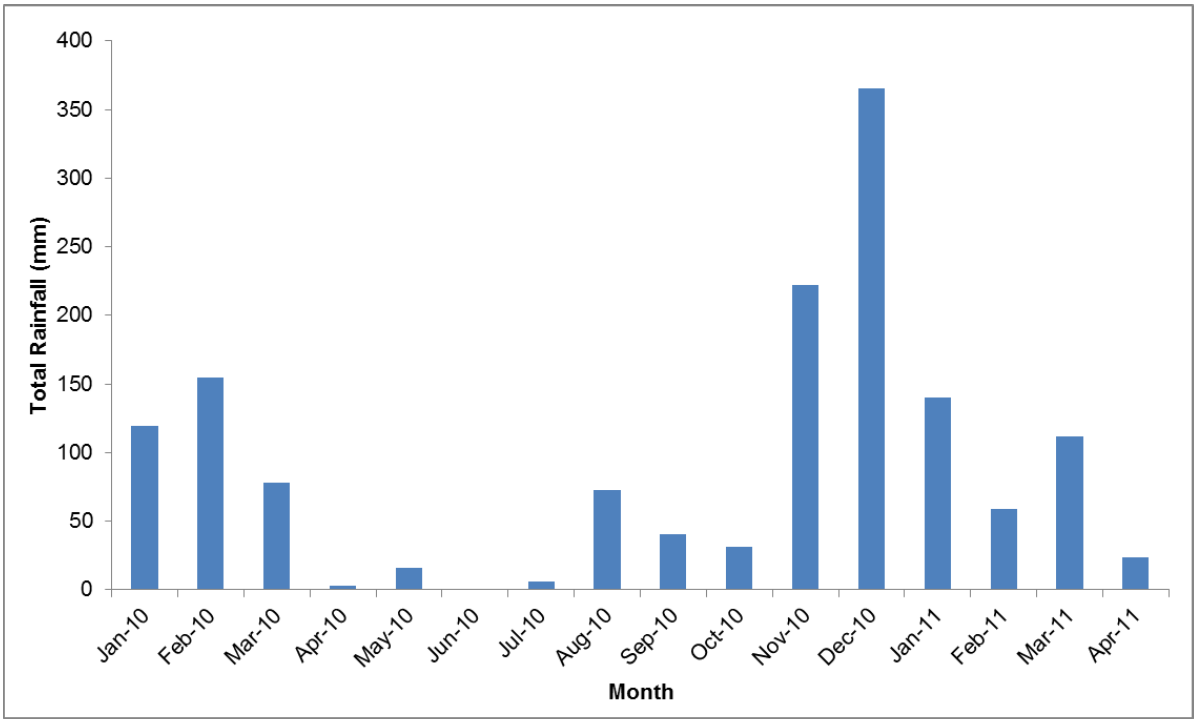


3 Hydrology

3.2.2 2010-2011 Wet Season

Given the narrow time period for which surface water quality analysis is available (see Section 4), it is important to note the weather events which occurred during the same timeframe. The 2010-2011 wet season was significant in terms of the volume of rainfall within the Isaac River catchment; which contributed to peak flows which were higher than average for the wet season. For example, total monthly rainfall for December 2010 was 365 mm (Figure 3-3); over 285 mm higher than the mean monthly average of 80 mm depicted in Figure 3-2.

Figure 3-3 Total monthly rainfall (mm) at Goonyella (January 2010 to April 2011; SILO Data Drill)



3.2.3 Stream Flows

The Department of Natural Resources and Mines (NRM) maintains stream flow data for several locations close to the EIS study area-two stream gauge stations are located within the existing MLA at Goonyella (Table 3-1). River flows in the EIS study area are characterised by large annual variations due to the seasonal and highly variable nature of rainfall. Stream flows generally occur during December to February when most of the region's rainfall occurs. The prolonged winter dry periods give rise to the ephemeral nature of the key watercourses.

Table 3-1 NRM Stream Flow Gauging Stations

Gauge Number	Location	Period of Record (may vary between parameters for each site)	Catchment Area (km^2)
1304056	Eureka Creek (Isaac River Junction)	1989 - 1991	86.4
130414A	Junction of Goonyella Creek and Isaac River (within GRM MLA 70421)	1983 - present	1214

3.3 Existing Stream Characteristics

The Isaac River catchment is classified as 'upland freshwater' within the Queensland Water Quality Guidelines (QWQG) (DERM 2009d, Appendix B2.2.1). The QWQG provide the following definition for upland freshwater streams:

> *"Small (first, second and third order) upland streams. Moderate to fast flowing due to steep gradients. Substrate usually cobbles, gravel or sand – rarely mud."* (DIBM 2001 in DERM 2009d).

In addition, it is stated that the classification is relevant for all freshwater streams or stream sections above 150 m elevation, although it is accepted that this may not apply in some areas (ANZECC 2000, in DERM 2009d).

The headwaters of the Isaac River catchment are elevated above the 150 m limit (between lowland/upland classifications) but substrate is sand, and/or mud. The main channel of Isaac River shows characteristics of an upland river. Tributaries to the west are at even higher elevations, with steeper gradients. Therefore, Goonyella Creek, Eureka Creek and other, smaller tributaries are also upland freshwater streams.

The following assessment of existing geomorphic characteristics within the Isaac River catchment is adapted from information provided by Alluvium (2011) (Red Hill Mining Lease EIS Appendix I6).

Vegetation and Erosion

Changes in land use throughout the Isaac River catchment, i.e. a significant increase in vegetation clearance, have resulted in increased sediment inputs to river systems. As a result, the condition of the Isaac River has been compromised; a majority of bedforms are smothered by sediment, pools have been infilled, and the creation of a smoother sand bed profile has reduced the potential for aquatic habitat development outside of the wet season. Some actively eroding vertical scarps were identified by Alluvium (2011) in reaches of the Isaac River where the contemporary channel encroaches on the terraces.

The riparian vegetation along reaches within the EIS study area and GRB mine complex sites remains reasonably continuous at the overstorey level, but minimal at the understorey level. Groundcover is variable but often dense, with exotic grasses dominant. These provide conditions for deposition of a mud drape over banks, which enhance stability (Alluvium 2011).

Bedrock outcropping in the channel bed occurs sporadically (and spatially) along Isaac River, within the mine plan area. Exact locations of outcrops have not been mapped as sediment migration during flow events results in shifting bed conditions. Bedrock controls are present but not dominant throughout the 15 km of Isaac River upstream of the proposed Red Hill operations area. As such, the reach of Isaac River running through the site was classified as a low to moderate sinuosity alluvial stream.

Geomorphic Character

Alluvium (2011) assessed the geomorphic character of the Isaac River and two major tributaries within the EIS study area; Goonyella Creek and 12 Mile Gully. A summary of this assessment is provided in Table 3-2 below.

3 Hydrology

Table 3-2 Geomorphic Assessment of Major Watercourses (adapted from Alluvium 2011)

Watercourse	Geomorphic characterisation	Channel Geometry	Channel Pattern	Geomorphic Units: Channel Zone	Geomorphic Units: Floodplain Zone	Geomorphic Behaviour	Sediment Transfer Behaviour
Isaac River	Alluvial continuous – terrace confined	Compound with low and high level benches. Floodplain inset below broad terrace.	Single; low to moderate sinuosity.	Plain sand bed; low and high level benches; point bar/bench complexes	Scroll bars with ridge and swale topography in floodplain.	Oblique accretion trend with present sediment supply regime. Limited lateral activity.	Transport limited, oblique accretion storing sediment on banks.
Goonyella Creek	Partly confined; low to moderate sinuosity.	Compound with low level benches.	Single, low to moderate sinuosity with frequent bedrock or terrace controls on planform.	Pool-riffle-run bed; benches; bank.	As per Isaac River terrace.	Limited channel adjustment where bedrock controlled. Mud drape covered banks limit change in bank profile in Isaac River terrace.	Hydraulic conditions able to transfer most sediment through reach.
12 Mile Gully	Alluvial continuous – meandering single channel.	Symmetrical straights, asymmetrical bends.	Moderate to high sinuosity with meander cutoffs.	Sand smothered bed; point bar/bench complexes on high angle meanders; banks.	Flood channel(s); meander cutoffs; gilgai.	Laterally active channel with outside of bend bank erosion prevalent. Meander cutoffs prevalent. Incises down to Isaac River invert level in lower reaches where there are near vertical banks.	Excess sediment supply from upstream smothering bedforms in some reaches. Where steeper and more incised most sand transported through.

Existing Water Quality

4.1 Guidelines

Water quality objectives to protect the environmental values defined for the Isaac-Connors catchment and the corresponding guideline values have been defined within Schedule 1 of the EPP (Water) which came into effect during September 2011. In addition, the recently amended environmental authority (EA) for the GRB mine complex (EPML00853413) dated 6th September 2013 defines water quality trigger level criteria for selected toxicants (as indicated in Table 4-1 below) for the section of the Isaac River immediately below the release point from GRM. The EA water quality trigger values have been assigned on the following assumptions:

- Mine affected water may only be released during periods of natural flow events (where receiving water stream flow is greater than or equal to 3m^3/sec) (Condition W9).
- Releases from Discharge Point 1 on Isaac River may occur during *periods of no flow* in the Isaac River (Condition W10), provided that:
  - surface flows are recorded in Eureka Creek (Monitoring Point 2) within 24 hours prior to release; and
  - the release only allows for the total volume of inflow into GS4A dam (resulting from natural flows in Eureka Creek) to be conveyed via the GS4A dam into the Isaac River.

This EA was issued for existing mining leases; it is therefore assumed that conditions for release will be similar for the proposed expansion associated with MLA70421. While not strictly water quality guidelines, these trigger levels have been locally modified where appropriate on the basis of reference data using methods set out in the QWQG and hence provide a local context for water quality in the Isaac River in the vicinity of the project. Water quality objectives for surface water resources in the EIS study area are provided in Table 4-1. Further guidelines for toxicants are provided in Table 4-3.

Table 4-1 Water Quality Guidelines for Physico-Chemical Stressors and Toxicants in the Surface Water Receiving Environment

Parameter	Units	Water Quality Objectives	Guideline Source
Physico-chemical parameters, nutrients and hydrocarbons			
Total Suspended Solids	mg/L	30	EPP (Water) 2011
Electrical Conductivity	µS/cm	2,000 (high flow)	EPML00853413, Table W5
Sulphate (SO_4)	mg/L	1,000	EPML00853413, Table W5
Total Nitrogen	µg/L	500	EPP (Water) 2011
Total Phosphorus	µg/L	50	EPP (Water) 2011
pH	pH units	6.5-8.5	EPP (Water) 2011
Ammonia Nitrogen	µg/L	20	EPP (Water) 2011
Oxidised Nitrogen (NO_x)	µg/L	60	EPP (Water) 2011
Organic Nitrogen	µg/L	420	EPP (Water) 2011
Nitrate	µg/L	1,100	QWQG 2009
Filterable Reactive Phosphorus	µg/L	20	EPP (Water) 2011
Chlorophyll-α	µg/L	5	EPP (Water) 2011
Dissolved oxygen	% saturation	85 - 110	EPP (Water) 2011
Turbidity	NTU	50	EPP (Water) 2011

Parameter	Units	Water Quality Objectives	Guideline Source
Petroleum hydrocarbons (C6-C9)	µg/L	50	LoR for analytical methods defined in EPML00853413
Petroleum hydrocarbons (C10-C36)	µg/L	200	LoR for analytical methods defined in EPML00853413
Toxicants (Total and Dissolved)			
Aluminium	µg/L	1,530	EPML00853413, Table W3
Chromium	µg/L	3	EPML00853413, Table W3
Copper	µg/L	3	EPML00853413, Table W3
Iron	µg/L	970	EPML00853413, Table W3
Nickel	µg/L	11	EPP (Water) 2011/ ANZECC 2000
Zinc	µg/L	8	EPP (Water) 2011/ ANZECC 2000
Molybdenum	µg/L	34	EPP (Water) 2011/ ANZECC 2000
Selenium	µg/L	10	EPP (Water) 2011/ ANZECC 2000
Uranium	µg/L	1	EPP (Water) 2011/ ANZECC 2000
Vanadium	µg/L	10	EPP (Water) 2011/ ANZECC 2000

4.2 Historical Water Quality

Historical water quality grab sample data was provided by BMA to describe water quality conditions prior to any project activities. This water quality data is understood to have been collected in accordance with EA conditions for the existing GRB mine complex and covers the period August 2010 – April 2011. As the Isaac River and tributaries are ephemeral, samples were only collected when flow was present or from remnant pools at each sampling location.

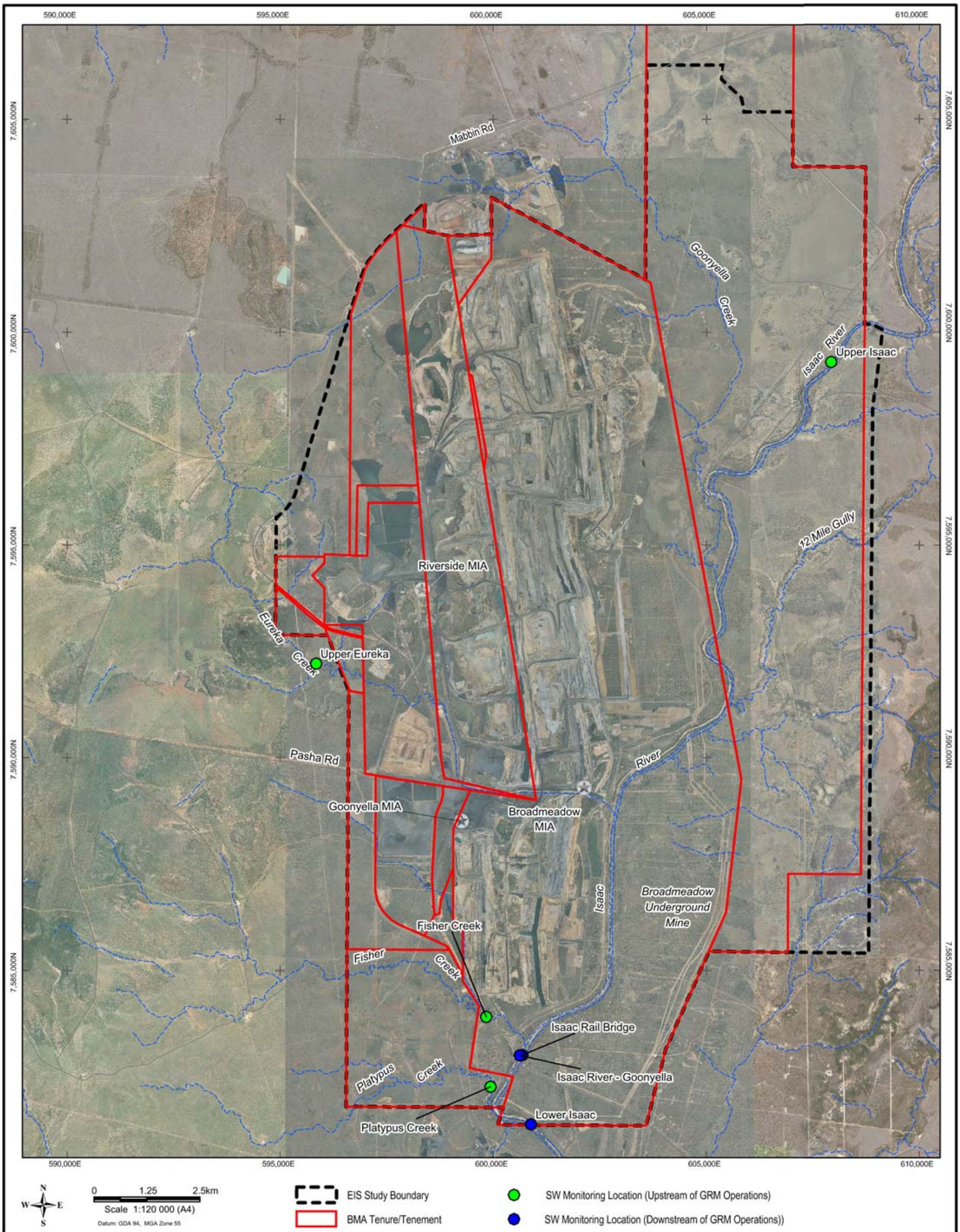
4.2.1 Data Management and Interpretation

The location and number of samples for available water quality grab sample data is shown in Table 4-2. A map of the water quality sampling locations is provided in Figure 4–1.

Table 4-2 Surface Water Quality Monitoring Locations

Site Name	GIS Coordinates		Data Source	No. of samples
	Latitude	Longitude		
Fisher Creek	-21.847405	147.965036	BMA	12
Platypus Creek	-21.862274	147.966101	BMA	11
Upper Eureka	-21.772706	147.925908	BMA	51
Upper Isaac	-21.801764	147.994955	BMA	45
Lower Isaac	-21.870222	147.975359	BMA	51

Figure 4-2 provides an overview of the distribution of sampling events against the hydrograph for the GRB mine complex, based on stream discharge data extracted from the NRM gauge at Goonyella (130414A). It illustrates that sampling covered a wide range of hydrological conditions including occasional high flow events and periods of flow stability during the wet season of 2010 to 2011.



Source: © Mapinfo Australia Pty Ltd and PSMA Australia Ltd., © Copyright Commonwealth of Australia (Geoscience Australia) 2006 , © Copyright The State of Queensland (Department of Natural Resources and Water) 2008, © The State of Queensland (Department of Mines and Energy) 2006-2008, © The State of Queensland (Department of Environment and Resource Management) 2010, Bing Maps © Microsoft Corporation and its data suppliers, Images from Client Oct 2011

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BMA
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RED HILL MINING LEASE
SURFACE WATER QUALITY TECHNICAL REPORT

LOCATION OF HISTORICAL WATER QUALITY MONITORING SITES

URS

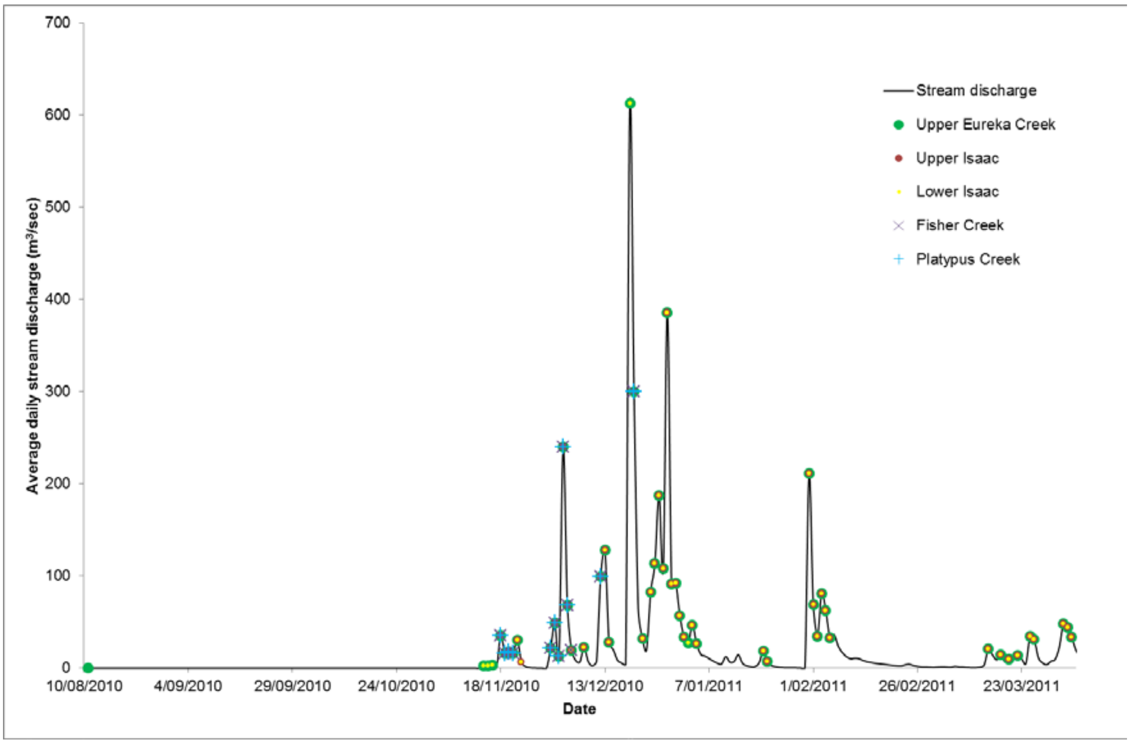
SURFACE WATER

Figure: **4-1**

File No: **42627136-g-2158.wor** Drawn: **VH** Approved: **CT** Date: **24-06-2013** Rev. **A** A4

4 Existing Water Quality

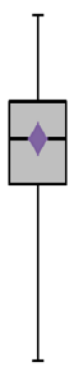
Figure 4-2 Distribution of surface water monitoring events against hydrograph (NRM gauge 130414A, Isaac River at Goonyella), 2010-2011



The available water quality data were then compared against the water quality objectives listed in Table 4-1 to assess the suitability of local water quality to meet defined environmental values in accordance with the methodology defined in the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) guidelines.

4.2.2 Results: Physico-chemical Attributes

Summary results are discussed in this section. The complete raw water quality data set is provided in Appendix A of this report. Summary statistics comprising minimum, 25th percentile, median, 75th percentile and maximum were calculated from the selected 2010-2011 water quality dataset and presented graphically for each parameter as follows to facilitate data interpretation:



Maximum

75^{th} percentile
Median
25^{th} percentile

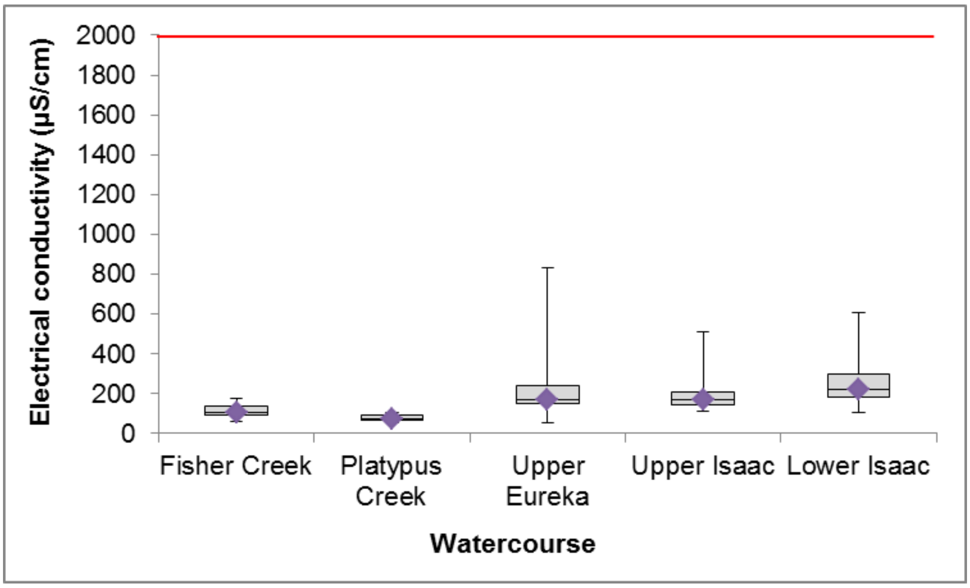
Minimum

4 Existing Water Quality

Electrical Conductivity

Historical electrical conductivity (EC) results for upstream and downstream sites (as classified in Table 4-2 and Table 4-3) are shown in Figure 4-3 with the red line representing the water quality objective during high flow conditions (Table 4-1).

Figure 4-3 Statistical summary of EC results (2010-2011)



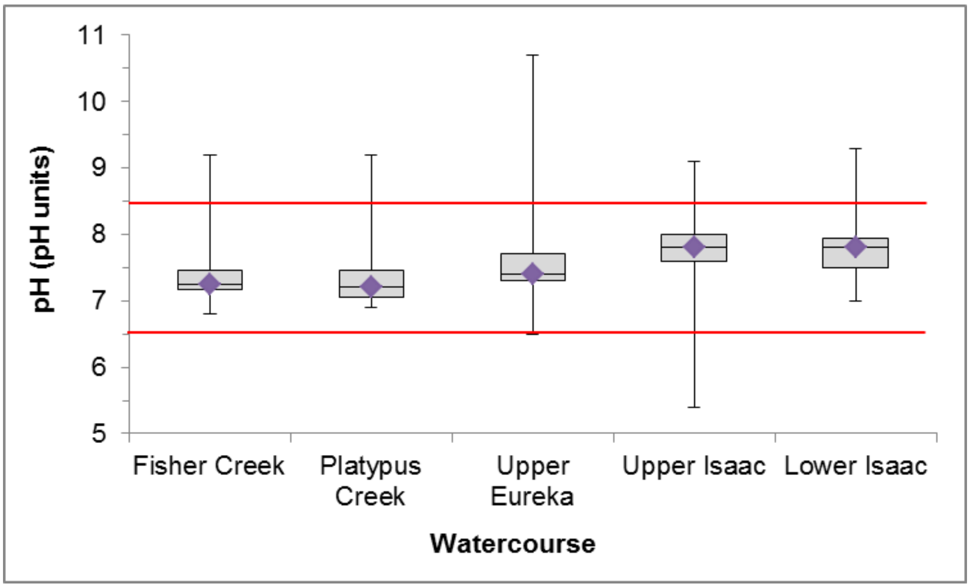
The results show that median values for EC (salinity) were well within the EA trigger value of 2,000 microSiemens per centimetre (µS/cm) at all sites. The median value at the Lower Isaac site was slightly higher than for the other sites, however the EC range recorded for the Lower Isaac site was similar to that recorded at Upper Eureka Creek.

pH

Median values for pH were within the guidelines for aquatic ecosystem protection at all sites as shown in Figure 4-4. However, the maximum value for Upper Eureka (10.7 pH units) and the minimum value for Upper Isaac (5.4 pH units) were outside the optimal range of between 6.5 and 8.5 pH units.

4 Existing Water Quality

Figure 4-4 Statistical summary of pH results (2010-2011)



Turbidity and Total Suspended Solids

Summary water quality data for turbidity and total suspended solids are provided in Figure 4-5 and Figure 4-6 respectively.

Figure 4-5 Statistical summary of turbidity results (2010-2011)

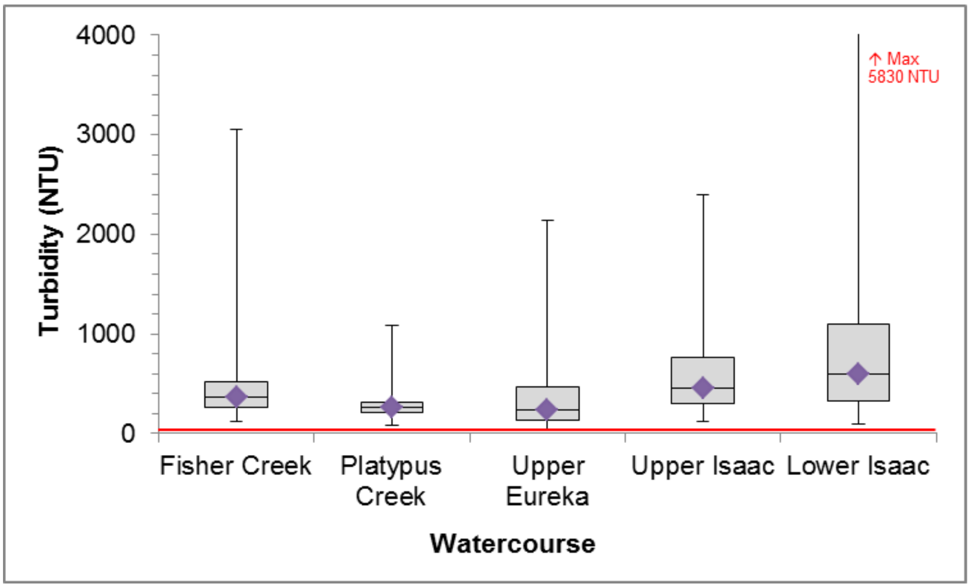
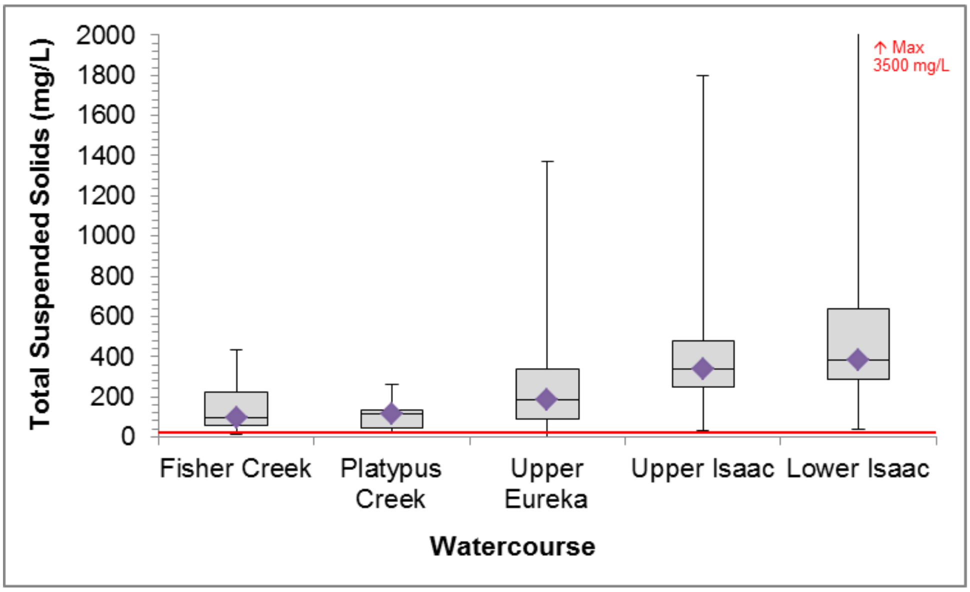


Figure 4-6 Statistical summary of Total Suspended Solids results (2010-2011)



The results show that median turbidity and total suspended solids (TSS) concentrations exceeded water quality guidelines at all sites (respective guideline values of 50 Nephelometric Turbidity Units (NTU) for turbidity, and 30 milligrams per litre (mg/L) for TSS). The Lower Isaac site exhibited slightly higher median values for both turbidity and TSS compared to the Upper Isaac, and maximum TSS and turbidity results were also highest for the Lower Isaac site.

4.2.3 Results: Toxicants

Table 4-3 presents the guideline values for toxicants in surface waters, taking into consideration the applicable environmental values from Table 4-1. It also includes guideline values for various water use activities such as livestock drinking water and recreation. Results were compared to these guidelines to provide some indication of how surface water resources may be utilised within the study area. Summary statistics for each toxicant are provided in Figure 4-7 to Figure 4-8. The data presented for each toxicant is discussed in terms of the guideline values presented in Table 4-3.

It is noted that the concentration of dissolved metals is generally lower than that of total metals. This is because metal ions tend to bind to sediment, organic particulates, and other compounds (such as sulphides) in water; this is considered the ‘total’ fraction. Metals which have dissociated from such particles and compounds and exist as free ions are measured in the ‘dissolved’ fraction. The solubility of heavy metals in fresh water is generally dependent on the chemical properties of the metal themselves, and the physico-chemical state of the aquatic environment (for example, concentration of TSS and pH).

Table 4-3 Guidelines for Toxicants in Surface Water

	Guideline Values for Toxicants				
Parameter	ANZECC Aquatic Ecosystem protection (modified local water quality objectives)	NHMRC (2008) Primary Contact Recreation	ANZECC (2000) Livestock Drinking Water	ANZECC (2000) Suitability for Irrigation: Long Term Use[a]	ANZECC (2000) Suitability for Irrigation: Short Term Use[b]
Aluminium (µg/L)	1,530	2,000	5,000	5,000	20,000
Chromium (µg/L)	3	500	1,000	ND	ND
Copper (µg/L)	3	ND	1,000	50	100
Iron (µg/L)	970	3,000	ND	200	10,000
Molybdenum (µg/L)	34	500	ND	10	50
Nickel (µg/L)	11	200	1,000	200	2,000
Selenium (µg/L)	10	100	20	20	50
Uranium (µg/L)	1	20	20	10	100
Vanadium (µg/L)	10	ND	ND	100	500
Zinc (µg/L)	8	3,000	20,000	2,000	5,000
Ammonia (µg/L)	20	500	ND	ND	ND
Nitrate	60	500,000	400,000	ND	ND

ND – Insufficient data to establish a guideline value

[a]Long term defined as up to 100 years (ANZECC 2000, Table 4.2.10)

[b]Short term defined as up to 20 years (ANZECC 2000, Table 4.2.10)

Aluminium

Summary data for total aluminium is provided in Figure 4-7 whilst summary data for dissolved aluminium is provided in Figure 4-8.

Figure 4-7 Statistical summary of results for Total Aluminium (2010-2011)

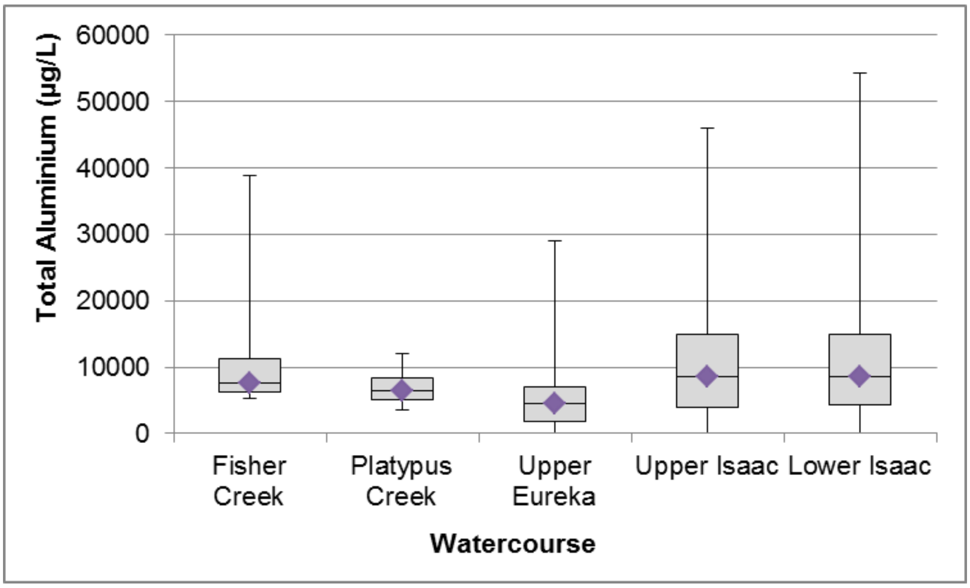


Figure 4-7 shows that total aluminium concentrations exceeded the guidelines for aquatic ecosystem protection; primary contact recreation, suitability of water for livestock drinking water, and long term irrigation at all locations. Maximum aluminium concentrations recorded at Fisher Creek, Upper Eureka, Upper Isaac and Lower Isaac also exceeded the short term irrigation guidelines at both upstream and downstream sites. While the median values were similar, the maximum value recorded at Lower Isaac was slightly higher than for the Upper Isaac site.

Figure 4-8 Statistical summary of results for Dissolved Aluminium (2010-2011)

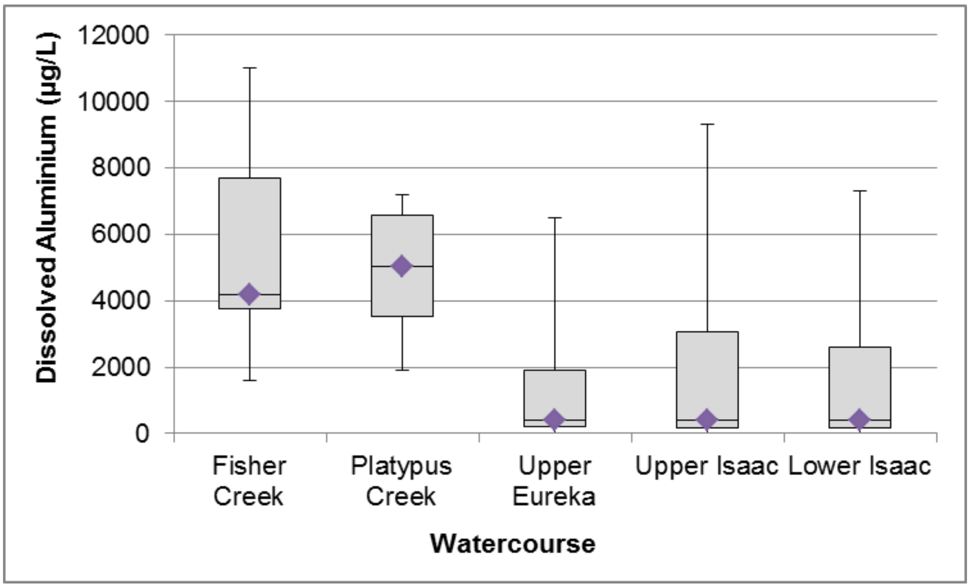
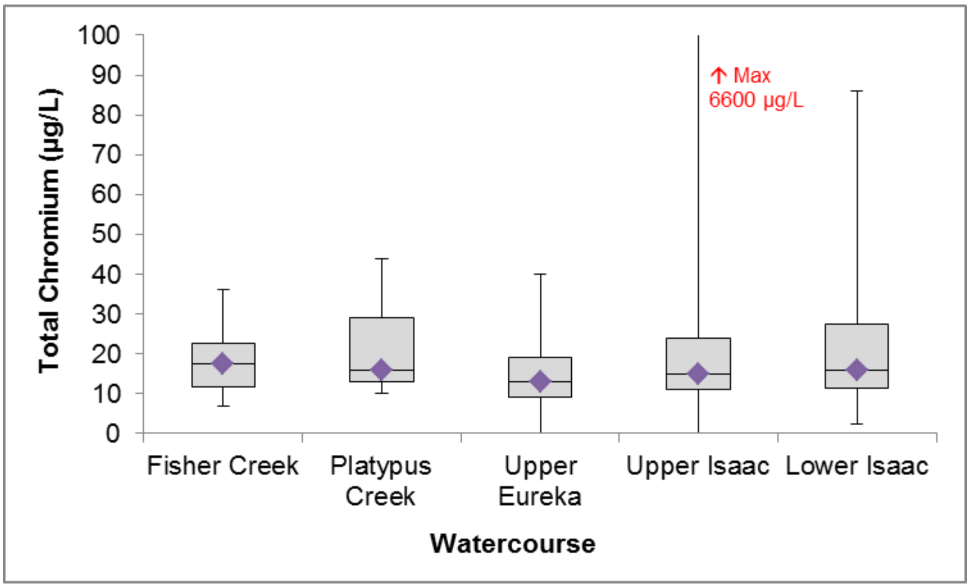


Figure 4-8 shows that, overall, dissolved aluminium concentrations were significantly lower that total aluminium concentrations. This indicates that the majority of the aluminium present in the water samples, collected between 2010 and 2011, was adsorbed to suspended sediment. The results also show that the median concentrations at Fisher Creek and Platypus Creek exceeded the modified trigger value for aquatic ecosystem protection. Median values at the other three sites were below the modified trigger value for aquatic ecosystem protection.

Chromium

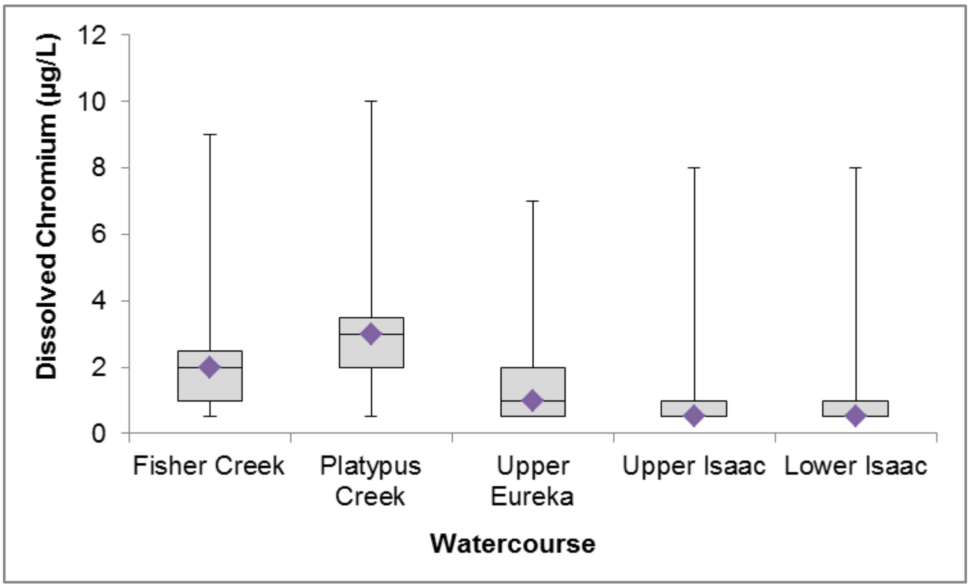
Summary statistics for total chromium are provided in Figure 4-9 whilst summary data for dissolved chromium is provided in Figure 4-10.

Figure 4-9 Statistical summary of results for Total Chromium (2010-2011)



Total chromium concentrations exceeded the guideline value for aquatic ecosystem protection at all upstream and downstream locations. The highest concentration (6,600 µg/L) was recorded at the Upper Isaac site during an isolated event in February 2011.

Figure 4-10 Statistical summary of results for Dissolved Chromium (2010-2011)

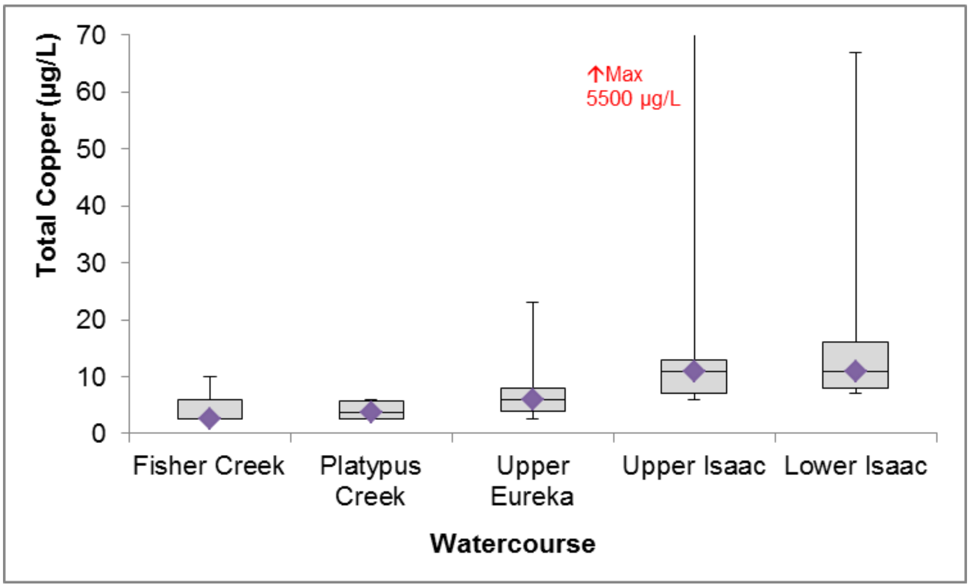


The data shown in Figure 4-10 indicates that dissolved chromium concentrations were significantly less than total concentrations, which indicates that chromium was mostly bound to suspended solids. The median concentration of dissolved chromium at Platypus Creek was equivalent to the modified trigger value for aquatic ecosystem protection whilst median concentrations at Fisher Creek, Upper Eureka, Upper Isaac and Lower Isaac were in compliance.

Copper

Summary statistics for total copper are provided in Figure 4-11 whilst summary data for dissolved copper are provided in Figure 4-12.

Figure 4-11 Statistical summary of results for Total Copper (2010-2011)



Total copper concentrations exceeded the guideline value for aquatic ecosystem protection at all locations. Whilst the median concentrations were comparable at all sites, maximum concentrations were higher in the main channel of the Isaac River than in its tributaries, and were generally highest at the Lower Isaac site (in terms of the 75th percentile result). The extremely high maximum concentration observed at Upper Isaac (5,500 µg/L) was again a function of an isolated event that occurred in February 2011.

Figure 4-12 Statistical summary of results for Dissolved Copper (2010-2011)

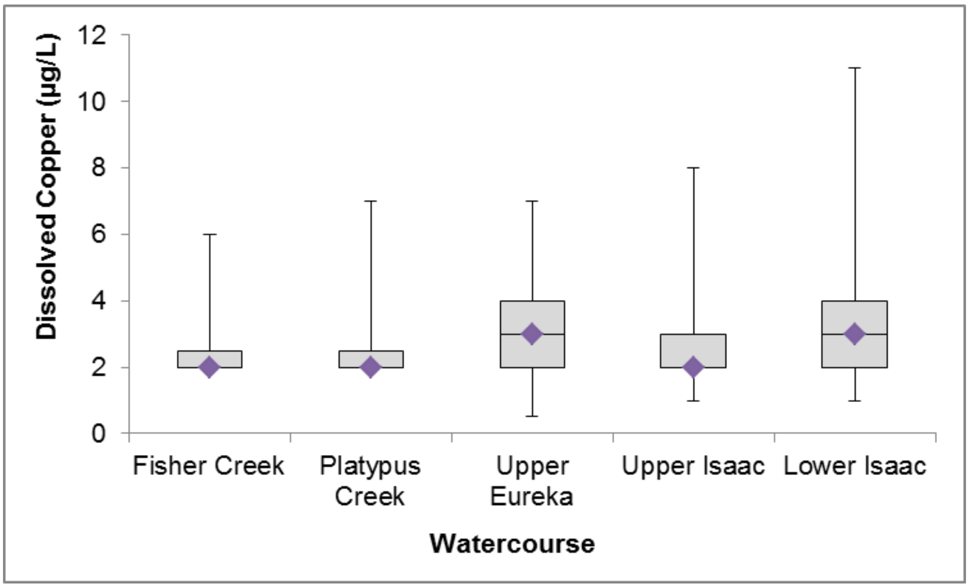
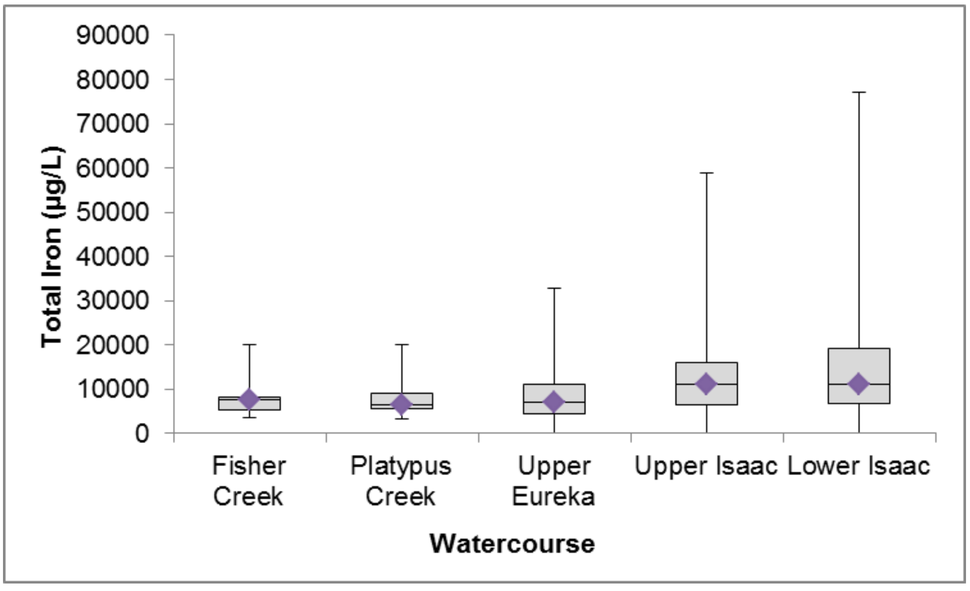


Figure 4-12 shows that dissolved copper concentrations complied with the guideline value for aquatic ecosystem protection at all sites. As for total copper, the highest concentration of dissolved copper was recorded at the Lower Isaac site. However, it is also apparent that the dissolved copper concentrations were a small fraction of the total concentration indicating that the majority of copper detected in surface water samples was adsorbed to suspended particles.

Iron

Total iron concentrations (Figure 4-13) exceeded the guidelines for primary contact recreation, and long term irrigation, at all locations. The median concentration at the Upper Isaac site also exceeded the guideline values for short term irrigation.

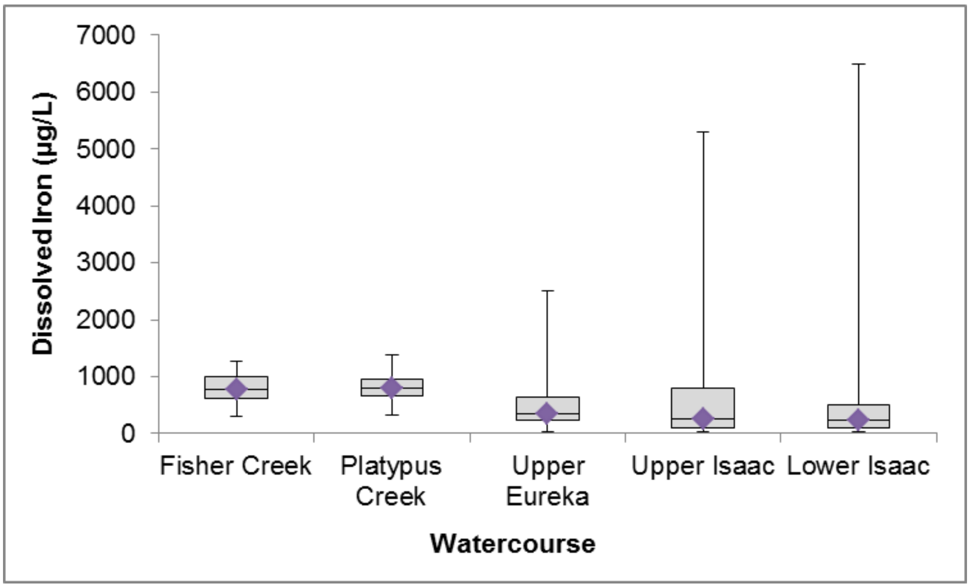
Figure 4-13 Summary statistics of results for Total Iron (2010-2011)



4 Existing Water Quality

Figure 4-14 shows that median dissolved iron concentrations complied with the modified guideline for aquatic ecosystem protection. A comparison of the dissolved iron concentrations with the total iron concentrations presented in Figure 4-13 indicates that the vast majority of the iron present in samples was in a free ionic form.

Figure 4-14 Statistical summary of results for Dissolved Iron (2010-2011)



Molybdenum

Molybdenum concentrations were generally below laboratory detection limits at all locations sampled. The highest concentration detected was at Upper Isaac in February 2011, where the concentration of total molybdenum spiked to 210 µg/L during an isolated event. This value significantly exceeded the ANZECC guidelines for aquatic ecosystem protection and long and short term irrigation (as indicated in Table 4-3). A concentration of 6 µg/L was observed at Lower Isaac during the same period.

Nickel

Total nickel concentrations exceeded the guideline value for aquatic ecosystem protection at all locations and were highest at the Lower Isaac site (Figure 4-15).

Figure 4-15 Statistical summary of results for Total Nickel (2010-2011)

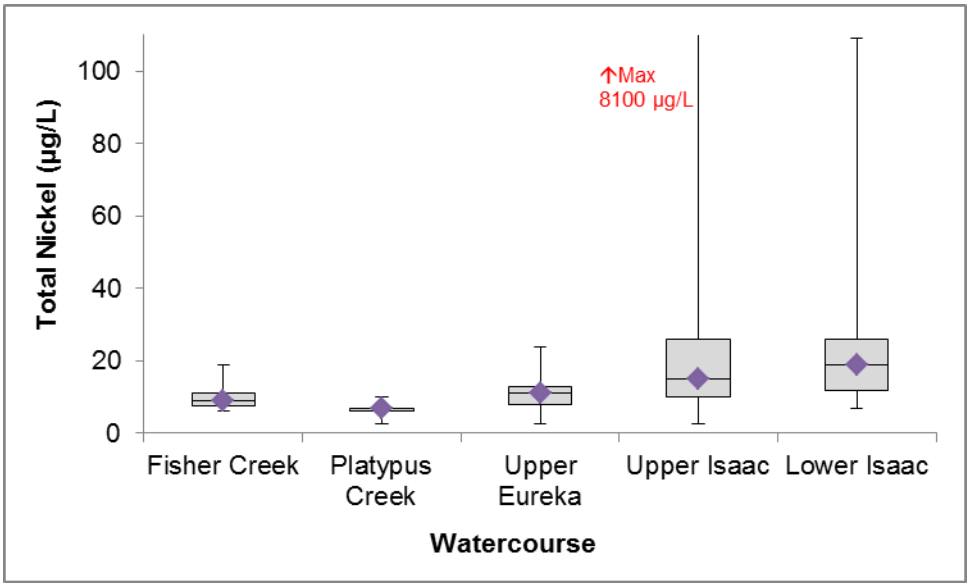
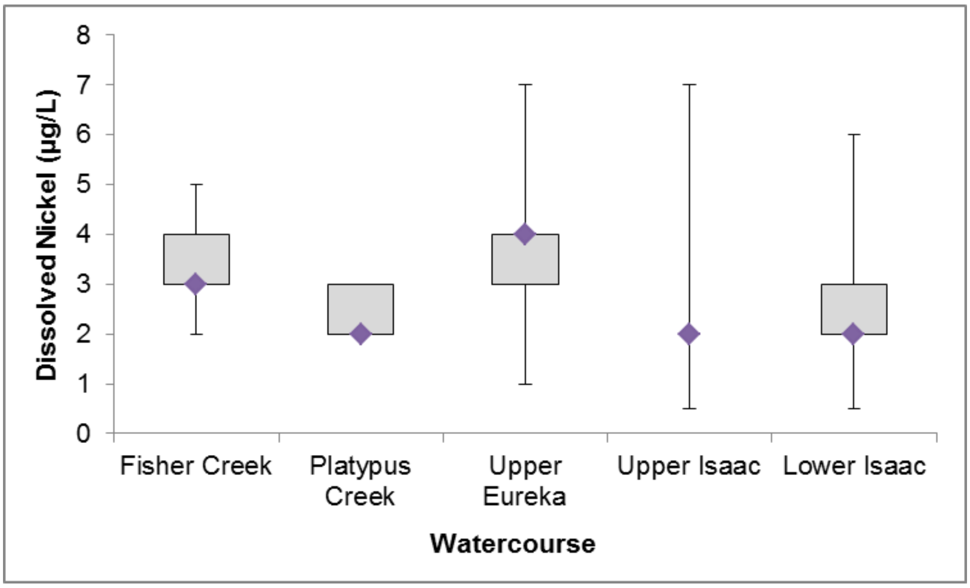


Figure 4-16 shows that all dissolved nickel results were below the guideline value for aquatic ecosystem protection at all sites. Dissolved nickel concentrations are comparable at all sites, and were generally lower than total nickel concentrations. This indicated that the majority of the nickel present in samples was bonded to suspended particles in the water column.

Figure 4-16 Statistical summary of results for Dissolved Nickel (2010-2011)



Selenium

Selenium concentrations were predominantly below detection limits at all locations sampled. The maximum total concentrations recorded within the dataset were 12 µg/L at Upper Eureka Creek and 11 µg/L at Lower Isaac. The maximum result for Upper Eureka narrowly exceeded the guideline trigger value for aquatic ecosystem protection (11 µg/L).

Uranium

Uranium was generally below detection limits at all upstream and downstream locations and was well below the guideline trigger value for aquatic ecosystem protection.

Vanadium

Total vanadium concentrations exceeded the guideline value for aquatic ecosystem protection at all locations, and were of a similar extent across all locations (Figure 4-17).

Figure 4-17 Statistical summary of results for Total Vanadium (2010-2011)

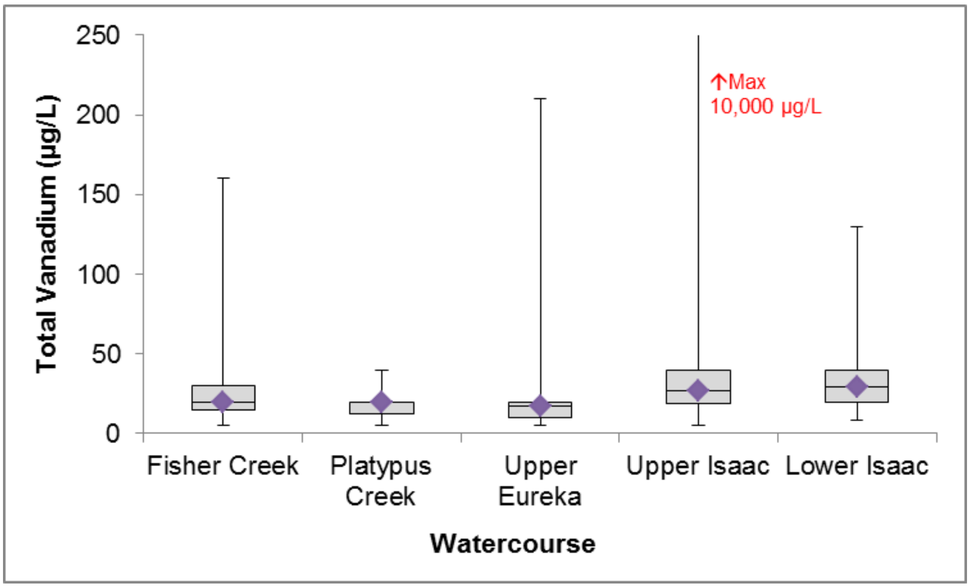
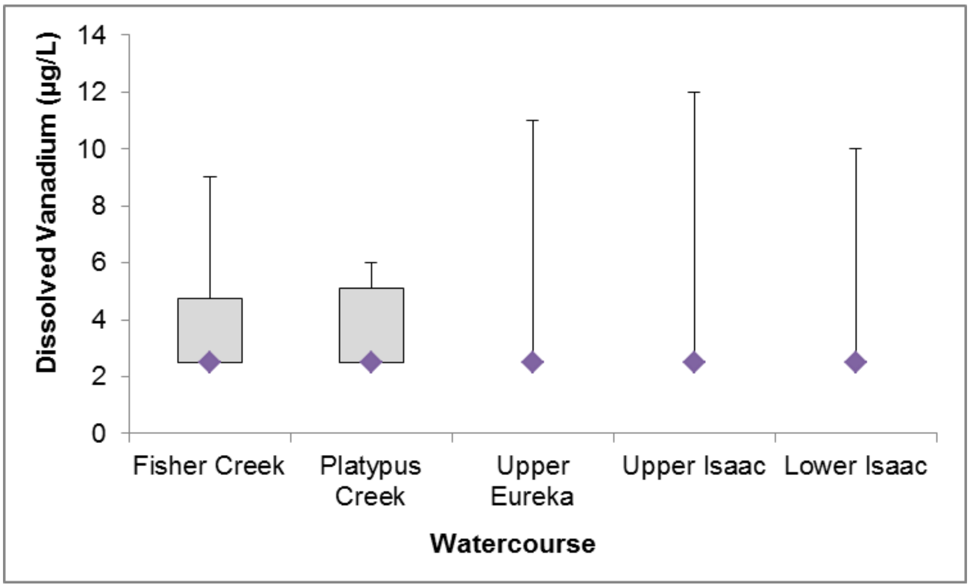


Figure 4-18 shows that median dissolved vanadium concentrations were comparable at all sites. Maximum concentrations recorded at the Upper Eureka and Upper Isaac sites exceeded the guideline concentration for aquatic ecosystem protection. A comparison of the results presented in Figure 4-17 and Figure 4-18 indicates that the majority of the vanadium was adsorbed to sediment particles.

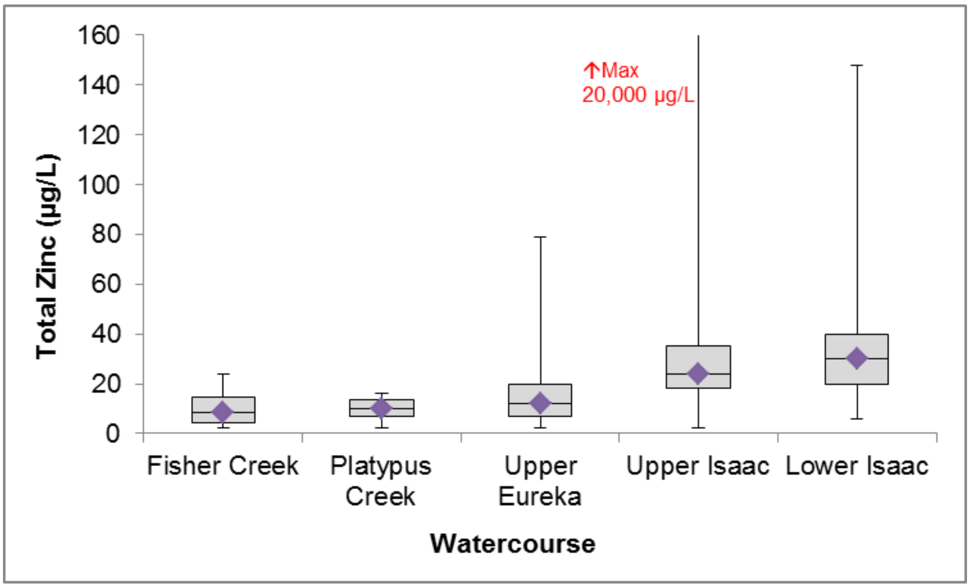
Figure 4-18 Statistical summary of results for Dissolved Vanadium (2010-2011)



Zinc

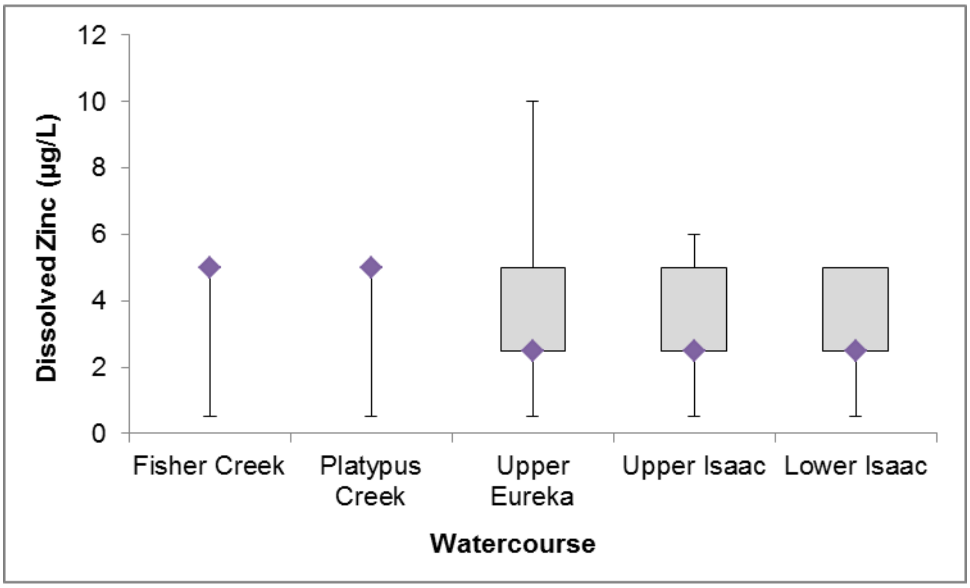
Figure 4-19 shows that total zinc concentrations exceeded the guideline value for aquatic ecosystem protection at all locations and were generally highest at Lower Isaac, with the exception of the maximum concentration observed at Upper Isaac during an isolated event in February 2011 (20,000 µ/L).

Figure 4-19 Statistical summary of results for Total Zinc (2010-2011)



The laboratory detection limit for dissolved zinc was 10 µg/L; given that the highest median values for dissolved zinc (at Fisher and Platypus Creeks) were 10 µg/L, and that value is also higher than the ANZECC guideline for aquatic ecosystem protection (8 µg/L) it was assumed that the results obtained for dissolved zinc did not indicate any significant trends. This is illustrated by the spread of data depicted in Figure 4-20.

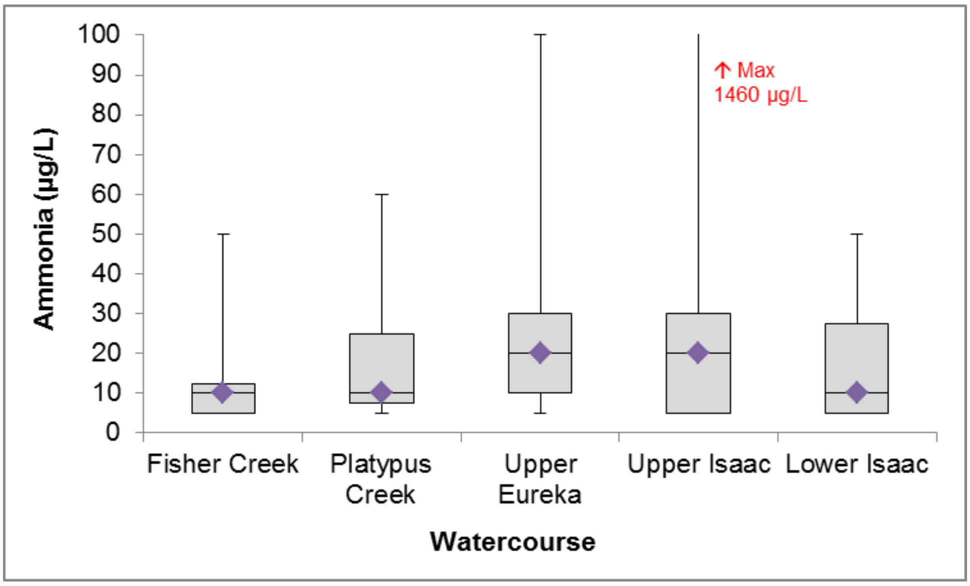
Figure 4-20 Statistical summary of results for Dissolved Zinc (2010-2011)



Ammonia

Median ammonia concentrations shown in Figure 4-21 complied with the guideline value for aquatic ecosystem protection (20 µg/L) and primary contact recreation (500 µg/L) at all locations. However, the maximum value observed at Upper Isaac was significantly greater than the primary recreation guideline.

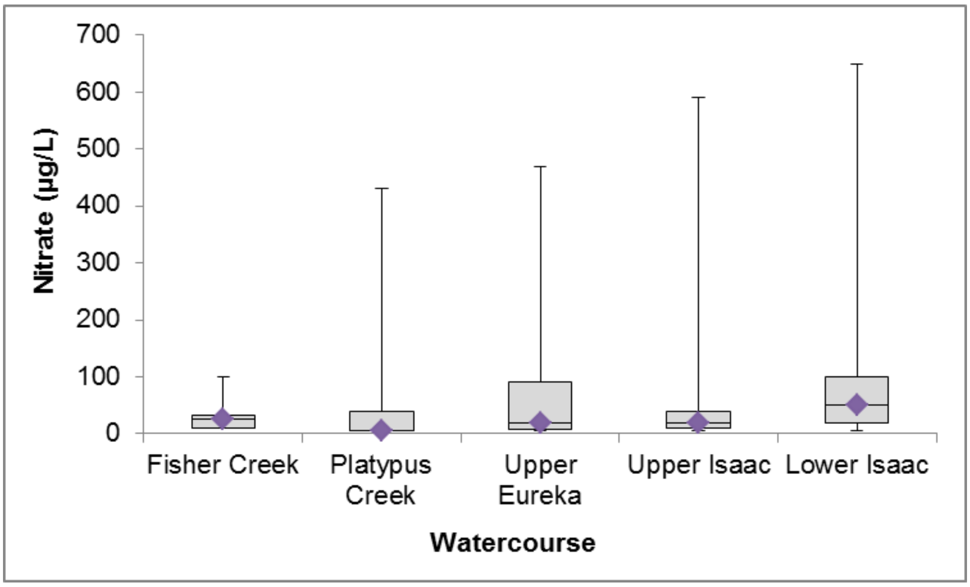
Figure 4-21 Statistical summary of results for Ammonia (2010-2011)



Nitrate

Figure 4-22 indicates that nitrate concentrations complied with the guideline values for aquatic ecosystem protection, primary contact recreation and livestock drinking water at all locations.

Figure 4-22 Statistical summary of results for Nitrate (2010-2011)



4.3 Summary of Surface Water Quality (2010-2011)

The following trends were identified in terms of historic water quality observed between August 2010 and April 2011:

- Electrical conductivity met EA downstream release conditions at all locations.
- pH was measured within the optimal range of between 6.5 and 8.5 pH units at most locations; the most acidic conditions were observed in Upper Isaac (single sample measuring 5.4 pH units) while Upper Eureka Creek was more alkaline (maximum value of 10.7 pH units).
- Turbidity and TSS were observed at concentrations significantly higher than their respective guideline values at all locations.
- The aquatic ecosystem protection guidelines values for total aluminium, chromium, copper, nickel, vanadium and zinc were exceeded at all locations.
- In general, concentrations of dissolved heavy metals were much lower than that of total metals, indicating that most metals were adsorbed to suspended solids (rather than existing in a soluble state in the receiving environment).
- Concentrations of ammonia and nitrate were found to be lower than the applicable guideline values at all locations, except for one isolated event at Upper Isaac where ammonia was measured above the guideline for primary recreation at 1,460 µg/L.
- The effects of high flow events on the surface water quality were relatively obvious within the dataset, as they were typically correlated with high concentrations of turbidity, EC and TSS and an associated spike in total concentrations of heavy metals.

Impact Assessment and Mitigation Measures

The following section details the major planned activities for the project, through the different stages of construction, operation and decommissioning. The potential impacts of each activity on surface water resources are assessed and mitigation measures have been identified to minimise potential impacts. All mitigation measures discussed are aimed at maintaining or improving water quality within the creek systems.

5.1 Construction Phase

For the purpose of the surface water assessment of construction phase impacts, the construction phase is considered to comprise construction of infrastructure and mine facilities to support the project. The mining activities (e.g. drive development, subsidence, gas drainage) are considered to be relevant for operational phase and post mining impacts of the project.

In general terms the project requires limited construction activity within the proposed RHM footprint, with the majority of construction activities being undertaken within the existing GRB mine complex footprint. Construction of the CHPP and associated conveyors and train load out facility will take place within the existing GRB mine water management area. Adequate containment and water management facilities exist within the GRB mine water management system to cater for potential surface runoff and contaminants arising from construction of these additional components.

Construction activities in the RHM footprint area will involve earthmoving activities including removal of vegetation, top soil stripping and stockpiling, earthworks including cut, fill and compaction, and trenching for any underground pipelines and services. These activities may contribute to increased erosion and sedimentation of receiving waters and mobilisation of other contaminants in runoff from the construction site. The construction activities which will be undertaken outside the existing mine footprint and mine water management area comprise the following:

- Construction of the MIA, Red Hill levee and drift portal. These activities will take place in an area which drains directly to the Isaac River.
- Construction of the Red Hill accommodation village. The accommodation village is located in the 12 Mile Gully catchment which flows to the Isaac River.
- Construction of internal access roads including a road to the accommodation village and associated bridge across the Isaac River. These works take place in the 12 Mile Gully catchment and areas that drain directly to the Isaac River.

5.1.1 Erosion and Sediment Mobilisation

Each of the construction activities described above can cause increased erosion potential and mobilisation of sediment to varying levels.

Potential Impacts

Sediment mobilised during construction activities may enter surface water runoff during rainfall events and discharge to watercourses, leading to adverse effects on water quality. Sediment exposed or generated during construction may also be carried by wind into surface water bodies.

Additionally, based on existing water quality results, it appears that there is potential for natural occurring metals to be present in sediments mobilised during construction activities.

Suspended sediments in the water column reduce light penetration, consequently affecting primary productivity of benthic ecosystems. As shown in Figure 4-5 and Figure 4-6, turbidity and TSS levels in the Isaac River and its tributaries are generally well in excess of guidelines at all sites due to natural catchment and stream characteristics as well as land use practices in the catchment. While a large, long term increase in suspended solids may further degrade aquatic ecosystems, short term increases in storm events are unlikely to have any significant impact.

Deposition of suspended sediment within watercourses can lead to geomorphological changes within the streams. However, the Isaac River has relatively high sediment loads which have already influenced the bed characteristics of these streams. Any small additional sediment from runoff from construction areas during storm events is unlikely to significantly change the geomorphological characteristics of the river or its tributaries. Further, several underground mines are currently subsiding the Isaac River downstream of the proposed RHM footprint, and depressions in the Isaac River bed caused by this subsidence will tend to capture sediment runoff from construction activities, thus limiting effects to the immediate vicinity of the project.

Sediments mobilised by erosion may have other contaminants associated with sediment particles including heavy metals derived from the local geology. When sediment particles containing heavy metals enter water, the metals may, under certain conditions be released into the water column and become bioavailable. This in turn can affect health of aquatic plants and animals. The mechanisms by which metals adsorbed to particles can become bioavailable are very complex.

The water quality results presented in Section 4.2 indicate that the majority of metals detected are bound to sediment particles. Metals released from sediments to the water column can be influenced by lower pH, however, pH results indicate that surface water pH is generally within the range of 6.5-8.5, thus minimising this mechanism for metal release from sediment particulates.

With erosion and sediment controls in place, the quantities of sediment likely to be mobilised from construction activities is likely to be low, and mobilisation in smaller storm events, below the 1 in 1 or 1 in 2 Annual Exceedence Probability (AEP) size events unlikely.

Mitigation and Management Measures

Areas of disturbed or exposed soil should be managed to reduce sediment mobilisation and erosion. The following general mitigation measures are proposed for each of the components outside the existing mine water management area:

- Permanent stormwater management systems should be installed as early as possible in the construction program.
- An erosion and sediment control plan should be prepared and executed. Further details are provided in the Red Hill Mining Lease EIS Section 5.3.
- Diversion bunds should be constructed to divert clean water flows around the construction site where practical.
- Erosion and sediment control protection measures should be installed prior to the commencement of land disturbance activities.
- Erosion and sediment control structures should be regularly inspected and maintained.
- Topsoil should be stockpiled away from drainage lines to protect it from erosion by surface water runoff.
- Vegetation clearing and earthworks should not be carried out during heavy rainfall.

- Dust suppression measures should be implemented.
- Vehicle washdown should take place in designated areas away from flood plains and drainage lines.
- Vehicle washdowns should be designed to contain washdown water in a sump or tank.
- Water from vehicle washdown areas should be treated to remove seeds, oils and other contaminants before reuse for dust suppression or other on-site use or directed to the GRB mine complex water management system for reuse.

Additional mitigation measures to be implemented for each individual facility or infrastructure component are identified below for each construction activity.

Flood Protection Levee

- Construction should take place in the dry season wherever possible and practicable.
- If practicable, the flood protection levee should be in place before the first wet season.

Red Hill MIA, and Drift Portal

If practicable, the flood protection levee should be in place before the first wet season construction period for the MIA and drift portal.

Red Hill Accommodation Village

If construction is staged, clearing should be progressive and occur immediately before construction of each stage if practicable.

Internal access roads and bridge crossing

- For stream crossings, construction of linear infrastructure should be conducted in the shortest possible time and in accordance with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" (NRM 2012). Wherever possible stream crossings will be constructed outside the wet season, when there is no flow in streams.
- Regular inspections of road alignments should be undertaken to ensure that disturbed surfaces are stable and not subject to concentration of flows or erosion. Repair works should be undertaken proactively to prevent erosion from occurring or worsening.

5.1.2 Contaminant Mobilisation

Contaminants may be mobilised during construction activities through chemical and fuel spills from:

- temporary refuelling facilities;
- temporary chemical storage facilities (including oil and waste oil);
- temporary vehicle washdown areas; and
- construction and commissioning of permanent fuel and chemical storage facilities.

The main areas where aqueous waste streams may be produced will be associated with the construction of the MIA and Red Hill accommodation village. However, there is also a possibility that contaminant spills may occur during construction of internal access roads;, the flood protection levee, and the bridge and pipeline crossings.

Potential Impacts

Without appropriate mitigation measures, potentially contaminated drainage generated through these activities could enter into drainage lines, altering the physical and chemical characteristics of the receiving waters. This in turn may have acute or chronic toxicity effects on aquatic plants and animals.

These pollutants can also have the potential to be a public health and safety issue if moderate to large quantities are released directly to watercourses.

The main potential impact on surface water quality will arise from accidental spills and leaks. The main contaminants of concern in this regard are fuels and oils. While some other chemicals will be utilised during construction, the quantities and natures of these chemicals is such that the risk of significant environmental harm in the event of a spill is low.

The significance of potential impacts on surface waters will depend on the quantity and nature of contaminants as well as whether the contaminants are directly released to surface waters. Even if spills or leaks occur in most construction areas, contaminants will either soak into soils or be captured by sediment containment devices and/or permanent stormwater systems. Should water in sediment containment devices or stormwater systems become contaminated by a fuel or oil spill, it will be removed by a vacuum truck and taken to an authorised liquid waste treatment and disposal facility. Prompt clean-up of spills to soils will also minimise mobilisation of contaminants by surface water flows.

The risk of spills and leaks of fuels and oils directly entering a watercourse is higher for construction of the access road to the proposed accommodation village and the bridge across the Isaac River as these areas are more difficult to contain. More stringent measures will be required in these areas to reduce the likelihood of spills and leaks in these areas.

Small quantities of aqueous waste will be generated from removal of stormwater and contaminants from bunded areas and sumps. Provided this is treated in accordance with the management measures outlined below, this should not cause any impact on surface water quality.

Mitigation and Management Measures

General

The following general mitigation measures are required to manage impacts of spills and leaks of fuels, oils and other contaminants on receiving waters:

- Temporary and permanent fuel storage areas to be designed in accordance with Australian Standard (AS) 1940 (The storage and handling of flammable and combustible liquids). This includes provision for secondary containment.
- Chemical storage areas to be designed and operated in accordance with and AS3780 (The storage and handling of corrosive substances).
- Refuelling to occur within contained, hardstand areas in accordance with AS1940 wherever possible. Where this is not possible, refuelling activities should be located away from streams and drainage lines and be closely supervised, with a spill kit available that is capable of containing spills of around 100 litres (L).
- Storage and refuelling areas to be located away from areas subject to stormwater inundation.

- Storage and refuelling areas to be designed to minimise the ingress of clean stormwater either from overland flow or incidental rainfall.
- Bunds and sumps should be emptied after each rainfall event. Water and oily water from fuel and oil storage areas removed from bunds and sumps should be treated through an oil water separator and then reused for dust suppression or other on-site use. Water and other contaminants from other chemical storage areas should be treated through on-site wastewater treatment plants and then utilised in dust suppression or irrigated in accordance with the site environmental authority.
- Items are not to be stored or placed within bunds or sumps.
- Contaminants and major spills should be collected by a licensed waste collection and transport contractor for disposal at an offsite licensed facility.
- Spill clean-up kits are to be located in appropriate locations, based on the risk of a spill occurring and potential volume of material that might be spilled at the particular location.
- Workers involved in storage, handling and management of fuels and chemicals are to receive training in spill prevention and control.
- Instructions on spill containment and clean-up to be available at refuelling locations and in vehicles where there is a moderate risk associated with spill events.
- Spills are to be contained and cleaned up immediately to prevent the mobilisation of pollutants in drainage lines or watercourses.
- Wastewater from vehicle washdown areas should be directed through oil and grease separators and effluent utilised for dust suppression or other use, or directed to the GRB mine complex water management system for reuse.

Internal access roads and bridge crossing

In addition to the measures above, the following specific measures are to be applied to construction of internal access roads and the Isaac River bridge crossing as well as IMG management activities:

- Refuelling is not to take place within 100 m of the Isaac River and 50 m of 12 Mile Gully and tributaries.
- Fuels, oils and other chemicals, including wastes contaminated with fuels, oils or other chemicals are not to be stored or placed within 100 m of the Isaac River and 50 m of 12 Mile Gully and tributaries.
- Where practicable, all construction wastes are to be removed to a lay down area or MIA within 24 hours.

5.1.3 Poor Water Quality from Dewatering of Excavations

Excavation works are required during the construction of the MIA and the drift portal. Dewatering of these excavations may be required following heavy rainfall. This water is likely to have high suspended solids concentrations, and may also collect small amounts of hydrocarbon contaminants. Quantities will depend on the amount of rainfall received, but will generally be in the order of less than 10 megalitres (ML).

Some dewatering of groundwater inflows will also be required during drift construction. This water is likely to have a high sediment load and may also be saline (groundwater quality and quantity is discussed in Appendix J of the Red Hill Mining Lease EIS).

Potential Impacts

Water derived from dewatering activities will only be directly released into surface waters during very high flow conditions, as might occur during severe storm events.

Mitigation and Management Measures

Water removed from excavations will be pumped to the MIA dam or another stormwater retention pond. Groundwater inflows pumped from the drift will be pumped to the MIA dam. These waters will be reused on site as a first preference or pumped to the GRB mine water management system if pumping systems are in place.

During construction water removed from excavations will only be released to surface waters if the turbidity is less than 50 NTU and there is no visible hydrocarbon contamination.

5.2 Operational Phase

Mining operations associated with the project will involve the following activities:

- dewatering and degassing target coal seams;
- underground longwall operations; and
- coal handling, preparation (screening and washing) and transportation.

As all mine water from dewatering the underground mine and from incidental mine gas production will be managed through the existing GRB mine water management system, potential water quality impacts will only arise from the operation of this system rather than from direct discharges of mine water. In addition, surface runoff may convey contaminants to surface waters downstream of the proposed mine. Potential impacts are discussed below.

5.2.1 Releases from GRB Mine Water Management System

Mine water generated during operations of the project will be sent to the GRB mine water management system. Waters will be stored and reused within the mine complex, including in the coal handling and preparation plants and for dust suppression. Mine water releases from the GRB complex are released under EA EPML00853413 via an authorised release point on Eureka Creek, just upstream of the confluence with the Isaac River.

The EA conditions permit releases of mine water based on flow conditions in the Isaac River, the concentration of contaminants present in the discharge and the water quality at the downstream point in the Isaac River.

The GRB mine water management system is configured to allow controlled releases that meet the environmental authority conditions. Further details of the operation of the GRB mine water management system are provided in the Red Hill Mining Lease EIS Appendix I2.

In order to assess the impact of the additional mine water from the project on GRB mine water releases during operation, water and salt balance modelling was commissioned by BMA applying the conditions imposed in the environmental authority for the GRB mine complex. It is understood that on most occasions that the demand created by the proposed RHM and Red Hill CHPP would exceed the volume of water produced from dewatering. However, as it is recognised that surplus conditions may present a worst case in terms of compliance with the existing GRB mine complex environmental authority, the surplus conditions scenario was modelled for the water balance modelling. Surplus conditions are expected to occur in the initial stages of de-gassing prior to mining and operations (1 to 2 years) and also later in the life of mine (> 15 years of mining based on groundwater ingress predictions). The water balance modelling results for salinity at the downstream monitoring point is shown below. Figure 5-1 shows the percentage of time that a particular electrical conductivity is predicted to be exceeded at the downstream monitoring point, whilst Figure 5-2 focuses on the lower probability occurrences.

Figure 5-1 EC levels in Isaac River (downstream) during MAW releases: Project Case versus Base Case

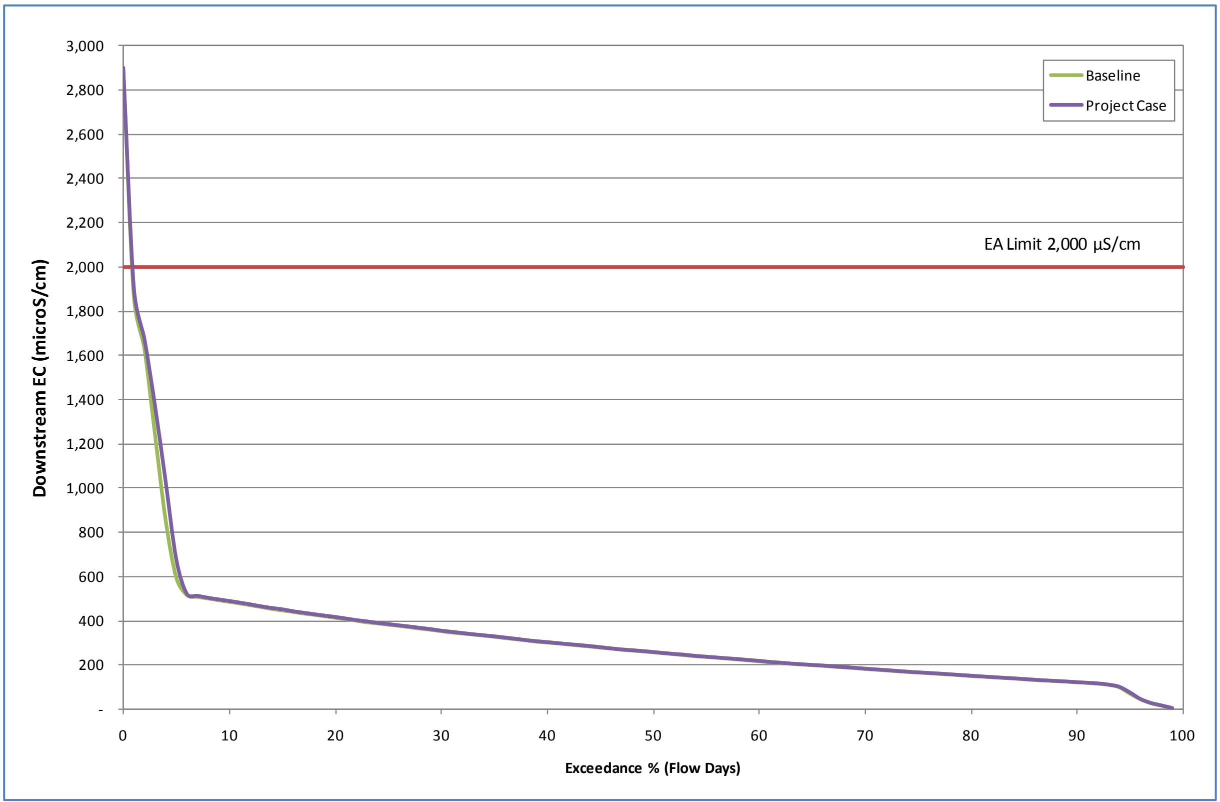
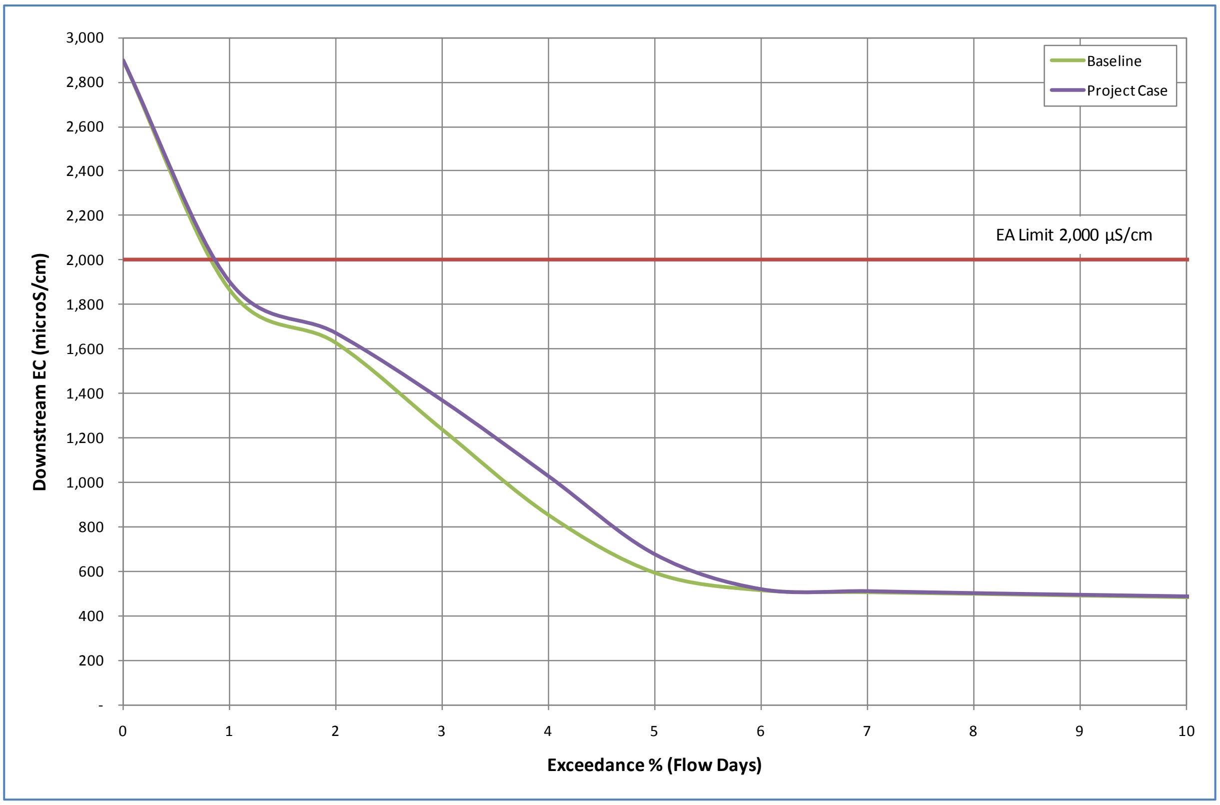


Figure 5-2 EC levels in Isaac River (downstream) during MAW releases: Project Case versus Base Case (Low probability occurrences)



The results indicate that for the majority of the time salinity concentrations downstream of the mine release would comply with the environmental authority licence condition of 2,000 µS/cm (1,220 mg/L TDS) with or without the addition of water from the proposed project activities. The model identified three one-day occurrences, during the 108 year modelling period, that the EC of releases from GS4A causes the downstream EA receiving water trigger level of 2,000 µS/cm to be exceeded. The time salinity concentrations in the Isaac River downstream of the mine release are predicted to exceed the environmental authority trigger of 2,000 µS/cm, with or without the addition of water from the project is insignificant.

The addition of the project water slightly increases the salt levels in the receiving environment (as measured at the downstream monitoring location) for around 3% of the time but this increase is not sufficient to cause the release to exceed the environmental authority trigger. For the vast majority (97%) of the time, however, the difference between salt levels in the receiving environment with and without the addition of project water is negligible.

Whilst this analysis has focused on TDS it is expected that if the mine water management system is operated correctly and, compliance with the existing environmental authority conditions for other contaminants present within mine water releases is achieved, there would be negligible potential for adverse impacts to arise from releases.

In summary, modelling indicates that the addition of mine water from the project will not impact on the ability of the GRB mine to achieve compliance with the existing environmental authority.

5.2.2 Water Management System Failures

Water management system failures could potentially lead to discharge of potentially contaminated water to the receiving environment where mine water is able to migrate from the containment area. Potential failures include:

- Storage containment failure caused by inadequate storage capacity, overfilling of storage, inadequate diversion of clean catchment or extreme storm events.
- Storage embankment failure caused by piping failure (related to poor construction of embankment maintenance) or overtopping.
- Water management system infrastructure failure including pipeline, pumps, drains, bunds and/or levee failures (caused by machinery damage, weathering, channel erosion, incorrect placement or during relocation).

The project will result in the construction of two new mine water storages:

- A dam at the Red Hill MIA with nominal capacity of 50 ML. This dam will provide a balancing storage for water supply to project operations and also collect stormwater drainage from the MIA
- An IMG production water dam, with nominal capacity of 10 ML. This dam will provide several days storage for production water from the incidental mine gas management system in the event that this water cannot be transferred directly to the GRB water management system.

In addition, a number of pipes and pumps will be used to transfer water from the project activities to the GRB water management system.

Based on flood modelling projections, for 1 in 1,000 AEP (Red Hill Mining Lease Appendix I5), a flood protection levee will be required to provide flood immunity to the MIA and mine access.

Potential Impacts

Failure of any component of the water management system could potentially lead to a discharge of mine water which has potential for adverse water quality impacts for downstream receiving waters, ecosystems and water users. A catastrophic failure of a large storage may also result in flash flooding.

The MIA dam will be located within the MIA area and behind a proposed flood levee. Failure of this dam would result in up to 50 ML of water being released. Flow into the Isaac River would be curtailed by the proposed levee and hence risk of death or injury to persons downstream would be reduced. This water would be saline, and could potentially cause water quality impacts, depending on flow conditions in the Isaac River at the time. Given the volume of water in the MIA dam, this is unlikely to have any significant long term effects on aquatic ecology, however, some short term stress to aquatic organisms may occur during low flow conditions.

The IMG production water dam which has a nominal capacity of 10 ML will only be used intermittently. Failure of this dam would result in the discharge of saline water and other contaminants to land and, by overland flow, towards the Isaac River and 12 Mile Gully. The limited volume of water contained in the IMG dam means that environmental impacts and community safety risks are relatively low. Overland flow of the water may cause erosion through scouring, resulting in releases to the Isaac River elevated in sediment, salt and hydrocarbons. If salty water remains on land and evaporates, soils may become saline, although this would probably leach out in subsequent rain events.

Risk associated with dam failure has been qualitatively assessed in Section 20 of the Red Hill Mining Lease EIS.

In the event that the flood protection levee (or other flood protection mechanism) failed immediately prior to or during a flood event, the MIA and mine access would be flooded in a large flood event. This would result in mobilisation of contaminants such as sediment and coal fines into flood waters. However, during major flood events, flood waters typically contain naturally high concentrations of sediment, nutrients and toxicants catchment runoff, making it unlikely that the additional quantities of sediment likely to be added from flooding of the MIA would add significantly to the degradation of water quality that might occur.

The GRB mine complex dam structures have been designed to have sufficient capability to ensure that there are no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year Average Recurrence Interval (ARI) wet season. In the event that an event exceeded the 1 in 10 year ARI and mine access flooded, a quantity of mine affected water would need to be pumped out of the underground mine. The salinity of this water would be similar to mine water generated during normal operations. If this is pumped to the adjacent GRB mine water management system, and then released in accordance with the GRB mine complex EA, water quality impacts would be negligible.

Failure of pipes transporting mine water from dewatering operations would also result in low volume releases of saline water. The external impact would depend on the location of the failure.

Failures of water pipelines transporting incidental mine gas production water would result in water being released to land and then flowing overland to Goonyella Creek, 12 Mile Gully and the Isaac River. Pipes buried beneath streams could also fail if there is significant bed or bank erosion.

Failure of pumps would result in an accumulation of mine water upstream of the pump location and, depending on water volumes, system configuration and system storage capacity, an overflow towards downstream surface waters may occur. Generally the quantities of water being transferred by pumps is low, however larger capacity pumps will be in place to transfer water from RHM dewatering to the GRB mine water management system. Failure of these pumps would result in mine water not being removed from the underground workings. Further details regarding the probability of overflows occurring and resulting in adverse impacts to the surface water environment are included in Appendix I2 of the Red Hill Mining Lease EIS. Community safety risks are not likely to arise from any of these failure events and environmental impacts will be relatively low provided that leaks are detected and repaired promptly. Overland flow of the water may cause erosion through scouring, resulting in sediment-laden and saline releases to surface waters. If salty water remains on land and evaporates, soils may become saline, although this would probably leach out in subsequent rain events.

If failure of pipes and pumps at the MIA or within the GRB mine water management system occurred, water would be contained within the MIA stormwater system and GRB mine water management system and the external environmental impact would be minimal. Some scouring may occur at the point of failure and would need to be stabilised to avoid potential exacerbation of erosion.

Mitigation and Management Measures

The following mitigation strategies will be considered in the design, construction and operation phases to address water management system failure risk:

- Mine water storages should be designed with consideration given to the predictions of the water balance model (see Red Hill Mining Lease EIS Appendix I2) which considers all inputs and outputs which has run through a long-term period of climatic data to test storage capacities particularly in high rainfall wet seasons.

- In the design stage, proposed mine water storages should be assessed against the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP 2012b). If determined to be regulated structures, the following requirements will also apply in relation to design, construction, operation and maintenance:
  - Guideline Structures which are dams or levees constructed as part of environmentally relevant activities (EHP, March 2013, Version 3); and
  - Code of Compliance Environmental authorities for high hazard dams containing hazardous waste (EHP 2012a).
- Pipes and pump systems to be designed with consideration to volume requirements predicted from water balance modelling and designed and constructed under the supervision of qualified professional engineers.
- Monitoring equipment to be installed to monitor storage volume during operation and to prevent overfilling.
- Regular inspections of mine water storages, particularly in relation to integrity of embankment.
- Regular pipeline, drain, bund and levee inspections and maintenance.

5.2.3 Flooding of Mine Areas

A range of potential contaminants will be present in the MIA, including fuels, oils, chemicals and particulates. Flooding of this area would lead to mobilisation of these contaminants into flood water and these contaminants would then be conveyed downstream. In addition, if the mine entrance becomes flooded and flood waters flow into the mine access and underground workings, this water would become contaminated with particulates and possibly dissolved salts. This water would need to be removed from the mine workings before mining could re-commence.

Potential Impacts

If flooding of the MIA occurs, floodwaters may become contaminated with:

- Hydrocarbons from residues of fuel and oils on land surfaces and from oily wastes stored in the MIA.
- Chemicals from chemical stores (if these are inundated) and from waste storage areas.
- Particulates from coal dust and other sediment present on land surfaces.

Given that fuel storages will be designed to meet AS1940, it is unlikely that, even in the event of a major flood, releases of fuel from storages would occur.

In a large flood event, the concentration of contaminants is likely to be reasonably low due to the effect of dilution, but nevertheless could result in increases in contaminant levels downstream as floodwaters recede. Floodwaters would eventually report to the Fitzroy River mouth and contaminants in floodwaters would be released to the Great Barrier Reef World Heritage Area and Marine Park at very low concentrations.

Declining water quality in discharges from the Fitzroy Basin has been identified as a major threat to the reef (GBRMPA 2009). Although the contribution to contaminant levels in flood discharges from contaminants mobilised from the RHM MIA would be very small, it is appropriate to mitigate this potential impact, given the importance of the GBRWHA and Marine Park.

Should the underground mine workings become filled with floodwaters, this would not result in an uncontrolled release, but rather, waters could be pumped out in a controlled manner. Flood waters entering the underground workings would become contaminated with suspended sediments and may also become more saline, depending on the length of time that the waters were held within the mine prior to release. Water quality of flood waters entering the underground workings would not be any worse than groundwater from dewatering and would be suitable to be managed in the GRB mine water management network in the same manner that groundwater from mine dewatering is proposed to be managed.

Mitigation and Management Measures

Flood protection of the MIA and mine access is proposed, with the current conceptual design involving a levee built to the 1 in 1,000 AEP level. In a larger flood event, water quality of floodwaters would be very poor and any additional contribution from the MIA would be unlikely to make any difference to contaminant levels in floodwaters.

In addition, the proposed RHM will have an emergency management plan that will include preparatory measures for large flood events to minimise both environmental and health and safety risks.

5.2.4 Erosion and Sediment Mobilisation

During operation, land disturbing activities may result in increased erosion potential and mobilisation of sediment to surface waters. Installation and operation of incidental mine gas management infrastructure will be carried out across the RHM and BRM panel extension footprints. Erosion may also occur around the accommodation village and MIA particularly associated with diversion drains.

Subsidence related impacts are discussed in Section 7 of the Red Hill Mining Lease EIS.

Potential Impacts

Erosion and sediment mobilisation can lead to deleterious effects on downstream water quality and aquatic habitats. The Isaac River has relatively high turbidity levels, probably attributable to the level of disturbance in the upper catchment, hence, low levels of sediment input are unlikely to cause significant changes to water quality and to the aquatic ecology.

The installation and operation of incidental mine gas management infrastructure poses the most significant risk in terms of mobilisation of sediment, as disturbance will occur across the area of the underground mine footprint, and access tracks and gas well pads will remain exposed for some time. Ongoing, proactive erosion and sediment control, including in-stream controls at stream crossing locations will be required for this activity to minimise release of sediment to waterways.

As discussed in Section 5.1.1, receiving waters are naturally high in suspended solids and, provided that erosion and sediment control measures are used to minimise input of sediment, it is unlikely that the sediment mobilised from areas disturbed by IMG infrastructure will result in significant degradation of water quality and associated impacts to aquatic ecosystems. As the Isaac River is in the process of being subsided downstream by existing mining activities, sediment lost during rain events will tend to be captured in downstream subsidence troughs.

Other mine activity areas, such as the Red Hill CHPP and MIA, will have engineered stormwater systems, which should contain any sediment laden runoff from these areas.

Detailed design will establish whether the CHPP and MIA warrant stormwater to be captured and managed separately from mine water. The Red Hill CHPP will be located within the GRB mine water management area and treated stormwater would either be harvested for reuse in operations, or, after settlement to remove suspended solids, released to the GS4A dam and then to Isaac River in planned release events. Stormwater collected at the MIA would either be treated and released to the Isaac River or retained for reuse within the MIA.

The Red Hill accommodation village will be outside the mine water management system and hence, stormwater releases from this area will flow to local streams after passing through sediment basins.

Detailed design will determine sizing of stormwater retention basins to allow sufficient sediment settling time for captured stormwater runoff.

Erosion risk may occur in diversion drains at the proposed accommodation village where concentration of flow may wash out earthen drain structures and release points where concentration of flow may cause scouring. These areas will need to be considered in detailed design and inspected to identify the need for repairs.

With design and mitigation measures in place, water quality impacts on the Isaac River are expected to be minimal.

Management Measures

Erosion control and mitigation measures are set out in Section 5.3 of the Red Hill Mining Lease EIS and should include the following in relation to incidental mine gas management infrastructure:

- An erosion and sediment control plan should be prepared and executed for all IMG management activities and any other activities causing surface disturbance.
- Erosion and sediment control protection measures should be installed prior to the commencement of land disturbance activities associated with incidental mine gas installation.
- Erosion and sediment control structures should be regularly inspected and maintained.
- Topsoil and excavated material should be separately stockpiled away from drainage lines to protect it from erosion.
- Wherever possible, vegetation clearing should not be carried out during or immediately prior to heavy rainfall.
- Dust suppression measures should be implemented.
- Stream crossings (tracks and pipelines) should be as close as possible to right angles to the direction of flow.
- Pipeline trenches will be backfilled and stabilised to prevent bank erosion. Soil profiles to be restored as part of backfilling of trenches. Soft structures to be used to stabilise bed and banks of streams.
- For stream crossings, construction of linear infrastructure should be conducted in the shortest possible time and in accordance with the NRM guideline “Activities in a watercourse, lake or spring associated with mining operations” (NRM 2012). Wherever possible stream crossings should be constructed outside the wet season when there is no flow in streams.
- Road crossings of streams should be stabilised to minimise wash outs and bank erosion. Stabilisation may include placement of matting along banks.

- Regular inspections of road and pipeline alignments should be undertaken to ensure that disturbed surfaces are stable and not subject to concentration of flows or erosion. Repair works will be undertaken proactively to prevent erosion from occurring or worsening.

Other mine activity areas, such as the Red Hill accommodation village and MIA should be inspected regularly to check that stormwater management systems are effective and concentration of flow or scouring is not occurring.

Detailed design of the MIA, CHPP and accommodation village should address design of stormwater collection and retention systems to ensure that stormwater can be captured and adequately treated.

5.2.5 Contaminant Mobilisation

Diesel fuel will be stored at the MIA and a small fuel storage area may also be located at the proposed accommodation village. Refuelling facilities will also be located at fuel storages and some mobile refuelling of equipment involved in incidental mine gas management activities may take place across the mine footprint.

Small quantities of chemicals for use in water and wastewater treatment will also be stored at the MIA, CHPP and accommodation village. Small quantities of oils and oily wastes will also be stored at the MIA and CHPP associated with vehicle and equipment maintenance. All fuel and chemical storages will be designed and operated in accordance with Australian standards, including AS1940 and AS3780.

A vehicle wash will be located at the MIA. The MIA will also have a vehicle and equipment parking area.

Potential Impacts

Any spills or leaks of fuels or chemicals at the Red Hill MIA or CHPP will be contained within the stormwater management systems for these areas, which in turn are within the mine water management system. Hence, releases to the environment from these areas are unlikely. The accommodation village will also have a self-contained stormwater system, and hence, in the event of a spill during refuelling, or containment failure, diesel will be contained within the stormwater system and can be pumped out using a vacuum truck or similar. These measures significantly reduce the likelihood of a spill or leak entering downstream surface waters.

Apart from diesel storage at the MIA, the quantities of fuels and chemicals required are low and hence, unlikely to cause widespread environmental harm, even if released to a surface waterway. Release to a surface waterway is effectively prevented by stormwater management systems. On this basis, risk of environmental harm arising from spills or leaks of fuel or chemicals at the MIA, CHPP or accommodation village is low.

Minor spills and leaks of fuels and oils may occur across the mine footprint from refuelling and operation of equipment involved in installation and operation of incidental mine gas management infrastructure. Likely quantities of fuel or oils that may be spilled would be low, typically in the order of 10 to 20 L. If spills occur to soils, mobilisation of contaminants to surface waters is unlikely to result in any significant water quality degradation. Spills occurring within or immediately adjacent to watercourses may cause localised water quality degradation, but this is likely to be short lived.

Water used in the vehicle wash will be recirculated or returned to the mine water management system, with no external release directly from the vehicle wash system. Equipment and vehicle parking areas will drain through oil/water separators to the mine water management system, again, with no external release.

Mitigation and Management Measures

General

The following general mitigation measures are required to manage impacts of spills and leaks of fuels, oils and other contaminants on receiving waters:

- Fuel storage areas to be designed and operated in accordance with AS1940 Storage and handling of flammable and combustible liquids. This includes provision for containment.
- Chemical storage areas will be designed and operated in accordance with relevant Australian standards and recommendations from manufacturers.
- Refuelling to occur within contained, hardstand areas in accordance with AS1940 wherever possible. Where this is not possible, refuelling activities should be located away from streams and drainage lines and be closely supervised, with a spill kit available that is capable of containing spills of around 100 L.
- Storage and refuelling areas to be designed to minimise the ingress of clean stormwater either from overland flow or incidental rainfall.
- Bunds and sumps should be emptied after each rainfall event. Water and oily water from fuel and oil storage areas removed from bunds and sumps should be treated through an oil water separator and then reused for dust suppression or other on-site use. Water and other contaminants collected in other chemical storage areas should be treated through on-site wastewater treatment plants and then utilised in dust suppression or irrigated in accordance with the site environmental authority.
- Items are not to be stored or placed within bunds or sumps.
- Contaminants and major spills should be collected by a licensed waste collection and transport contractor for disposal at an offsite licensed facility.
- Spill clean-up kits are to be located in appropriate locations, based on the risk of a spill occurring and potential volume of material that might be spilled at the particular location.
- Workers involved in storage, handling and management of fuels and chemicals are to receive training in spill prevention and control.
- Instructions on spill containment and clean-up to be available at refuelling locations and in vehicles where there is a moderate risk associated with spill events.
- Spills are to be contained and cleaned up immediately to prevent the mobilisation of pollutants in drainage lines or watercourses.
- Wastewater from the vehicle washdown should be directed through oil and grease separators and recirculated for use in the washdown facility. Excess water is to be returned to the mine water management system.

Incidental mine gas management

In addition to the measures above, the following specific measures are to be applied to installation and operation of incidental mine gas management infrastructure:

- Refuelling is not to take place within 100 m of the Isaac River and 50 m of 12 Mile Gully and tributaries.

- Fuels, oils and other chemicals, including wastes contaminated with fuels, oils or other chemicals are only to be stored at the MIA.
- All construction wastes are to be removed to a lay down area or MIA within 24 hours.

5.2.6 Water quality degradation due to subsidence

Subsidence following underground mining activities during operation has the potential to cause ponding of surface runoff with potential impacts on surface water quality.

Potential Impacts

Based on water quality in pools in local streams, water quality in subsidence ponds is likely to be variable over time.

Initial inflows will be from surface water runoff and hence relatively low in salinity but potentially containing suspended solids collected from the catchment. As water is lost through evaporation the concentration of salts and any dissolved contaminants may be expected to increase over time, as is observed in ponds forming in existing waterways in the EIS study area. There may also be changes to other physicochemical characteristics which, however, are expected to be consistent with naturally ponded areas. The reduction in flows due to the ponding within subsided areas also has the potential to impact on water quality downstream through reduced dilution flows. This latter consideration is particularly relevant for subsidence within the 12 Mile Gully catchment.

Subsidence is predicted to increase erosion of stream banks (Alluvium 2011). This will contribute to sediment load in affected streams, but in each case, sediment released through erosion is expected to be captured by subsidence troughs created downstream.

Mitigation and Management Measures

Ponded areas should be selectively drained in accordance with the measures identified within the subsidence hydrology report (Red Hill Mining Lease EIS Appendix I7). This will reduce the potential for water quality degradation within ponded areas and will also contribute flushing flows for 12 Mile Gully.

5.3 Decommissioning Phase

The decommissioning phase will involve the following activities:

- Dewatering of water storage dams which will not be suitable for ongoing beneficial use.
- Earthworks associated with the removal of all infrastructure on the site and establishing a final landform that is stable and not subject to subsidence, slumping or erosion.

Full details of the decommissioning activities are provided in Section 5.5 of the Red Hill Mining Lease EIS.

5.3.1 Dewatering of Water Storage Dams

The MIA dam will need to be dewatered at decommissioning as would the IMG production water dam, should it contain any water. As the life of mine for the proposed project activities is shorter than the adjacent GRB mine complex, both dams can be pumped into the GRB mine water management system using existing water transfer systems (which would then be decommissioned). The dams would then need to be decommissioned so that it does not capture water in future. As the quantities of water to be transferred are small, and as existing equipment will be used, it is unlikely that any accidental release to the environment would occur during this activity.

Potential Impacts

The release of contaminated water from a pipeline failure during decommissioning has the potential to have adverse impacts on water quality within the receiving environment and may compromise downstream environmental values. However, the likelihood of failure, and the quantities potentially involved are low and significant environmental impact is unlikely.

Mitigation and Management Measures

- Ensure water is disposed of in an appropriate manner.
- Ensure that pipe and pump network is operating properly before commencing dewatering.

5.3.2 Earthworks and Final Landform

Ground disturbance activities undertaken during above ground infrastructure removal have the potential to cause mobilisation of sediment and erosion to varying levels. The final landform may also be a source of sediment mobilisation if not fully stabilised on accordance with identified rehabilitation success criteria.

Potential Impacts

Sediment mobilised during decommissioning activities may enter surface water runoff during rainfall events and discharge to watercourses, leading to adverse effects on water quality. Sediment exposed during decommissioning may also be carried by wind into surface water bodies. Leaving stormwater systems in place until late in the decommissioning process will assist in capturing sediment laden runoff and as the areas where infrastructure and facilities are to be removed are relatively small, the quantity of sediment that may be released is relatively low.

The final landform may also be a significant source of sediment, however if rehabilitation success criteria set out in Section 5.5 of the Red Hill Mining Lease EIS are met, it is unlikely that runoff from this area will contain higher sediment loads than any other grazing land in the upper Isaac River catchment.

Mitigation and Management Measures

- Leave stormwater structures in place until as late as possible in decommissioning.
- Promptly spread topsoil and sow pasture grass on areas disturbed by decommissioning.
- Retain erosion and sediment control measures until rehabilitation success criteria have been achieved.

Monitoring

A receiving environment monitoring program (REMP) and a comprehensive monitoring program are already in place for the GRB mine complex, in accordance with requirements of the existing EA EPML00853413 (6 September 2013). It is anticipated that the proposed expansion will initially be covered by the existing REMP, as that program is already required define the receiving environment as “the waters of the Isaac River and connected or surrounding waterways within 10km downstream of the release” (Condition W20, EPML00853413). MLA70421 is currently within 10km of the existing MAW discharge location. The current REMP monitoring locations are listed in Table 6-1.

Table 6-1 Existing REMP Monitoring Locations (from Tables W4 and W6, EPML00853413)

Monitoring Point	Receiving Waters Location Description	GIS Coordinates (GDA94)	
		Easting	Northing
Upstream Background Monitoring Locations			
Monitoring Point 2 Upstream Eureka Creek	Eureka Creek	-21.77123422	147.9290457
Monitoring Point 3 Upstream Isaac River – Drop Structure	Isaac River upstream of Eureka Creek	-21.78412215	148.0156385
Release Point Monitoring Locations			
Monitoring Point 1 Eureka Creek Diversion (GS4A Dam)	Eureka Creek	-21.8004023	147.9931368
Discharge Point 1 (MAW during flow events)	Upper Isaac River	-21.73525314	148.0166348
Downstream Monitoring Locations			
Monitoring Point 4 Isaac River (Downstream) Railway Bridge	Isaac River	-21.85541921	147.9732334

Water quality monitoring for the proposed project activities will be based on the existing REMP and monitoring program, with some augmentation as required to address possible impacts on Goonyella Creek and 12 Mile Gully, as well as to progressively replace existing water quality monitoring sites that may be affected by subsidence. Proposed additional sampling locations for the monitoring program are listed in Table 6-2 below and shown in Figure 6-1. Monitoring will be undertaken in accordance with the Monitoring and Sampling Manual (DERM 2009c), which provides guidance on techniques, methods and standards for sample collection; sample handling; quality assurance and control; and data management.

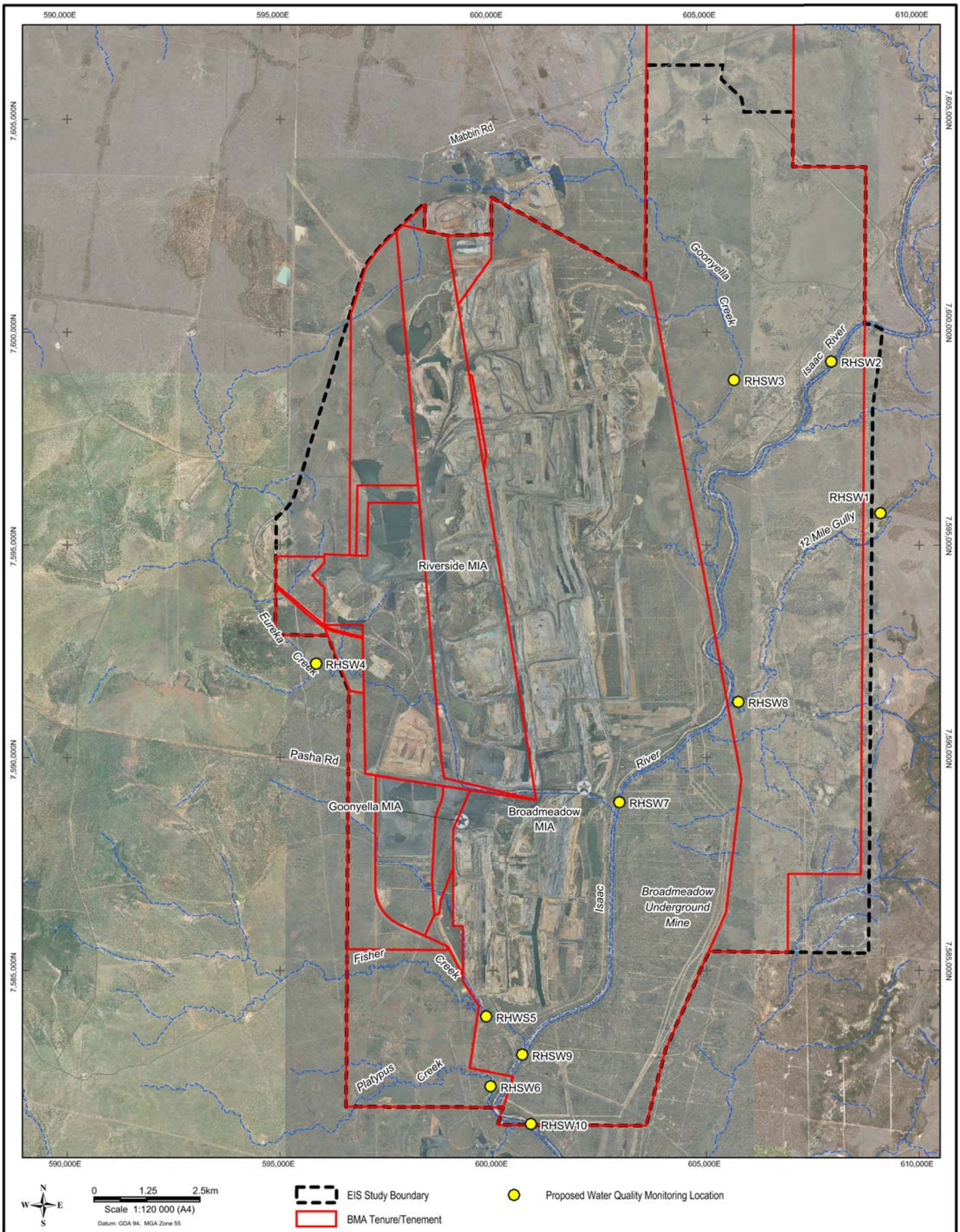
Where baseline data is not already available from the GRB mine complex monitoring, baseline data will be collected over a two year period prior to disturbance, aiming for 12 to 18 data points. The Upper Isaac sites will be developed as subsidence affects existing Isaac River upstream monitoring points. Final locations will be confirmed following discussions with relevant landholders and identification of safe access points.

Table 6-2 Proposed Water Quality Monitoring Locations

	Site Description	GIS Coordinates	
		Latitude	Longitude
RHSW1	12 Mile Gully	-21.740032	148.053816
RHSW2	Upper Isaac u/s Red Hill	-21.7081	148.042489
RHSW3	Goonyella Creek	-21.712069	148.020328
RHSW7	Upper Isaac	-21.801764	147.994955
RHSW8	12 Mile Gully Downstream	-21.78033	148.02174
RHSW9	Isaac River Rail Bridge	-21.855446	147.973224
RHSW10	Lower Isaac	-21.870222	147.975359

6.1 Parameters for Monitoring

The choice of parameters for water quality monitoring is based on protection of environmental values as identified in Section 2. The parameters chosen are those that may be influenced by coal mining operations and in turn adversely impact on the environmental values. Table 6-3 lists the monitoring parameters to be tested at each location, and provides additional rationale for their inclusion in the program.



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RED HILL PROJECT
SURFACE WATER QUALITY TECHNICAL REPORT

PROPOSED WATER QUALITY MONITORING LOCATIONS

URS

SURFACE WATER

Figure: **6-1**

File No: **42627136-g-2159.wor** Drawn: **VH** Approved: **CT** Date: **24-06-2013** Rev. **A** A4

Table 6-3 Parameters for Baseline Monitoring Program

Analyte Group	Parameter	Rationale
Physicochemical	Electrical Conductivity (field & lab)	Generic parameters for data analysis to indicate general stream condition
	pH (field & lab)	
	Suspended Solids	
	Turbidity (field)	
	Flow rate	
	Dissolved Oxygen (field)	
	Temperature (field)	
	Sulphate	
	Fluoride	
	Sodium	
Metals (total & dissolved)	Aluminium	Indicators of naturally occurring metal contents in the region. During mine activities elevated metal concentrations could indicate uncontrolled mine drainage.
	Arsenic	
	Boron	
	Cadmium	
	Chromium	
	Cobalt	
	Copper	
	Iron	
	Lead	
	Manganese	
	Mercury	
	Molybdenum	
	Nickel	
	Selenium	
	Silver	
	Uranium	
	Vanadium	
	Zinc	
Total Petroleum Hydrocarbons	C_8 to C_9	Indicates hydrocarbon pollution from potential spills
	C_{10} to C_{36}	
Nutrients	Ammonia	May vary as a result of contamination from mine activities
	Nitrate	

6.2 Monitoring Schedule

Sampling events will correspond with rainfall events that generate enough runoff to trigger sampling. Given that the watercourses are ephemeral and only flow after large rain events, stream gauging stations with data loggers may be used for highly variable parameters including pH and EC at three locations. The stream gauging stations can also be used to alert monitoring staff of flow events that may indicate that a grab sample should be collected.

6 Monitoring

The proposed monitoring schedule is outlined in Table 6-4 and should be undertaken until construction activities commence. More frequent monitoring may be required to establish baseline conditions for sites not already included in the GRB mine complex REMP.

Table 6-4 Water Quality Monitoring Schedule

Monitoring Type	Sites	Parameter	Frequency
Stream Gauging Stations	RHSW1, RHSW2, RHSW3, RHSW9	EC, pH, Turbidity, Flow	Real time telemetry for EC and pH with grab samples at commencement and weekly thereafter when safe to do, and if access permits. Daily grab samples when flow is detected (if telemetry is not available).
Event Sampling	RHSW1, RHSW2, RHSW3, RHSW7, RHSW8, RHSW9, RHSW10	All parameters indicated in Table 6–2.	Monthly during and after major rainfall events where flow is sufficient and access is available.
		Sulphate	Grab sampling at commencement of release and weekly thereafter, when safe to do so and if access permits.

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A

Appendix A Raw Water Quality Data (2010-2011)

URS

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010
Aluminium (µg/L)	7530	9330	10100	54300	8520	10600	8440	9500	6060	36000	14000	7200	18000	11000	23000	16000	12000
Ammonia as N (µg/L)	10	5	5	30	5	10	10	5	5	40	5	5	5	10	30	5	5
Antimony (µg/L)																	
Arsenic (µg/L)	2.5	2.5	2.5	7	2.5	2.5	2.5	2.5	5	4	2.5	2.5	2.5	2.5	5	2.5	5
Barium (µg/L)																	
Beryllium (µg/L)															2.5		
Boron (µg/L)	70	70	70	160	120	90	130	60	80	80	60	80	60	50	80	50	50
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																	
Chloride (µg/L)																	
Chromium (µg/L)	35	36	24	86	15	12	15	16	8	52	15	15	35	15	67	19	34
Copper (µg/L)											11	12	31	12	67	20	9
Cyanide (µg/L)																	
Fluoride (µg/L)	200	300	100	200	100	100	200	100	100	300	50	100	100	100	100	100	100
Iron (µg/L)	24800	18700	12300	71400	7800	8080	7400	13100	7040	55000	10400	11000	25600	12600	50000	18400	6530
Lead (µg/L)	12	6	5	32	2.5	5	2.5	7	2.5	21	5	5	18	8	26	12	2.5
Magnesium (µg/L)											273						
Manganese (µg/L)	464	253	171	1730	181	326	182	390	186	690		249	1200	416	1060	650	135
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.1
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	41	28	22	97	22	19	22	18	13	59	21	20	40	21	109	26	10
Nitrate as NO3 (µg/L)	650	220	5	190	60	70	140	50	150	280	40	10	60	50	150	20	50
Nitrite as NO2- (µg/L)																	
Oxygen (µg/L)																	
pH (units)	7.2	7.2	7.1	9.3	7.7	7.9	7.9	7.7	7.7	7.5	7.3	7.5	7.7	7.8	8	7.5	7.8
Potassium (µg/L)																	
Selenium (µg/L)	2.5	2.5	2.5	6	7	5	6	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)																	
Sulfate (mg/L)	78	20	32	33	19	18	37	10	25	74	8	25	5	8	14	2	2
Zinc (µg/L)	47	31	33	119	18	20	29	34	12	58	20	22	62	25	148	39	8
Ammonium (NH4+) (µg/L)																	
Chlorophyll α (µg/L)																	
Dissolved Oxygen (µg/L)																	
Filterable Reactive Phosphate (FRP) (µg/L)	967	322	387	490	333	338	611	246	473	969							
NOx (µg/L)																	
Electrical Conductivity (µS/cm)											213	475	198	242	299	164	149
Total Nitrogen as N (µg/L)																	
Total Phosphorus as P (µg/L)																	
Total Dissolved Solids (mg/L)	485	455	454	372	201	162	314	189	316	494	269	371	444	224	318	254	354
Total Solids (mg/L)																	

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010
Total Suspended Solids (mg/L)	632	362	130	604	251	222	77	160	280	1830	644	330	127	293	40	437	1300
Turbidity (NTU)	4840	1270	758	5780	219	460	322	1020	415	2750	1280	476	2390	1030	5830	1100	801
Cobalt (µg/L)	18	10	8	47	7	8	7	7	5	26	9	8	24	10	48	14	2.5
Dissolved Aluminium (µg/L)											6700	4100	7300	5300	3200	220	3000
Dissolved Antimony (µg/L)																	
Dissolved Arsenic (µg/L)											1	1	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)															2.5		
Dissolved Boron (µg/L)	60	40	50	100	80	50	90	60	70	80	50	70	40	50	50	40	40
Dissolved Cadmium (µg/L)											0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																	
Dissolved Chromium (µg/L)	0.5	1	2	0.5	1	0.5	1	0.5	0.5	2	8	5	0.5	0.5	1	0.5	1
Dissolved Copper (µg/L)	2	3	3	4	3	2	3	3	2	2	11	2	2	3	2	2	5
Dissolved Iron (µg/L)	110	90	80	25	210	70	270	260	80	670	720	680	1030	510	300	260	100
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																	
Dissolved Manganese (µg/L)	3	1	1	0.5	1	0.5	2	2	0.5	2.5	12	5	6	8	6	5	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	3	1	2	6	4	2	5	1	2	2.5	1	2	0.5	0.5	1	0.5	0.5
Dissolved Nickel (µg/L)	4	4	4	6	6	3	6	3	3	6	6	4	2	2	4	2	2
Dissolved Potassium (µg/L)																	
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5
Oil and Grease (mg/L)																	
MBAS (mg/L)																	
Chemical Oxygen Demand (mg/L)											48	26	45	33	284	44	47
Bicarbonate Alkalinity (mg/L)																	
Total Alkalinity (mg/L)																	
C6-C9 (µg/L)											25	25	25	25	25	25	25
C10-C14 (µg/L)											25	25	25	25	25	25	25
C15-C28 (µg/L)											100	100	100	100	100	100	100
C29-C36 (µg/L)											25	100	25	25	130	25	60
BOD (lab) (mg/L)											3	1	2	1	2	1	2
C10 - C36 Fraction (sum) (µg/L)												100			130		60
NO2 + NO3 (µg/L)																	
Orthophosphate as P (ug/L)																	
Dissolved Cobalt (ug/L)											0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)											0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)											0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)											0.2	0.2	0.1	0.1	0.1	0.1	0.05
Total Uranium (ug/L)											0.25	0.5	1.1	0.5	1.5	0.7	0.25
Dissolved Vanadium (ug/L)											10	7	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)											30	30	70	30	100	60	130

ND - No data

ORANGE — Parameters discussed in surface water quality assessment

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Aluminium (µg/L)	19000	15000	48000	17300	14300	31000	2100	2600	2200	3600	4300	4600	2000	2600	7300	3600
Ammonia as N (µg/L)	5	50	5	5	5	30	50	20	20	20	30	20	50	30	20	40
Antimony (µg/L)																
Arsenic (µg/L)	2.5	2.5	23	2.5	2.5	2.5	2.5	2.5	2.5	6	1	1	1	1	1	5
Barium (µg/L)																
Beryllium (µg/L)																
Boron (µg/L)	40	50	30	50	50	60	40	40	40	30	25	25	25	25	50	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																
Chloride (µg/L)																
Chromium (µg/L)	22	2.5	27	31	22	34	7	10	9	15	17	18	9	10	13	23
Copper (µg/L)	17	2.5	6	23	20	22	7	9	7	11	11	13	7	7	9	11
Cyanide (µg/L)																
Fluoride (µg/L)	100	100	50	50	100	50	50	50	50	50	50	50	50	100	50	50
Iron (µg/L)	14400	6150	6600	20000	15200	34000	2900	3900	3200	5200	16000	15000	4000	7800	8600	6500
Lead (µg/L)	10	5	2.5	12	7	16	2.5	5	2.5	6	7	8	4	4	5	5
Magnesium (µg/L)																
Manganese (µg/L)	616	127	83	751	340	700	220	300	170	340	290	300	140	150	190	240
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5	5	5	5	5	2.5
Nickel (µg/L)	24	9	7	39	22	34	9	12	9	16	17	18	9	10	12	20
Nitrate as NO3 (µg/L)	30	50	50	30	80	20	50	10	20	5	40	20	20	40	20	70
Nitrite as NO2- (µg/L)																
Oxygen (µg/L)																
pH (units)	7.9	7.8	7.2	7	7.6	8.5	8.6	8.4	8.5	8.2	7.8	8.3	7.8	8	7.7	7.5
Potassium (µg/L)																
Selenium (µg/L)	5	6	2.5	2.5	2.5	2.5	11	9	7	11	1	1	1	1	1	7
Sodium (µg/L)																
Sulfate (mg/L)	4	7	2	5	13	1	2	1	26	1	2.3	1	2.2	3.1	1	3.1
Zinc (µg/L)	31	10	6	41	36	43	6	21	17	24	120	39	41	60	33	28
Ammonium (NH4+) (µg/L)																
Chlorophyll α (µg/L)																
Dissolved Oxygen (µg/L)																
Filterable Reactive Phosphate (FRP) (µg/L)																
NOx (µg/L)																
Electrical Conductivity (µS/cm)	161	226	107	143	301	140	180	160	190	130	200	170	190	230	180	200
Total Nitrogen as N (µg/L)																
Total Phosphorus as P (µg/L)																
Total Dissolved Solids (mg/L)	344	358	110	274	262	95	88	110	130	92	120	80	140	130	150	240
Total Solids (mg/L)																

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Total Suspended Solids (mg/L)	1070	338	1180	280	202	610	490	670	490	810	510	450	310	290	290	510
Turbidity (NTU)	1040	767	2950	1190	597	470	260	360	280	500	290	360	170	160	600	1000
Cobalt (µg/L)	11	2.5	2.5	20	8	17	2.5	6	2.5	8	7	7	3	4	4	8
Dissolved Aluminium (µg/L)	3400	360	6300	30	160	25	60	2600	2200	3600	310	350	440	470	170	3600
Dissolved Antimony (µg/L)																
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5
Dissolved Beryllium (µg/L)																
Dissolved Boron (µg/L)	30	40	20	40	40	40	30	40	40	30	20	40	40	50	40	40
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																
Dissolved Chromium (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Copper (µg/L)	10	7	4	8	5	2	1	2	4	5	1	2	4	5	6	5
Dissolved Iron (µg/L)	90	170	240	25	25	25	2900	3900	3200	5200	200	230	310	300	170	6500
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																
Dissolved Manganese (µg/L)	0.5	1	1	0.5	1	2	3	3	2	1	2	4	0.5	2	0.5	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	1	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	2	3	2	2	2	1	2	2	2	0.5	2	2	2	1	2
Dissolved Potassium (µg/L)																
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7	7	5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																
MBAS (mg/L)																
Chemical Oxygen Demand (mg/L)	56	29	44	38	26	35	29	40	28	41	23	30	17	20	28	32
Bicarbonate Alkalinity (mg/L)																
Total Alkalinity (mg/L)																
C6-C9 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)	160	25	80	25	25	25	25	25	120	25	100	25	60	70	120	90
BOD (lab) (mg/L)	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3.1
C10 - C36 Fraction (sum) (µg/L)	160		80			100	100	100	120	100	100	100	60	70	120	90
NO2 + NO3 (µg/L)																
Orthophosphate as P (ug/L)																
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	5	5	5	5	5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	0.05	0.1	0.2	0.05	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.05
Total Uranium (ug/L)	0.6	0.25	0.25	0.8	0.6	0.25	0.25	0.25	0.25	0.5	2.5	2.5	2.5	2.5	2.5	0.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)	60	20	70	50	30	50	20	20	20	30	26	28	14	17	20	30

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Aluminium (µg/L)	4200	6200	2900	53000	12000	2900	15000	5800	6100	17000	15000	15000	11000	120	90	6200	2800	5500
Ammonia as N (µg/L)	30	20	20	25	30	5	40	10	5	5	5	5	5	5	5	10	10	10
Antimony (µg/L)																		
Arsenic (µg/L)	1	2.5	2.5	2.5	1	1	0.5	0.5	0.5	2	2.5	0.5	2.5	2.5	2.5	6	2.5	2.5
Barium (µg/L)																		
Beryllium (µg/L)																		
Boron (µg/L)	50	50	60	125	25	70	60	25	25	50	60	70	50	50	70	30	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.5	0.1	0.1	0.3	0.2	0.2	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																		
Chloride (µg/L)																		
Chromium (µg/L)	18	52	15	78	13	7	16	9	9	12	24	28	37	16	14	11	8	8
Copper (µg/L)	9	18	8	51	10	3	12	8	4	16	14	14	18	11	12	9	7	8
Cyanide (µg/L)																		
Fluoride (µg/L)	50	10	10	10	10	10	10	100	200	100	200	200	100	100	100	100	100	50
Iron (µg/L)	14000	30000	10000	77000	17000	5100	23000	8400	9900	21000	21000	20000	14000	90	5900	6900	3400	6700
Lead (µg/L)	5	7	2.5	33	9	1	10	5	6	11	2.5	7	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)																		
Manganese (µg/L)	190	550	190	1200	270	43	350	170	170	460	260	230	180	360	130	240	180	240
Mercury (µg/L)	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	14	50	16	92	17	9	17	12	11	26	22	33	34	20	18	12	9	11
Nitrate as NO3 (µg/L)	120	10	100	100	30	100	10	90	170	270	30	5	30	20	320	90	170	10
Nitrite as NO2- (µg/L)		5	5					10	10									
Oxygen (µg/L)																		
pH (units)	7.6	8.1	8.4	7.7	7.6	7.4	7.4	7.5	7.3	7.4	7.3	7.9	7.8	8.1	8	7.9	7.8	7.8
Potassium (µg/L)																		
Selenium (µg/L)	1	2.5	2.5	2.5	0.5	3	7	11	0.5	2	1	2	1	0.5	1	2.5	2.5	6
Sodium (µg/L)																		
Sulfate (mg/L)	3.8	2.5	6.3	9.3	5.4	21	6.4	3.7	7.8	4.1	3.8	4.7	1	1	4.7	1	4.3	4.8
Zinc (µg/L)	37	37	30	110	23	6	25	36	43	37	17	41	30	21	20	17	10	14
Ammonium (NH4+) (µg/L)																		
Chlorophyll α (µg/L)																		
Dissolved Oxygen (µg/L)																		
Filterable Reactive Phosphate (FRP) (µg/L)																		
NOx (µg/L)																		
Electrical Conductivity (µS/cm)	270	190	400	220	220	610	210	280	440	330	260	420	270	210	400	270	350	390
Total Nitrogen as N (µg/L)																		
Total Phosphorus as P (µg/L)																		
Total Dissolved Solids (mg/L)	270	230	210	330	110	270	180	180	370	310	390	440	340	170	240	210	240	300
Total Solids (mg/L)																		

Lower Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac	Lower Isaac
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Total Suspended Solids (mg/L)	330	730	220	3700	340	36	640	410	360	900	650	570	1000	590	380	350	310	220
Turbidity (NTU)	670	190	370	4700	510	100	710	160	290	1600	1000	2100	1100	320	510	180	210	440
Cobalt (µg/L)	5	16	2.5	42	6	2	8	4	4	10	10	12	7	8	4	5	2.5	2.5
Dissolved Aluminium (µg/L)	390	250	780	120	160	420	350	760	520	1600	25	1300	1400	120	70	50	90	30
Dissolved Antimony (µg/L)																		
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)																		
Dissolved Boron (µg/L)	50	40	50	25	25	80	25	25	25	25	50	70	25	25	25	50	50	60
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																		
Dissolved Chromium (µg/L)	0.5	0.5	0.5	0.5	4	2	1	1	0.5	1	2	2	3	0.5	0.5	2	1	6
Dissolved Copper (µg/L)	6	2	2	1	2	1	2	5	2	2	2	2	2	3	3	3	4	1
Dissolved Iron (µg/L)	290	210	420	110	190	360	330	570	340	900	25	510	810	90	90	60	100	70
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																		
Dissolved Manganese (µg/L)	0.5	2	2	2.5	2.5	2.5	5	2.5	2.5	2.5	4	2.5	2.5	2.5	2.5	4	2	0.5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	1	0.5	1	2.5	2.5	6	2.5	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	0.5	2	2
Dissolved Nickel (µg/L)	2	3	3	1	1	5	1	3	2	2	3	3	3	3	3	2	3	2
Dissolved Potassium (µg/L)																		
Dissolved Selenium (µg/L)	2.5	2.5	2.5	0.5	0.5	2	0.5	11	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	0.5	0.5	0.5	0.5	3	0.5	2	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																		
MBAS (mg/L)																		
Chemical Oxygen Demand (mg/L)	34	39	36	81	75	36	77	30	23	26	27	28	33	24	30	34	28	28
Bicarbonate Alkalinity (mg/L)																		
Total Alkalinity (mg/L)																		
C6-C9 (µg/L)	25	25		10	25	25	10	25	25	25	25	25	25	25	25	10	10	10
C10-C14 (µg/L)	25	25		25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100		50	100	100	50	100	100	100	100	100	100	100	100	50	50	50
C29-C36 (µg/L)	90	25		50	25	25	50	25	25	25	60	25	70	25	25	50	50	100
BOD (lab) (mg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5	1	1	1	1	1	1	1	1	1	1	2
C10 - C36 Fraction (sum) (µg/L)	90	100		50	100	100	50	100	100	100	100	100	100	100	100	50	50	100
NO2 + NO3 (µg/L)								100	180									
Orthophosphate as P (ug/L)																		
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	0.25	0.25	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.2	0.2	0.3	50	0.1	0.1	0.05	0.2	0.3	0.1	0.05	0.3	0.2	0.2	0.3	0.3	0.3	0.1
Total Uranium (ug/L)	2.5	0.25	0.25	50	1	1	0.2	0.5	0.6	0.25	0.5	0.7	0.5	0.25	0.6	0.25	0.25	0.6
Dissolved Vanadium (ug/L)	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	10
Total Vanadium (ug/L)	24	40	20	100	22	8	29	17	18	33	30	35	25	26	16	40	20	10

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	51.0	12193.9	8520	4250	15000	90	54300
Ammonia as N (µg/L)	51.0	16.4	10.0	5.0	27.5	5.0	50.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	51.0	3.0	2.5	2.3	2.5	0.5	23.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	51	58	50	40	70	25	160
Cadmium (µg/L)	51.0	0.2	0.3	0.3	0.3	0.1	0.5
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	51.0	22.4	16.0	11.5	27.5	2.5	86.0
Copper (µg/L)	41.0	14.1	11.0	8.0	16.0	2.5	67.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	51.0	94.3	100.0	50.0	100.0	10.0	300.0
Iron (µg/L)	51	16137	11000	6650	19350	90	77000
Lead (µg/L)	51.0	7.6	5.0	2.5	8.5	1.0	33.0
Magnesium (µg/L)	1	273	273	273	273	273	273
Manganese (µg/L)	50.0	373.1	251.0	180.3	409.5	43.0	1730.0
Mercury (µg/L)	51.0	0.1	0.1	0.1	0.1	0.1	0.2
Molybdenum (µg/L)	51.0	2.9	2.5	2.5	2.5	2.5	6.0
Nickel (µg/L)	51	25	19	12	26	7	109
Nitrate as NO3 (µg/L)	51	86.8	50	20	100	5	650
Nitrite as NO2- (µg/L)	4	7.5	7.5	5	10	5	10
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	51.0	7.8	7.8	7.5	8.0	7.0	9.3
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	51.0	3.5	2.5	2.0	5.0	0.5	11.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	51.0	11.4	4.8	2.3	13.5	1.0	78.0
Zinc (µg/L)	51	36	30	20	40	6	148
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	10.0	513.6	430.0	334.3	580.8	246.0	969.0
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	41	253.4	220	180	299	107	610
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	51	259	254	166	342	80	494
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Total Suspended Solids (mg/L)	51	548	380	285	636	36	3700
Turbidity (NTU)	51	1116	597	321	1100	100	5830
Cobalt (µg/L)	51	10	7	4	10	2	48
Dissolved Aluminium (µg/L)	41.0	1520.2	420.0	160.0	2600.0	25.0	7300.0
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	41.0	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	51.0	45.6	40.0	30.0	50.0	20.0	100.0
Dissolved Cadmium (µg/L)	41	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	51	1.2	0.5	0.5	1.0	0.5	8.0
Dissolved Copper (µg/L)	51	3.3	3.0	2.0	4.0	1.0	11.0
Dissolved Iron (µg/L)	51	675.0	240.0	90.0	510.0	25.0	6500.0
Dissolved Lead (µg/L)	51	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	51	2.5	2.0	1.0	2.8	0.5	12.0
Dissolved Mercury (µg/L)	51	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	51	1.6	1.0	0.5	2.5	0.5	6.0
Dissolved Nickel (µg/L)	51	2.8	2.0	2.0	3.0	0.5	6.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	51	2.5	2.5	2.5	2.5	0.5	11.0
Dissolved Zinc (µg/L)	51	3.3	2.5	2.5	5.0	0.5	5.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	0	42	33	28	41	17	284
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	0	23.1	25	25	25	10	25
C10-C14 (µg/L)	40	23.1	25	25	25	25	25
C15-C28 (µg/L)	40	25.0	100	100	100	50	100
C29-C36 (µg/L)	40	93.8	25	25	73	25	160
BOD (lab) (mg/L)	40	53.4	1	1	2	1.0	3.1
C10 - C36 Fraction (sum) (µg/L)	41	1.4	100	90	100	50	160
NO2 + NO3 (µg/L)	33	93.3	140	120	160	100	180
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	0	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	41	0.5	0.3	0.3	2.5	0.3	5.0
Dissolved Silver (ug/L)	41	1.6	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	40	0.7	0.2	0.1	0.2	0.1	50.0
Total Uranium (ug/L)	41	1.4	0.5	0.3	1.0	0.2	50.0
Dissolved Vanadium (ug/L)	41	2.0	2.5	2.5	2.5	2.5	10.0
Total Vanadium (ug/L)	41	3.1	29.0	20.0	40.0	8.0	130.0

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010	13/12/2010	14/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010
Aluminium (µg/L)	37800	9630	16100	10700	10200	6450	16000	13000	7500	15000	12000	10000	14000	35000	18000	24000	9530	31000	2300	3100
Ammonia as N (µg/L)	30	10	40	10	5	5	70	10	5	10	20	10	5	5	5	90	1460	20	50	20
Antimony (µg/L)																				
Arsenic (µg/L)	5	2.5	2.5	2.5	2.5	5	2	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)																				
Beryllium (µg/L)												2.5								
Boron (µg/L)	120	120	90	110	60	60	25	60	70	40	50	60	60	60	30	40	40	60	30	30
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																				
Chloride (µg/L)																				
Chromium (µg/L)	47	17	20	25	14	7	20	24	14	31	17	20	14	29	26	2.5	17	31	7	11
Copper (µg/L)								16	12	25	12	13	13	11	18	2.5	13	19	7	9
Cyanide (µg/L)																				
Fluoride (µg/L)	200	200	100	200	100	100	200	100	100	100	100	100	100	100	100	100	50	50	50	50
Iron (µg/L)	38600	8250	13000	14100	12300	7080	18000	12200	12200	22800	14000	13300	13300	7230	16000	5980	8890	30000	3100	4400
Lead (µg/L)	16	2.5	7	7	8	2.5	5	8	6	16	6	7	8	2.5	11	2.5	5	14	2.5	6
Magnesium (µg/L)								407												
Manganese (µg/L)	994	188	494	351	462	184	270		263	957	262	350	381	164	695	112	194	550	210	290
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	64	23	26	31	17	10	20	28	17	33	14	17	17	13	28	8	15	29	9	12
Nitrate as NO3 (µg/L)	110	5	5	5	40	60	40	10	60	40	30	40	30	30	20	20	30	10	20	5
Nitrite as NO2- (µg/L)																				
Oxygen (µg/L)																				
pH (units)	9.1	7.9	7.8	7.9	7.8	7.7	5.4	7.2	7.5	7.6	7.8	7.7	7.5	7.7	7.8	7.6	7.8	8.5	8.6	8.1
Potassium (µg/L)																				
Selenium (µg/L)	2.5	2.5	6	6	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	5	2.5	2.5	7	8
Sodium (µg/L)																				
Sulfate (mg/L)	23000	22000	6000	26000	3000	4000	55000	5	6	2	2	4	1	2	1	2	3	1	1	1
Zinc (µg/L)	76	18	38	27	31	9	34	34	22	11	18	27	26	8	33	8	24	39	5	22
Ammonium (NH4+) (µg/L)																				
Chlorophyll α (µg/L)																				
Dissolved Oxygen (µg/L)																				
Filterable Reactive Phosphate (FRP) (µg/L)	399	392	185	465	186	226	294													
NOx (µg/L)																				
Electrical Conductivity (µS/cm)								208	238	157	157	185	144	157	131	158	162	140	140	140
Total Nitrogen as N (µg/L)																				
Total Phosphorus as P (µg/L)																				
Total Dissolved Solids (mg/L)	411	222	124	264	212	242	178	255	260	210	18	360	238	280	324	362	214	97	89	95
Total Solids (mg/L)																				
Total Suspended Solids (mg/L)	340	209	139	305	62	190	456	594	307	486	450	31	343	1670	1020	236	158	480	480	630

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	23/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010	12/12/2010	13/12/2010	14/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010
Turbidity (NTU)	2380	305	352	470	453	420	776	1340	610	1930	987	856	491	2120	1210	650	590	440	200	260
Cobalt (µg/L)	29	7	12	11	8	2.5	8	12	7	19	6	7	8	5	12	2.5	5	13	2.5	6
Dissolved Aluminium (µg/L)								5900	4400	6500	4700	4900	230	3600	3000	380	120	110	2300	3100
Dissolved Antimony (µg/L)																				
Dissolved Arsenic (µg/L)								1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)												2.5								
Dissolved Boron (µg/L)	80	40	30	100	60	60	25	60	60	30	40	50	40	40	40	40	40	40	40	40
Dissolved Cadmium (µg/L)								0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																				
Dissolved Chromium (µg/L)	0.5	0.5	0.5	1	0.5	0.5	1	6	4	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Copper (µg/L)	4	1	2	3	3	2	2	3	3	2	2	2	2	7	6	5	8	2	4	2
Dissolved Iron (µg/L)	25	80	25	310	150	100	600	880	850	840	610	210	260	80	60	260	25	100	3100	4400
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																				
Dissolved Manganese (µg/L)	0.5	0.5	0.5	2	0.5	0.5	2.5	12	6	6	6	6	6	0.5	0.5	2	0.5	3	5	4
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	5	2	0.5	7	0.5	1	2.5	1	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	5	2	2	7	2	2	2	4	3	2	2	2	2	2	2	2	1	2	2	2
Dissolved Potassium (µg/L)																				
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	0.5	5	5	5	5	5	5	5	5	5	5	2.5	2.5	2.5
Oil and Grease (mg/L)																				
MBAS (mg/L)																				
Chemical Oxygen Demand (mg/L)								40	26	37	33	29	32	64	50	34	23	34	32	37
Bicarbonate Alkalinity (mg/L)																				
Total Alkalinity (mg/L)																				
C6-C9 (µg/L)								25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)								25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)								100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)								25	70	25	80	25	25	25	140	25	25	25	25	25
BOD (lab) (mg/L)								2	1	2	1	1	1	3	2	1	1	1	1	1
C10 - C36 Fraction (sum) (µg/L)									70		80				140			100	100	100
NO2 + NO3 (µg/L)																				
Orthophosphate as P (ug/L)																				
Dissolved Cobalt (ug/L)								0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)								0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)								0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)								0.1	0.2	0.1	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.2	0.2	0.2
Total Uranium (ug/L)								0.5	0.5	0.9	0.25	0.5	0.5	0.25	0.7	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)								10	8	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5
Total Vanadium (ug/L)								40	30	70	30	50	50	90	60	20	20	50	20	30

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Data Source	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	27/12/2010	28/12/2010	29/12/2010
Aluminium (µg/L)	2000	3900	6500
Ammonia as N (µg/L)	50	20	20
Antimony (µg/L)			
Arsenic (µg/L)	2.5	2.5	1
Barium (µg/L)			
Beryllium (µg/L)			
Boron (µg/L)	30	30	25
Cadmium (µg/L)	0.25	0.25	0.25
Calcium (µg/L)			
Chloride (µg/L)			
Chromium (µg/L)	9	14	18
Copper (µg/L)	6	11	13
Cyanide (µg/L)			
Fluoride (µg/L)	50	50	50
Iron (µg/L)	2900	5300	19000
Lead (µg/L)	2.5	6	8
Magnesium (µg/L)			
Manganese (µg/L)	160	330	300
Mercury (µg/L)	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	5
Nickel (µg/L)	8	15	18
Nitrate as NO3 (µg/L)	5	5	5
Nitrite as NO2- (µg/L)			
Oxygen (µg/L)			
pH (units)	8.1	8.2	7.9
Potassium (µg/L)			
Selenium (µg/L)	7	2.5	1
Sodium (µg/L)			
Sulfate (mg/L)	1	1	1
Zinc (µg/L)	15	24	95
Ammonium (NH4+) (µg/L)			
Chlorophyll α (µg/L)			
Dissolved Oxygen (µg/L)			
Filterable Reactive Phosphate (FRP) (µg/L)			
NOx (µg/L)			
Electrical Conductivity (µS/cm)	140	120	190
Total Nitrogen as N (µg/L)			
Total Phosphorus as P (µg/L)			
Total Dissolved Solids (mg/L)	92	83	73
Total Solids (mg/L)			
Total Suspended Solids (mg/L)	380	370	490

URS

Data Source	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	27/12/2010	28/12/2010	29/12/2010
Turbidity (NTU)	300	540	300
Cobalt (µg/L)	2.5	7	7
Dissolved Aluminium (µg/L)	70	3900	420
Dissolved Antimony (µg/L)			
Dissolved Arsenic (µg/L)	0.5	0.5	1
Dissolved Beryllium (µg/L)			
Dissolved Boron (µg/L)	40	30	30
Dissolved Cadmium (µg/L)	0.05	0.05	0.05
Dissolved Calcium (µg/L)			
Dissolved Chromium (µg/L)	0.5	0.5	0.5
Dissolved Copper (µg/L)	4	2	3
Dissolved Iron (µg/L)	2900	5300	260
Dissolved Lead (µg/L)	0.5	0.5	0.5
Dissolved Magnesium (µg/L)			
Dissolved Manganese (µg/L)	3	0.5	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	1	2
Dissolved Potassium (µg/L)			
Dissolved Selenium (µg/L)	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5
Oil and Grease (mg/L)			
MBAS (mg/L)			
Chemical Oxygen Demand (mg/L)	35	40	21
Bicarbonate Alkalinity (mg/L)			
Total Alkalinity (mg/L)			
C6-C9 (µg/L)	25	25	25
C10-C14 (µg/L)	25	25	25
C15-C28 (µg/L)	100	100	100
C29-C36 (µg/L)	60	25	60
BOD (lab) (mg/L)	1	1	1
C10 - C36 Fraction (sum) (µg/L)	60	100	60
NO2 + NO3 (µg/L)			
Orthophosphate as P (ug/L)			
Dissolved Cobalt (ug/L)	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	5
Dissolved Silver (ug/L)	0.05	0.05	
Dissolved Uranium (ug/L)	0.2	0.2	0.2
Total Uranium (ug/L)	0.25	0.5	2.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5
Total Vanadium (ug/L)	20	40	28

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	30/12/2010	31/12/2010	1/01/2011	3/01/2011	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011
Aluminium (µg/L)	3200	3900	3300	3200	4500	7500	2300	46000	12000	8500	16000	19000	6100	9300	23000	5400	6700	100	140	7300
Ammonia as N (µg/L)	20	30	20	80	40	20	10	25	50	30	20	20	5	20	5	5		5	5	5
Antimony (µg/L)																				
Arsenic (µg/L)	1	1	1	5	1	2.5	2.5	2.5	1	1	1200	1	0.5	2	2.5	1	2.5	2.5	2.5	2.5
Barium (µg/L)																				
Beryllium (µg/L)																				
Boron (µg/L)	25	25	25	50	50	50	70	125	25	50	50	25	25	60	70	70	60	50	70	50
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.1	0.1	69	0.1	0.1	0.1	0.25	0.1	0.25	0.25	0.25	0.25
Calcium (µg/L)																				
Chloride (µg/L)																				
Chromium (µg/L)	15	11	10	13	11	48	9	70	11	9	6600	17	8	16	45	9	41	18	0.25	12
Copper (µg/L)	10	8	8	9	7	16	6	41	9	7	5500	12	4	6	19	7	21	11	2.5	11
Cyanide (µg/L)																				
Fluoride (µg/L)	50	50	100	50	400	10	10	10	10	10	10	100	100	50	200	200	100	50	50	100
Iron (µg/L)	15000	4500	7500	4600	11000	28000	6100	59000	16000	12000	23000	22000	9600	9300	34000	6500	7000	90	5700	8200
Lead (µg/L)	7	5	5	2.5	5	6	2.5	27	8	6	24000	13	6	5	2.5	4	7	2.5	2.5	6
Magnesium (µg/L)																				
Manganese (µg/L)	240	190	180	210	180	480	130	1300	260	190	60000	350	160	72	340	89	100	300	120	390
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	5	5	2.5	5	2.5	2.5	2.5	2.5	2.5	210	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	14	11	10	11	10	45	10	78	13	12	8100	17	10	9	37	9	42	19	2.5	16
Nitrate as NO3 (µg/L)	5	5	5	10	10	10	30	10	80	80	10	120	10	590	20	10	20	30	40	100
Nitrite as NO2- (µg/L)						5	5					10	50							
Oxygen (µg/L)																				
pH (units)	8.2	8.1	7.9	7.8	7.5	7.9	8.3	7.8	7.6	7.7	7.6	7.6	7.6	7.4	7.3	7.9	7.9	8.2	8	8.1
Potassium (µg/L)																				
Selenium (µg/L)	1	1	1	6	1	2.5	2.5	2.5	0.5	1	0.5	0.5	0.5	0.5	2.5	0.5	0.5	2	1	2.5
Sodium (µg/L)																				
Sulfate (mg/L)	1	1	1	1	1	2.5	5	2.5	2.5	11	2.5	1	1	1	2.1	3	1	1	1	1
Zinc (µg/L)	29	35	61	22	24	37	20	89	23	18	20000	37	35	14	29	14	37	19	2.5	23
Ammonium (NH4+) (µg/L)																				
Chlorophyll α (µg/L)																				
Dissolved Oxygen (µg/L)																				
Filterable Reactive Phosphate (FRP) (µg/L)																				
NOx (µg/L)																				
Electrical Conductivity (µS/cm)	140	110	150	190	190	180	330	150	160	380	140	170	180	170	210	510	270	170	260	250
Total Nitrogen as N (µg/L)																				
Total Phosphorus as P (µg/L)																				
Total Dissolved Solids (mg/L)	100	110	110	200	170	200	200	280	48	190	190	120	210	380	380	310	270	160	190	170
Total Solids (mg/L)																				
Total Suspended Solids (mg/L)	320	220	290	270	210	430	120	1800	330	260	610	430	340	250	1000	380	1300	530	280	400

Upper Isaac River

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac	Upper Isaac
Sample Date	30/12/2010	31/12/2010	1/01/2011	3/01/2011	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011
Turbidity (NTU)	320	120	190	400	410	230	170	2400	600	450	690	210	180	770	1800	600	900	180	340	180
Cobalt (µg/L)	6	4	4	2.5	4	14	2.5	36	6	4	1700	7	4	3	15	3	3	3	3	8
Dissolved Aluminium (µg/L)	370	280	400	3200	480	290	530	170	160	410	340	1500	380	9300	25	1900	1400	100	70	30
Dissolved Antimony (µg/L)																				
Dissolved Arsenic (µg/L)	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)																				
Dissolved Boron (µg/L)	40	30	40	50	40	40	60	25	25	60	25	25	25	60	50	60	25	50	25	50
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																				
Dissolved Chromium (µg/L)	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	4	1	0.5	2	0.5	8	2	2	2	0.5	0.5	1
Dissolved Copper (µg/L)	2	1	2	7	8	2	1	2	2	1	2	2	2	2	2	3	3	3	3	2
Dissolved Iron (µg/L)	240	190	260	4600	350	220	290	150	190	320	320	800	250	3500	25	1100	850	90	90	60
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																				
Dissolved Manganese (µg/L)	3	1	2	0.5	1	2	2	6	2.5	2.5	5	2.5	2.5	10	2.5	5	6	2.5	2.5	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	0.5
Dissolved Nickel (µg/L)	2	1	1	1	2	2	3	1	0.5	2	1	2	2	5	3	3	3	3	2	2
Dissolved Potassium (µg/L)																				
Dissolved Selenium (µg/L)	2.5	2.5	5	2.5	2.5	2.5	2.5	0.5	0.5	1	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	0.5	0.5	0.5	3	0.5	5	2.5	2	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																				
MBAS (mg/L)																				
Chemical Oxygen Demand (mg/L)	34	23	19	27	28	78	100	33	18	30	40	2.5	23	32	31	26	33	27	20	31
Bicarbonate Alkalinity (mg/L)																				
Total Alkalinity (mg/L)																				
C6-C9 (µg/L)	25	25	25	25	25	25	25	10	25	25	10	25	25	25	25	25	25	25	25	10
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	3200	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	50	100	100	50	100	100	100	100	100	5800	100	2800	50
C29-C36 (µg/L)	25	80	70	25	60	25	25	50	25	25	50	25	25	25	70	25	6100	25	25	50
BOD (lab) (mg/L)	1	1	1	2	1	2.5	2.5	2.5	2.5	2.5	2.5	2.8	1	2.5	2.1	1	2.8	1	1	1
C10 - C36 Fraction (sum) (µg/L)	100	80	70	100	60	100	100	50	100	100	50	100	100	100	100	100	15000	100	2800	50
NO2 + NO3 (µg/L)												120	50							
Orthophosphate as P (ug/L)																				
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	5	5	0.25	5	0.25	0.25	2.5	2.5	2.5	75	2.5	2.5	2.5	0.25	2.5	2.5	2.5	2.5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05
Dissolved Uranium (ug/L)	0.2	0.1	0.2	0.05	0.2	0.2	0.3	50	0.1	0.05	0.05	0.2	0.2	0.05	0.05	0.3	0.2	0.2	0.3	0.2
Total Uranium (ug/L)	2.5	2.5	2.5	0.5	2.5	0.25	0.25	50	1	0.6	0.4	0.4	0.5	0.25	0.5	0.7	0.6	0.25	0.25	0.5
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	9	2.5	6	6	2.5	2.5	2.5
Total Vanadium (ug/L)	24	19	18	40	19	40	20	89	21	18	10000	29	16	17	30	15	16	25	15	40

Data Source	BMA	BMA
Site ID	Upper Isaac	Upper Isaac
Sample Date	3/04/2011	4/04/2011
Aluminium (µg/L)	3200	5700
Ammonia as N (µg/L)	5	20
Antimony (µg/L)		
Arsenic (µg/L)	2.5	2.5
Barium (µg/L)		
Beryllium (µg/L)		
Boron (µg/L)	50	50
Cadmium (µg/L)	0.25	0.25
Calcium (µg/L)		
Chloride (µg/L)		
Chromium (µg/L)	7	13
Copper (µg/L)	7	9
Cyanide (µg/L)		
Fluoride (µg/L)	100	50
Iron (µg/L)	3600	6500
Lead (µg/L)	2.5	2.5
Magnesium (µg/L)		
Manganese (µg/L)	190	210
Mercury (µg/L)	0.05	0.05
Molybdenum (µg/L)	2.5	2.5
Nickel (µg/L)	9	11
Nitrate as NO3 (µg/L)	60	170
Nitrite as NO2- (µg/L)		
Oxygen (µg/L)		
pH (units)	7.5	8
Potassium (µg/L)		
Selenium (µg/L)	2.5	2.5
Sodium (µg/L)		
Sulfate (mg/L)	1	1
Zinc (µg/L)	14	18
Ammonium (NH4+) (µg/L)		
Chlorophyll α (µg/L)		
Dissolved Oxygen (µg/L)		
Filterable Reactive Phosphate (FRP) (µg/L)		
NOx (µg/L)		
Electrical Conductivity (µS/cm)	260	260
Total Nitrogen as N (µg/L)		
Total Phosphorus as P (µg/L)		
Total Dissolved Solids (mg/L)	210	230
Total Solids (mg/L)		
Total Suspended Solids (mg/L)	270	200

Data Source	BMA	BMA
Site ID	Upper Isaac	Upper Isaac
Sample Date	3/04/2011	4/04/2011
Turbidity (NTU)	140	450
Cobalt (µg/L)	2.5	2.5
Dissolved Aluminium (µg/L)	140	20
Dissolved Antimony (µg/L)		
Dissolved Arsenic (µg/L)	0.5	0.5
Dissolved Beryllium (µg/L)		
Dissolved Boron (µg/L)	50	50
Dissolved Cadmium (µg/L)	0.05	0.05
Dissolved Calcium (µg/L)		
Dissolved Chromium (µg/L)	0.5	5
Dissolved Copper (µg/L)	3	2
Dissolved Iron (µg/L)	100	25
Dissolved Lead (µg/L)	0.5	0.5
Dissolved Magnesium (µg/L)		
Dissolved Manganese (µg/L)	2	0.5
Dissolved Mercury (µg/L)	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5
Dissolved Nickel (µg/L)	2	1
Dissolved Potassium (µg/L)		
Dissolved Selenium (µg/L)	2.5	2.5
Dissolved Zinc (µg/L)	2.5	6
Oil and Grease (mg/L)		
MBAS (mg/L)		
Chemical Oxygen Demand (mg/L)	26	26
Bicarbonate Alkalinity (mg/L)		
Total Alkalinity (mg/L)		
C6-C9 (µg/L)	10	10
C10-C14 (µg/L)	25	25
C15-C28 (µg/L)	50	50
C29-C36 (µg/L)	50	100
BOD (lab) (mg/L)	1	2.1
C10 - C36 Fraction (sum) (µg/L)	50	100
NO2 + NO3 (µg/L)		
Orthophosphate as P (ug/L)		
Dissolved Cobalt (ug/L)	0.5	0.5
Total Silver (ug/L)	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05
Dissolved Uranium (ug/L)	0.2	0.1
Total Uranium (ug/L)	0.25	0.5
Dissolved Vanadium (ug/L)	2.5	12
Total Vanadium (ug/L)	5	10

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	45.0	11334	8500	3900	15000	100	46000
Ammonia as N (µg/L)	44.0	54.8	20.0	5.0	30.0	5.0	1460.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	45.0	29.0	2.5	2.0	2.5	0.5	1200.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	45	54	50	30	60	25	125
Cadmium (µg/L)	45.0	1.8	0.3	0.3	0.3	0.1	69.0
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	45.0	165.1	15.0	11.0	24.0	0.3	6600.0
Copper (µg/L)	38.0	156.1	11.0	7.0	13.0	2.5	5500.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	45.0	92.4	100.0	50.0	100.0	10.0	400.0
Iron (µg/L)	45	13358	11000	6500	16000	90	59000
Lead (µg/L)	45.0	539.7	6.0	2.5	8.0	2.5	24000.0
Magnesium (µg/L)	1	407	407	407	407	407	407
Manganese (µg/L)	44.0	1678.2	261.0	183.0	358.5	72.0	60000.0
Mercury (µg/L)	45.0	0.1	0.1	0.1	0.1	0.1	0.2
Molybdenum (µg/L)	45.0	7.4	2.5	2.5	2.5	2.5	210.0
Nickel (µg/L)	45	199	15	10	26	3	8100
Nitrate as NO3 (µg/L)	45	45.6	20	10	40	5	590
Nitrite as NO2- (µg/L)	4	17.5	7.5	5	20	5	50
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	45.0	7.8	7.8	7.6	8.0	5.4	9.1
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	45.0	2.6	2.5	1.0	2.5	0.5	8.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	45.0	3090.6	2.0	1.0	4.0	1.0	55000.0
Zinc (µg/L)	45	472	24	18	35	3	20000
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	7.0	306.7	294.0	206.0	395.5	185.0	465.0
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	38	194.7	170	146	210	110	510
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	45	203	200	120	260	18	411
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	45	446	340	250	480	31	1800

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Turbidity (NTU)	45	660	450	300	770	120	2400
Cobalt (µg/L)	45	45	6	3	8	3	1700
Dissolved Aluminium (µg/L)	38.0	1713.8	405.0	162.5	3075.0	20.0	9300.0
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	38.0	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	45.0	43.6	40.0	30.0	50.0	25.0	100.0
Dissolved Cadmium (µg/L)	38	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	45	1.2	0.5	0.5	1.0	0.5	8.0
Dissolved Copper (µg/L)	45	2.9	2.0	2.0	3.0	1.0	8.0
Dissolved Iron (µg/L)	45	787.7	260.0	100.0	800.0	25.0	5300.0
Dissolved Lead (µg/L)	45	0.5	0.5	0.5	0.5	0.5	2.0
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	45	3.0	2.5	1.0	5.0	0.5	12.0
Dissolved Mercury (µg/L)	45	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	45	1.4	0.5	0.5	2.5	0.5	7.0
Dissolved Nickel (µg/L)	45	2.2	2.0	2.0	2.0	0.5	7.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	45	2.0	2.5	1.0	2.5	0.5	5.0
Dissolved Zinc (µg/L)	45	3.3	2.5	2.5	5.0	0.5	6.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	38	34	32	26	35	3	100
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	38	23.0	25	25	25	10	25
C10-C14 (µg/L)	38	108.6	25	25	25	25	3200
C15-C28 (µg/L)	38	314.5	100	100	100	50	5800
C29-C36 (µg/L)	38	201.7	25	25	60	25	6100
BOD (lab) (mg/L)	38	1.6	1	1	2	1.0	3.0
C10 - C36 Fraction (sum) (µg/L)	31	655.5	100	70	100	50	15000
NO2 + NO3 (µg/L)	2	85.0	85	68	103	50	120
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	38	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	38	3.4	0.3	0.3	2.5	0.3	75.0
Dissolved Silver (ug/L)	37	0.8	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	38	1.5	0.2	0.1	0.2	0.1	50.0
Total Uranium (ug/L)	38	2.0	0.5	0.3	0.7	0.3	50.0
Dissolved Vanadium (ug/L)	38	3.7	2.5	2.5	2.5	2.5	12.0
Total Vanadium (ug/L)	38	294.1	26.5	19.0	40.0	5.0	10000.0

Upper Eureka Creek

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010
Aluminium (µg/L)	7780	9220	8280	15000	3900	2860	4100	4290	14000	6100	5500	7700	5500	6300	8500
Ammonia as N (µg/L)	10	10	5	30	10	5	10	10	40	10	10	20	20	10	20
Antimony (µg/L)															
Arsenic (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)															
Beryllium (µg/L)														2.5	
Boron (µg/L)	40	50	40	50	60	70	80	60	25	40	50	40	50	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)															
Chloride (µg/L)															
Chromium (µg/L)	32	36	18	27	9	18	13	13	26	15	11	31	12	19	19
Copper (µg/L)										7	6	11	6	5	8
Cyanide (µg/L)															
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	19100	19000	9010	19800	4420	8110	5530	9740	17000	9410	7190	13600	5280	6570	11400
Lead (µg/L)	7	6	2.5	10	2.5	2.5	2.5	2.5	4	2.5	2.5	5	2.5	2.5	2.5
Magnesium (µg/L)										150					
Manganese (µg/L)	455	393	134	422	66	110	85	56	150		106	278	138	56	100
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	24	24	13	22	9	15	11	11	14	13	10	17	10	11	13
Nitrate as NO3 (µg/L)	70	100	300	250	5	5	5	90	50	30	5	5	10	10	20
Nitrite as NO2- (µg/L)															
Oxygen (µg/L)															
pH (units)	7.5	7.3	7.3	10.7	7.4	7.4	7.4	7.8	6.5	7.1	7.3	7.2	7.4	7.4	7.5
Potassium (µg/L)															
Selenium (µg/L)	2.5	2.5	2.5	6	5	2.5	5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)															
Sulfate (mg/L)	3000	2000	3000	2000	2000	3000	4000	4000	1000	7	4	1	2	3	4
Zinc (µg/L)	22	20	14	20	6	19	16	20	28	15	5	19	10	9	10
Ammonium (NH4+) (µg/L)															
Chlorophyll α (µg/L)															
Dissolved Oxygen (µg/L)															
Filterable Reactive Phosphate (FRP) (µg/L)	100	99	88	70	97	112	131	181	59						
NOx (µg/L)															
Electrical Conductivity (µS/cm)										151	131	103	128	157	150
Total Nitrogen as N (µg/L)															
Total Phosphorus as P (µg/L)															
Total Dissolved Solids (mg/L)	72	363	222	266	52	56	84	263	237	238	265	163	214	266	321
Total Solids (mg/L)															
Total Suspended Solids (mg/L)	658	538	86	490	287	92	85	29	244	183	203	353	60	2.5	172
Turbidity (NTU)	1030	1740	509	1850	213	148	180	192	818	463	377	650	265	158	321
Cobalt (µg/L)	12	12	2.5	14	2.5	2.5	2.5	2.5	5	5	2.5	8	2.5	2.5	2.5

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	14/11/2010	15/11/2010	16/11/2010	18/11/2010	19/11/2010	20/11/2010	21/11/2010	22/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	8/12/2010
Dissolved Aluminium (µg/L)										5800	4300	5800	4600	4600	270
Dissolved Antimony (µg/L)															
Dissolved Arsenic (µg/L)										1	0.5	0.5	0.5	0.5	1
Dissolved Beryllium (µg/L)														2.5	
Dissolved Boron (µg/L)	30	60	30	30	40	40	50	60	25	40	50	30	40	60	50
Dissolved Cadmium (µg/L)										0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)															
Dissolved Chromium (µg/L)	3	2	1	0.5	1	2	2	2	2	6	6	0.5	1	2	0.5
Dissolved Copper (µg/L)	3	4	3	2	2	3	3	3	2	2	2	2	3	2	2
Dissolved Iron (µg/L)	390	280	150	180	220	280	250	260	730	720	580	960	760	550	450
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)															
Dissolved Manganese (µg/L)	4	5	3	0.5	2	3	3	4	6	7	6	6	6	5	5
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	4	3	3	2	3	4	4	4	3	4	4	3	4	4	4
Dissolved Potassium (µg/L)															
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	5	5	5	5	2	5	5	5	5	5	5
Oil and Grease (mg/L)															
MBAS (mg/L)															
Chemical Oxygen Demand (mg/L)										35	31	45	45	39	42
Bicarbonate Alkalinity (mg/L)															
Total Alkalinity (mg/L)															
C6-C9 (µg/L)										25	25	25	25	25	25
C10-C14 (µg/L)										25	25	25	25	25	25
C15-C28 (µg/L)										100	100	100	100	100	100
C29-C36 (µg/L)										25	50	25	25	25	25
BOD (lab) (mg/L)										2	1	3	1	1	2
C10 - C36 Fraction (sum) (µg/L)											50				
NO2 + NO3 (µg/L)															
Orthophosphate as P (ug/L)															
Dissolved Cobalt (ug/L)										0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)										0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)										0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)										0.1	0.1	0.05	0.05	0.05	0.1
Total Uranium (ug/L)										0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)										6	6	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)										20	20	40	20	20	40

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	12/12/2010	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Aluminium (µg/L)	6800	4600	4500	6700	3180	5560	14000	940	470	240	310	1800	600	540	270	3700	850
Ammonia as N (µg/L)	5	5	40	5	20	5	40	50	50	20	30	30	30	40	30	50	100
Antimony (µg/L)																	
Arsenic (µg/L)	15	2.5	2.5	20	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	1	1	1	1	2.5
Barium (µg/L)																	
Beryllium (µg/L)																	
Boron (µg/L)	70	40	50	30	40	50	70	50	40	40	30	60	70	50	25	25	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																	
Chloride (µg/L)																	
Chromium (µg/L)	40	18	2.5	26	8	16	35	7	2.5	2.5	2.5	12	11	7	3	13	9
Copper (µg/L)	23	5	2.5	2.5	5	7	10	2.5	2.5	2.5	2.5	4	4	4	2	5	2.5
Cyanide (µg/L)																	
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	4210	8250	3760	4100	3530	5670	21000	2500	1700	1000	620	5700	5500	5200	1900	7300	2100
Lead (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	1	2	1	3	2.5
Magnesium (µg/L)																	
Manganese (µg/L)	25	99	19	15	51	79	200	73	46	32	17	75	67	77	38	120	81
Mercury (µg/L)	0.1	0.05	0.05	0.05	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5	5	5	5	5	2.5
Nickel (µg/L)	7	11	7	2.5	7	11	20	6	2.5	2.5	2.5	9	10	6	4	9	7
Nitrate as NO3 (µg/L)	110	5	5	10	5	50	140	30	20	5	5	60	130	5	10	5	5
Nitrite as NO2- (µg/L)																	
Oxygen (µg/L)																	
pH (units)	7.6	7.5	7.3	6.9	7.3	7.1	7.8	8	8.2	8.3	8.2	7.8	7.7	7.6	7.8	7.4	7.3
Potassium (µg/L)																	
Selenium (µg/L)	2.5	6	7	2.5	2.5	2.5	2.5	12	8	7	9	1	1	1	1	1	2.5
Sodium (µg/L)																	
Sulfate (mg/L)	3	2	2	1	2	14	7.4	1	2.7	1	1	4.9	13	1	2.2	1	1
Zinc (µg/L)	7	6	2.5	2.5	2.5	10	22	2.5	9	2.5	6	65	33	44	14	79	7
Ammonium (NH4+) (µg/L)																	
Chlorophyll α (µg/L)																	
Dissolved Oxygen (µg/L)																	
Filterable Reactive Phosphate (FRP) (µg/L)																	
NOx (µg/L)																	
Electrical Conductivity (µS/cm)	168	156	172	53	82	261	370	210	230	210	88	300	590	160	250	150	150
Total Nitrogen as N (µg/L)																	
Total Phosphorus as P (µg/L)																	
Total Dissolved Solids (mg/L)	294	238	311	122	209	232	200	160	150	150	99	180	270	140	170	160	150
Total Solids (mg/L)																	
Total Suspended Solids (mg/L)	94	220	42	36	38	60	340	340	200	100	110	150	88	270	48	390	250
Turbidity (NTU)	549	238	138	126	302	173	290	120	83	33	73	330	56	89	37	110	210
Cobalt (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	7	2.5	2.5	2.5	2.5	3	3	3	1	4	2.5

Upper Eureka Creek

URS

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	12/12/2010	13/12/2010	14/12/2010	19/12/2010	20/12/2010	22/12/2010	24/12/2010	25/12/2010	26/12/2010	27/12/2010	28/12/2010	29/12/2010	30/12/2010	31/12/2010	1/01/2011	2/01/2011	3/01/2011
Dissolved Aluminium (µg/L)	4900	4000	420	6500	2650	790	90	90	60	25	230	130	140	110	50	1900	590
Dissolved Antimony (µg/L)																	
Dissolved Arsenic (µg/L)	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	1	1	0.5
Dissolved Beryllium (µg/L)																	
Dissolved Boron (µg/L)	70	50	60	120	100	50	50	50	50	50	30	30	50	50	50	40	40
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																	
Dissolved Chromium (µg/L)	2	2	2	0.5	3	0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2
Dissolved Copper (µg/L)	7	6	5	0.5	3	6	2	3	4	2	1	4	4	2	4	4	2
Dissolved Iron (µg/L)	520	720	810	820	980	220	120	2500	170	130	200	150	160	250	170	1600	2100
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																	
Dissolved Manganese (µg/L)	2	4	5	160	4	0.5	5	5	4	8	2	6	14	2	17	4	3
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	4	5	5	7	3	3	4	3	3	3	2	2	5	3	3	3	3
Dissolved Potassium (µg/L)																	
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	7	6	6	6	2.5	2.5
Dissolved Zinc (µg/L)	5	5	10	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6	2.5
Oil and Grease (mg/L)																	
MBAS (mg/L)																	
Chemical Oxygen Demand (mg/L)	38	54	45	38	44	38	33	38	39	41	42	29	38	43	33	50	42
Bicarbonate Alkalinity (mg/L)																	
Total Alkalinity (mg/L)																	
C6-C9 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
C29-C36 (µg/L)	25	170	60	80	25	25	25	25	60	70	25	90	80	110	90	100	70
BOD (lab) (mg/L)	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3.5	2.1
C10 - C36 Fraction (sum) (µg/L)		170	60	80			100	100	60	70	100	90	80	110	90	100	70
NO2 + NO3 (µg/L)																	
Orthophosphate as P (ug/L)																	
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	5	5	5	5	5	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.5	2.5	2.5	2.5	2.5	0.25
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)	210	30	10	50	20	5	30	20	20	10	10	12	12	10	5	15	10

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Aluminium (µg/L)	3900	2700	1500	1900	6200	11000	6000	1900	2600	9200	6200	7600	7400	180	420	5000	2900	4600
Ammonia as N (µg/L)	30	20	20	50	60	70	30	10	5	5	30	20	20	20	5	20	20	5
Antimony (µg/L)																		
Arsenic (µg/L)	1	2.5	2.5	2.5	1	2	0.5	0.5	0.5	1	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Barium (µg/L)																		
Beryllium (µg/L)																		
Boron (µg/L)	25	40	60	125	25	50	80	70	50	50	90	80	60	80	80	90	50	60
Cadmium (µg/L)	0.25	0.25	0.25	0.5	0.1	0.1	0.3	0.1	0.2	0.1	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)																		
Chloride (µg/L)																		
Chromium (µg/L)	18	30	12	2.5	14	10	15	9	8	13	11	10	19	21	0.25	23	12	15
Copper (µg/L)	6	9	5	2.5	5	8	6	5	0.5	9	6	6	8	11	8	9	7	8
Cyanide (µg/L)																		
Fluoride (µg/L)	50	10	10	10	10	10	10	50	100	100	100	100	50	50	50	50	50	50
Iron (µg/L)	11000	19000	6400	3300	11000	14000	11000	4300	4400	11000	9700	9700	8800	130	8700	8200	4700	7100
Lead (µg/L)	3	2.5	2.5	2.5	3	7	3	0.5	0.5	6	2.5	6	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)																		
Manganese (µg/L)	120	210	71	63	89	200	69	41	34	260	45	56	82	240	67	240	130	86
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	12	18	9	2.5	10	12	10	9	7	11	9	10	15	16	13	17	11	13
Nitrate as NO3 (µg/L)	20	10	70	220	10	10	50	90	130	130	100	470	10	40	10	30	20	50
Nitrite as NO2- (µg/L)		5	5					10	10									
Oxygen (µg/L)																		
pH (units)	7.1	7.7	7.9	7.2	7.2	7.6	7.2	7.3	7.2	7.7	7.2	7.2	7.3	7.7	7.6	7.8	7.6	7.5
Potassium (µg/L)																		
Selenium (µg/L)	1	2.5	2.5	2.5	0.5	1	9	12	1	0.5	2.5	0.5	1	0.5	0.5	2.5	2.5	6
Sodium (µg/L)																		
Sulfate (mg/L)	1	2.5	13	2.5	6.2	2.5	13	7.9	22	1	1	2.3	2.6	1	1	1	1	1
Zinc (µg/L)	14	16	7	3	9	21	11	15	10	21	12	34	13	11	6	11	9	13
Ammonium (NH4+) (µg/L)																		
Chlorophyll α (µg/L)																		
Dissolved Oxygen (µg/L)																		
Filterable Reactive Phosphate (FRP) (µg/L)																		
NOx (µg/L)																		
Electrical Conductivity (µS/cm)	170	120	460	84	170	170	280	400	830	260	240	210	160	180	140	190	180	180
Total Nitrogen as N (µg/L)																		
Total Phosphorus as P (µg/L)																		
Total Dissolved Solids (mg/L)	170	140	250	210	180	110	340	230	470	300	500	500	290	180	120	180	160	330
Total Solids (mg/L)																		
Total Suspended Solids (mg/L)	180	440	84	130	43	280	120	100	130	390	240	320	280	650	480	600	590	66
Turbidity (NTU)	290	210	87	130	240	470	770	140	49	630	810	700	380	240	320	140	170	230
Cobalt (µg/L)	4	7	2.5	2.5	3	5	3	2	1	4	2	3	3	4	3	7	2.5	2.5

Upper Eureka Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka	Upper Eureka
Sample Date	4/01/2011	20/01/2011	21/01/2011	31/01/2011	1/02/2011	2/02/2011	3/02/2011	4/02/2011	5/02/2011	15/03/2011	18/03/2011	20/03/2011	22/03/2011	25/03/2011	26/03/2011	2/04/2011	3/04/2011	4/04/2011
Dissolved Aluminium (µg/L)	510	770	730	250	210	430	320	210	330	2000	25	1100	670	180	240	250	370	480
Dissolved Antimony (µg/L)																		
Dissolved Arsenic (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
Dissolved Beryllium (µg/L)																		
Dissolved Boron (µg/L)	30	30	50	25	25	60	60	60	25	25	80	80	50	60	25	50	50	60
Dissolved Cadmium (µg/L)	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)																		
Dissolved Chromium (µg/L)	0.5	1	0.5	0.5	5	1	1	1	0.5	1	1	1	1	0.5	0.5	2	0.5	7
Dissolved Copper (µg/L)	6	2	1	0.5	2	1	1	5	1	2	1	2	3	3	4	3	4	3
Dissolved Iron (µg/L)	440	460	410	330	250	330	380	280	270	1100	25	530	490	130	230	300	350	510
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)																		
Dissolved Manganese (µg/L)	2	2	5	2.5	2.5	2.5	2.5	7	13	5	3	5	2.5	2.5	2.5	3	3	4
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	3	3	3	1	2	1	3	4	4	2	4	4	4	5	5	5	5	5
Dissolved Potassium (µg/L)																		
Dissolved Selenium (µg/L)	5	2.5	2.5	0.5	0.5	0.5	0.5	11	0.5	0.5	2.5	0.5	0.5	0.5	0.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	2.5	2.5	2.5	1	0.5	0.5	0.5	2	0.5	2	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5
Oil and Grease (mg/L)																		
MBAS (mg/L)																		
Chemical Oxygen Demand (mg/L)	31	130	72	30	30	36	37	23	35	20	29	36	35	32	28	52	53	53
Bicarbonate Alkalinity (mg/L)																		
Total Alkalinity (mg/L)																		
C6-C9 (µg/L)	25	25	25	10	25	130	10	25	25	25	25	25	25	25	25	10	10	10
C10-C14 (µg/L)	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
C15-C28 (µg/L)	100	100	100	50	100	100	50	100	100	100	100	100	100	100	100	50	50	100
C29-C36 (µg/L)	110	25	25	50	150	25	50	70	25	25	80	70	90	25	25	100	100	200
BOD (lab) (mg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5	2.1	1	1	1	1	3.7	1	1	1	1	2.5
C10 - C36 Fraction (sum) (µg/L)	110	100	100	50	100	100	50	100	100	100	100	100	100	100	100	100	100	300
NO2 + NO3 (µg/L)								90	130									
Orthophosphate as P (ug/L)																		
Dissolved Cobalt (ug/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	5	0.25	0.25	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	2.5	2.5	2.5	2.5	0.25	0.25	0.25
Dissolved Silver (ug/L)	0.05	0.05	0.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.05	2.5	2.5	2.5	2.5	0.05	0.05	0.05
Dissolved Uranium (ug/L)	0.05	0.05	0.05	50	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)	2.5	0.25	0.25	50	0.4	0.3	0.2	0.2	0.2	0.7	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	11
Total Vanadium (ug/L)	18	30	10	8	16	20	17	9	8	20	10	17	17	21	17	10	10	10

URS

Data Source	BMA
Site ID	Upper Eureka
Sample Date	11/08/2010
Aluminium (µg/L)	29000
Ammonia as N (µg/L)	60
Antimony (µg/L)	
Arsenic (µg/L)	2.5
Barium (µg/L)	
Beryllium (µg/L)	
Boron (µg/L)	45
Cadmium (µg/L)	0.1
Calcium (µg/L)	
Chloride (µg/L)	
Chromium (µg/L)	26
Copper (µg/L)	
Cyanide (µg/L)	
Fluoride (µg/L)	50
Iron (µg/L)	32900
Lead (µg/L)	8
Magnesium (µg/L)	
Manganese (µg/L)	400
Mercury (µg/L)	
Molybdenum (µg/L)	2.5
Nickel (µg/L)	18
Nitrate as NO3 (µg/L)	350
Nitrite as NO2- (µg/L)	
Oxygen (µg/L)	
pH (units)	8.2
Potassium (µg/L)	
Selenium (µg/L)	2.5
Sodium (µg/L)	
Sulfate (mg/L)	2000
Zinc (µg/L)	33
Ammonium (NH4+) (µg/L)	
Chlorophyll α (µg/L)	
Dissolved Oxygen (µg/L)	
Filterable Reactive Phosphate (FRP) (µg/L)	107
NOx (µg/L)	
Electrical Conductivity (µS/cm)	
Total Nitrogen as N (µg/L)	
Total Phosphorus as P (µg/L)	
Total Dissolved Solids (mg/L)	520
Total Solids (mg/L)	
Total Suspended Solids (mg/L)	1370
Turbidity (NTU)	2140
Cobalt (µg/L)	11

URS

Data Source	BMA
Site ID	Upper Eureka
Sample Date	11/08/2010
Dissolved Aluminium (µg/L)	
Dissolved Antimony (µg/L)	
Dissolved Arsenic (µg/L)	
Dissolved Beryllium (µg/L)	
Dissolved Boron (µg/L)	37
Dissolved Cadmium (µg/L)	
Dissolved Calcium (µg/L)	
Dissolved Chromium (µg/L)	2.5
Dissolved Copper (µg/L)	2.5
Dissolved Iron (µg/L)	1270
Dissolved Lead (µg/L)	2.5
Dissolved Magnesium (µg/L)	
Dissolved Manganese (µg/L)	22
Dissolved Mercury (µg/L)	0.05
Dissolved Molybdenum (µg/L)	2.5
Dissolved Nickel (µg/L)	5
Dissolved Potassium (µg/L)	
Dissolved Selenium (µg/L)	2.5
Dissolved Zinc (µg/L)	9
Oil and Grease (mg/L)	
MBAS (mg/L)	
Chemical Oxygen Demand (mg/L)	
Bicarbonate Alkalinity (mg/L)	
Total Alkalinity (mg/L)	
C6-C9 (µg/L)	
C10-C14 (µg/L)	
C15-C28 (µg/L)	
C29-C36 (µg/L)	
BOD (lab) (mg/L)	
C10 - C36 Fraction (sum) (µg/L)	
NO2 + NO3 (µg/L)	
Orthophosphate as P (ug/L)	
Dissolved Cobalt (ug/L)	
Total Silver (ug/L)	
Dissolved Silver (ug/L)	
Dissolved Uranium (ug/L)	
Total Uranium (ug/L)	
Dissolved Vanadium (ug/L)	
Total Vanadium (ug/L)	

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	51	5378.2	4600	1900	7100	180	29000
Ammonia as N (µg/L)	51	25	20	10	30	5	100
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	51	2.8	2.5	2.0	2.5	0.5	20.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	51	54	50	40	65	25	125
Cadmium (µg/L)	51	0.2	0.3	0.3	0.3	0.1	0.5
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	51	15.3	13	9	19	0.3	40
Copper (µg/L)	41	6.1	6	4	8	0.5	23
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	51	49.2	50	50	50	10	100
Iron (µg/L)	51	8520	7190	4350	11000	130	32900
Lead (µg/L)	51	3.1	2.5	2.5	2.8	0.5	10
Magnesium (µg/L)	1	150	150	150	150	150	150
Manganese (µg/L)	50	123.3	81.5	56	137	15	455
Mercury (µg/L)	50	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	51	2.8	2.5	2.5	2.5	2.5	5.0
Nickel (µg/L)	51	11	11	8	13	2.5	24
Nitrate as NO3 (µg/L)	51	66.2	20	7.5	90	5	470
Nitrite as NO2- (µg/L)	4	7.5	7.5	5	10	5	10
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	51	7.6	7.4	7.3	7.7	6.5	10.7
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	51	3.2	2.5	1	2.5	0.5	12
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	51	513	2.6	1	13	1	4000
Zinc (µg/L)	51	16	12	7	20	2.5	79
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	10	104.4	99.5	90.3	110.8	59	181
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	41	215.7	170	150	240	53	830
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	51	225.4	210	155	268	52	520
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	51	250	183	87	340	2.5	1370
Turbidity (NTU)	51	392.5	238	139	466.5	33	2140
Cobalt (µg/L)	51	3.9	2.5	2.5	4.0	1.0	14.0

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Dissolved Aluminium (µg/L)	41	1393.2	420	210	1900	25	6500
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	41	0.6	0.5	0.5	0.5	0.5	1.0
Dissolved Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	51	48.2	50	30	60	25	120
Dissolved Cadmium (µg/L)	41	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	51	1.5	1.0	0.5	2.0	0.5	7.0
Dissolved Copper (µg/L)	51	2.8	3.0	2.0	4.0	0.5	7.0
Dissolved Iron (µg/L)	51	518.9	350	225	650	25	2500
Dissolved Lead (µg/L)	51	0.5	0.5	0.5	0.5	0.5	2.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	51	7.9	4	2.5	5.5	0.5	160
Dissolved Mercury (µg/L)	51	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	51	1.1	0.5	0.5	2.3	0.5	2.5
Dissolved Nickel (µg/L)	51	3.6	4	3	4	1	7
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	51	2.6	2.5	2.5	2.5	0.5	11
Dissolved Zinc (µg/L)	51	3.6	2.5	2.5	5	0.5	10
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	41	41.1	38	33	44	20	130
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	41	25.7	25	25	25	10	130
C10-C14 (µg/L)	41	25	25	25	25	25	25
C15-C28 (µg/L)	41	95.1	100	100	100	50	100
C29-C36 (µg/L)	41	62.2	50	25	90	25	200
BOD (lab) (mg/L)	41	1.6	1.0	1.0	2.5	1.0	3.7
C10 - C36 Fraction (sum) (µg/L)	33	98.2	100	80	100	50	300
NO2 + NO3 (µg/L)	2	110	110	100	120	90	130
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	41	0.7	0.5	0.5	0.5	0.5	7
Total Silver (ug/L)	41	1.5	0.3	0.3	2.5	0.3	5
Dissolved Silver (ug/L)	40	0.7	0.1	0.1	2.5	0.1	2.5
Dissolved Uranium (ug/L)	41	1.3	0.1	0.1	0.1	0.1	50
Total Uranium (ug/L)	41	1.8	0.3	0.3	0.3	0.2	50
Dissolved Vanadium (ug/L)	41	2.9	2.5	2.5	2.5	2.5	11
Total Vanadium (ug/L)	41	22	17	10	20	5	210

Fisher Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	12/12/2010	20/12/2010
Aluminium (µg/L)	38800	7140	7260	5340	20000	12000	11000	11000	6500	8100	5400	5550
Ammonia as N (µg/L)	20	10	10	5	50	10	5	20	10	5	5	5
Antimony (µg/L)												
Arsenic (µg/L)	7	2.5	2.5	2.5	1	2.5	2.5	2.5	2.5	2.5	13	2.5
Barium (µg/L)												
Beryllium (µg/L)										2.5		
Boron (µg/L)	50	70	90	90	25	60	70	50	60	90	60	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)												
Chloride (µg/L)												
Chromium (µg/L)	36	17	18	19	27	12	8	21	7	14	35	11
Copper (µg/L)						5	2.5	10	2.5	2.5	2.5	7
Cyanide (µg/L)												
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	19900	7760	7430	8040	20000	7850	5710	9020	3610	4510	3530	7190
Lead (µg/L)	6	2.5	23	2.5	6	2.5	2.5	6	2.5	2.5	2.5	2.5
Magnesium (µg/L)						86						
Manganese (µg/L)	194	96	94	132	100		43	106	41	36	32	92
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	19	9	11	13	12	8	7	10	7	8	6	9
Nitrate as NO3 (µg/L)	40	30	10	100	60	10	10	20	10	10	30	30
Nitrite as NO2- (µg/L)												
Oxygen (µg/L)												
pH (units)	9.2	7.2	7.3	7.1	6.8	7.1	7.2	7.2	7.4	7.6	7.7	7.3
Potassium (µg/L)												
Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	6
Sodium (µg/L)												
Sulfate (mg/L)	1000	1000	1000	2000	1000	1	2	1	1	2	1	1
Zinc (µg/L)	14	13	19	16	24	5	2.5	11	5	6	2.5	2.5
Ammonium (NH4+) (µg/L)												
Chlorophyll α (µg/L)												
Dissolved Oxygen (µg/L)												
Filterable Reactive Phosphate (FRP) (µg/L)	53	70	91	103	81							
NOx (µg/L)												
Electrical Conductivity (µS/cm)						92	129	103	143	178	92	60
Total Nitrogen as N (µg/L)												
Total Phosphorus as P (µg/L)												
Total Dissolved Solids (mg/L)	534	40	48	74	298	99	236	244	226	245	188	205
Total Solids (mg/L)												
Total Suspended Solids (mg/L)	54	99	96	61	354	218	70	238	26	10	436	196
Turbidity (NTU)	3060	480	249	310	1200	411	266	646	165	123	482	331
Cobalt (µg/L)	10	5	2.5	6	6	2.5	2.5	2.5	2.5	2.5	2.5	5
Dissolved Aluminium (µg/L)						11000	9100	6300	3900	3600	4200	1590
Dissolved Antimony (µg/L)												
Dissolved Arsenic (µg/L)						0.5	0.5	0.5	0.5	0.5	1	0.5

URS

Fisher Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek	Fisher Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	5/12/2010	12/12/2010	20/12/2010
Dissolved Beryllium (µg/L)										2.5		
Dissolved Boron (µg/L)	40	40	50	60	25	50	60	40	60	80	60	40
Dissolved Cadmium (µg/L)						0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)												
Dissolved Chromium (µg/L)	0.5	2	4	2	1	9	6	0.5	1	2	1	2
Dissolved Copper (µg/L)	2	2	2	2	2	2	2	2	2	6	4	6
Dissolved Iron (µg/L)	310	600	630	350	680	970	880	1130	1270	830	1130	700
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	3	0.5	0.5
Dissolved Magnesium (µg/L)												
Dissolved Manganese (µg/L)	0.5	2	3	2	6	8	6	5	6	4	3	2
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	3	3	3	3	5	4	3	4	4	3	2
Dissolved Potassium (µg/L)												
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	0.5	5	5	5	5	5	5	5
Oil and Grease (mg/L)												
MBAS (mg/L)												
Chemical Oxygen Demand (mg/L)						36	35	47	45	37	48	33
Bicarbonate Alkalinity (mg/L)												
Total Alkalinity (mg/L)												
C6-C9 (µg/L)						25	25	25	25	25	25	25
C10-C14 (µg/L)						25	25	25	25	25	25	25
C15-C28 (µg/L)						100	100	100	100	100	100	100
C29-C36 (µg/L)						70	70	25	25	25	90	25
BOD (lab) (mg/L)						2	1	2	1	1	4	1
C10 - C36 Fraction (sum) (µg/L)						70	70				90	
NO2 + NO3 (µg/L)												
Orthophosphate as P (ug/L)												
Dissolved Cobalt (ug/L)						0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)						0.1	0.05	0.1	0.05	0.05	0.05	0.05
Total Uranium (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)						9	7	2.5	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)						20	10	30	5	20	160	30

ND - No data

ORANGE Parameters discussed in surface water quality assessment

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	12	11508	7680	6263	11250	5340	38800
Ammonia as N (µg/L)	12	12.9	10	5	12.5	5	50
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	12	3.6	2.5	2.5	2.5	1.0	13.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Boron (µg/L)	12	62.9	60	50	75	25	90
Cadmium (µg/L)	12	0.2	0.3	0.3	0.3	0.1	0.3
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	12	18.8	17.5	11.8	22.5	7	36
Copper (µg/L)	7	4.6	2.5	2.5	6.0	2.5	10
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	12	50	50	50	50	50	50
Iron (µg/L)	12	8713	7595	5410	8285	3530	20000
Lead (µg/L)	12	5.1	2.5	2.5	6.0	2.5	23
Magnesium (µg/L)	1	86	86	86	86	86	86
Manganese (µg/L)	11	87.8	94	42	103	32	194
Mercury (µg/L)	12	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	12	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	12	9.9	9	7.8	11.3	6	19
Nitrate as NO3 (µg/L)	12	30	25	10	33	10	100
Nitrite as NO2- (µg/L)	ND	ND	ND	ND	ND	ND	ND
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	12	7.4	7.3	7.2	7.5	6.8	9.2
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	12	2.6	2.5	2.5	2.5	0.5	6.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	12	500.8	2	1	1000	1	2000
Zinc (µg/L)	12	10.0	8.5	4.4	14.5	2.5	24
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	5	79.6	81	70	91	53	103
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	7	113.9	103	92	136	60	178
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	12	203.1	215.5	92.8	244.3	40	534
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	12	154.8	97.5	59.3	223	10	436
Turbidity (NTU)	12	643.6	371	261.8	523	123	3060
Cobalt (µg/L)	12	4.1	2.5	2.5	5.3	2.5	10
Dissolved Aluminium (µg/L)	7	5670	4200	3750	7700	1590	11000
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	7	0.6	0.5	0.5	0.5	0.5	1.0

URS

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Dissolved Beryllium (µg/L)	1	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Boron (µg/L)	12	50.4	50.0	40.0	60.0	25.0	80.0
Dissolved Cadmium (µg/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	12	2.6	2.0	1.0	2.5	0.5	9.0
Dissolved Copper (µg/L)	12	2.8	2.0	2.0	2.5	2.0	6.0
Dissolved Iron (µg/L)	12	790	765	623	1010	310	1270
Dissolved Lead (µg/L)	12	0.8	0.5	0.5	0.5	0.5	3.0
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	12	4.0	3.5	2.0	6.0	0.5	8.0
Dissolved Mercury (µg/L)	12	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	12	0.7	0.5	0.5	0.5	0.5	2.5
Dissolved Nickel (µg/L)	12	3.3	3.0	3.0	4.0	2.0	5.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	12	2.3	2.5	2.5	2.5	0.5	2.5
Dissolved Zinc (µg/L)	12	4.6	5.0	5.0	5.0	0.5	5.0
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	7	40.1	37	35.5	46	33	48
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	7	25	25	25	25	25	25
C10-C14 (µg/L)	7	25	25	25	25	25	25
C15-C28 (µg/L)	7	100	100	100	100	100	100
C29-C36 (µg/L)	7	47	25	25	70	25	90
BOD (lab) (mg/L)	7	1.7	1.0	1.0	2.0	1.0	4.0
C10 - C36 Fraction (sum) (µg/L)	3	76.7	70	70	80	70	90
NO2 + NO3 (µg/L)	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	7	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	7	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Silver (ug/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Uranium (ug/L)	7	0.1	0.1	0.1	0.1	0.1	0.1
Total Uranium (ug/L)	7	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Vanadium (ug/L)	7	4.1	2.5	2.5	4.8	2.5	9.0
Total Vanadium (ug/L)	7	39.3	20	15	30	5	160

Platypus Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	12/12/2010	20/12/2010
Aluminium (µg/L)	11100	5080	5170	4070	8200	7200	12000	8600	6400	3600	5240
Ammonia as N (µg/L)	30	20	10	60	40	10	5	20	10	5	5
Antimony (µg/L)											
Arsenic (µg/L)	10	2.5	2.5	2.5	0.5	2.5	2.5	2.5	10	2.5	2.5
Barium (µg/L)											
Beryllium (µg/L)											
Boron (µg/L)	30	60	70	70	25	40	50	40	40	40	40
Cadmium (µg/L)	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.25
Calcium (µg/L)											
Chloride (µg/L)											
Chromium (µg/L)	44	16	16	23	30	11	13	30	10	13	28
Copper (µg/L)						2.5	2.5	6	2.5	6	5
Cyanide (µg/L)											
Fluoride (µg/L)	50	50	50	50	50	50	50	50	50	50	50
Iron (µg/L)	20000	6560	5940	7340	14000	5240	6010	8370	3890	3400	9710
Lead (µg/L)	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5
Magnesium (µg/L)						47					
Manganese (µg/L)	182	55	41	76	98		38	74	31	24	75
Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1
Molybdenum (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	10	7	6	7	7	2.5	6	8	6	2.5	7
Nitrate as NO3 (µg/L)	120	5	5	430	30	5	5	5	10	5	50
Nitrite as NO2- (µg/L)											
Oxygen (µg/L)											
pH (units)	9.2	7	7.1	7	6.9	7.1	7.2	7.2	7.6	7.6	7.3
Potassium (µg/L)											
Selenium (µg/L)	5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Sodium (µg/L)											
Sulfate (mg/L)	1000	1000	2000	2000	1000	1	1	1	1	1	1
Zinc (µg/L)	14	10	13	16	15	2.5	5	9	5	11	10
Ammonium (NH4+) (µg/L)											
Chlorophyll α (µg/L)											
Dissolved Oxygen (µg/L)											
Filterable Reactive Phosphate (FRP) (µg/L)	55	68	84	87	63						
NOx (µg/L)											
Electrical Conductivity (µS/cm)						65	83	93	106	70	56
Total Nitrogen as N (µg/L)											
Total Phosphorus as P (µg/L)											
Total Dissolved Solids (mg/L)	244	46	48	48	134	134	197	171	190	146	132
Total Solids (mg/L)											
Total Suspended Solids (mg/L)	132	138	133	39	222	116	53	116	38	260	26

Platypus Creek

Data Source	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA	BMA
Site ID	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek	Platypus Creek
Sample Date	18/11/2010	19/11/2010	20/11/2010	21/11/2010	30/11/2010	1/12/2010	2/12/2010	3/12/2010	4/12/2010	12/12/2010	20/12/2010
Turbidity (NTU)	1080	284	218	240	382	291	204	262	141	325	86
Cobalt (µg/L)	5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Aluminium (µg/L)						6800	7200	5900	4200	3300	1900
Dissolved Antimony (µg/L)											
Dissolved Arsenic (µg/L)						0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)											
Dissolved Boron (µg/L)	30	40	40	40	25	30	40	30	40	40	30
Dissolved Cadmium (µg/L)						0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Calcium (µg/L)											
Dissolved Chromium (µg/L)	1	3	2	3	2	10	7	0.5	2	4	3
Dissolved Copper (µg/L)	2	2	2	2	2	2	2	2	3	6	7
Dissolved Iron (µg/L)	760	630	350	320	680	840	800	1390	1050	1120	790
Dissolved Lead (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)											
Dissolved Manganese (µg/L)	1	3	2	2	2.5	8	6	5	6	4	3
Dissolved Mercury (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Molybdenum (µg/L)	0.5	0.5	0.5	0.5	2.5	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Nickel (µg/L)	2	3	2	2	2	3	3	2	3	3	2
Dissolved Potassium (µg/L)											
Dissolved Selenium (µg/L)	2.5	2.5	2.5	2.5	0.5	2.5	2.5	2.5	2.5	2.5	2.5
Dissolved Zinc (µg/L)	5	5	5	5	0.5	5	5	5	5	5	5
Oil and Grease (mg/L)											
MBAS (mg/L)											
Chemical Oxygen Demand (mg/L)						35	38	49	50	43	31
Bicarbonate Alkalinity (mg/L)											
Total Alkalinity (mg/L)											
C6-C9 (µg/L)						25	25	25	25	25	25
C10-C14 (µg/L)						25	25	25	25	25	25
C15-C28 (µg/L)						100	100	100	100	100	100
C29-C36 (µg/L)						80	80	60	25	80	60
BOD (lab) (mg/L)						2	1	3	2	3	1
C10 - C36 Fraction (sum) (µg/L)						80	80	60		80	60
NO2 + NO3 (µg/L)											
Orthophosphate as P (ug/L)											
Dissolved Cobalt (ug/L)						0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Silver (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Uranium (ug/L)						0.05	0.05	0.05	0.05	0.05	0.05
Total Uranium (ug/L)						0.25	0.25	0.25	0.25	0.25	0.25
Dissolved Vanadium (ug/L)						6	6	2.5	2.5	2.5	2.5
Total Vanadium (ug/L)						10	20	20	5	40	20

ND - No data

ORANGE Parameters discussed in surface water quality assessment

Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Aluminium (µg/L)	11	6969	6400	5125	8400	3600	12000
Ammonia as N (µg/L)	11	19.5	10.0	7.5	25.0	5.0	60.0
Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	11	3.7	2.5	2.5	2.5	0.5	10.0
Barium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Beryllium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Boron (µg/L)	11	45.9	40	40	55	25	70
Cadmium (µg/L)	11	0.2	0.3	0.3	0.3	0.1	0.3
Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chloride (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chromium (µg/L)	11	21.3	16.0	13.0	29.0	10.0	44.0
Copper (µg/L)	6	4.1	3.8	2.5	5.8	2.5	6.0
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND	ND
Fluoride (µg/L)	11	50	50	50	50	50	50
Iron (µg/L)	11	8224	6560	5590	9040	3400	20000
Lead (µg/L)	11	2.5	2.5	2.5	2.5	2.0	2.5
Magnesium (µg/L)	1	47	47	47	47	47	47
Manganese (µg/L)	10	69.4	64.5	38.8	75.8	24	182
Mercury (µg/L)	11	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum (µg/L)	11	2.5	2.5	2.5	2.5	2.5	2.5
Nickel (µg/L)	11	6.3	7.0	6.0	7.0	2.5	10
Nitrate as NO3 (µg/L)	11	61	5.0	5.0	40	5.0	430
Nitrite as NO2- (µg/L)	ND	ND	ND	ND	ND	ND	ND
Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
pH (units)	11	7.4	7.2	7.1	7.5	6.9	9.2
Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Selenium (µg/L)	11	2.5	2.5	2.5	2.5	0.5	5.0
Sodium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Sulfate (mg/L)	11	637	1.0	1.0	1000	1.0	2000
Zinc (µg/L)	11	10	10	7.0	13.5	2.5	16
Ammonium (NH4+) (µg/L)	ND	ND	ND	ND	ND	ND	ND
Chlorophyll α (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (µg/L)	ND	ND	ND	ND	ND	ND	ND
Filterable Reactive Phosphate (FRP) (µg/L)	5	71.4	68	63	84	55	87
NOx (µg/L)	ND	ND	ND	ND	ND	ND	ND
Electrical Conductivity (µS/cm)	6	78.8	76.5	66.3	90.5	56	106
Total Nitrogen as N (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus as P (µg/L)	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (mg/L)	11	135	134	90	181	46	244
Total Solids (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (mg/L)	11	116	116	46	136	26	260

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Data Source	Summary Statistics						
Site ID							
Sample Date	Sample number (n)	Average	Median	Q1 - 25th %ile	Q3 - 75th %ile	Minimum	Maximum
Turbidity (NTU)	11	319	262	211	308	86	1080
Cobalt (µg/L)	11	2.8	2.5	2.5	2.5	2.5	5.0
Dissolved Aluminium (µg/L)	6	4883	5050	3525	6575	1900	7200
Dissolved Antimony (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Arsenic (µg/L)	6	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Beryllium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Boron (µg/L)	11	35	40	30	40	25	40
Dissolved Cadmium (µg/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Calcium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Chromium (µg/L)	11	3.4	3.0	2.0	3.5	0.5	10
Dissolved Copper (µg/L)	11	2.9	2	2	2.5	2	7
Dissolved Iron (µg/L)	11	794	790	655	945	320	1390
Dissolved Lead (µg/L)	11	0.5	0.5	0.5	0.5	0.5	0.5
Dissolved Magnesium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Manganese (µg/L)	11	3.9	3.0	2.3	5.5	1.0	8.0
Dissolved Mercury (µg/L)	11	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Molybdenum (µg/L)	11	0.7	0.5	0.5	0.5	0.5	2.5
Dissolved Nickel (µg/L)	11	2.5	2.0	2.0	3.0	2.0	3.0
Dissolved Potassium (µg/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Selenium (µg/L)	11	2.3	2.5	2.5	2.5	0.5	2.5
Dissolved Zinc (µg/L)	11	4.6	5	5	5	1	5
Oil and Grease (mg/L)	ND	ND	ND	ND	ND	ND	ND
MBAS (mg/L)	ND	ND	ND	ND	ND	ND	ND
Chemical Oxygen Demand (mg/L)	6	41	40.5	35.8	47.5	31	50
Bicarbonate Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity (mg/L)	ND	ND	ND	ND	ND	ND	ND
C6-C9 (µg/L)	6	25	25	25	25	25	25
C10-C14 (µg/L)	6	25	25	25	25	25	25
C15-C28 (µg/L)	6	100	100	100	100	100	100
C29-C36 (µg/L)	6	64.2	70	60	80	25	80
BOD (lab) (mg/L)	6	2.0	2.0	1.3	2.8	1.0	3.0
C10 - C36 Fraction (sum) (µg/L)	5	72	80	60	80	60	80
NO2 + NO3 (µg/L)	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P (ug/L)	ND	ND	ND	ND	ND	ND	ND
Dissolved Cobalt (ug/L)	6	0.5	0.5	0.5	0.5	0.5	0.5
Total Silver (ug/L)	6	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Silver (ug/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Dissolved Uranium (ug/L)	6	0.1	0.1	0.1	0.1	0.1	0.1
Total Uranium (ug/L)	6	0.3	0.3	0.3	0.3	0.3	0.3
Dissolved Vanadium (ug/L)	6	3.7	2.5	2.5	5.1	2.5	6.0
Total Vanadium (ug/L)	6	19.2	20	12.5	20	5.0	40

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