M Surface Water

M1 Geomorphology Technical Report

M2 Hydrology Technical Report

M3 Site Water Management System and Water Balance Technical Report

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M4 Surface Water Quality Technical Report

Report

Kevin's Corner Surface Water Quality Technical Report

31 MARCH 2011

Prepared for

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Abbreviations

Abbreviation	Description
AEP	Annual Exceedence Period
ANRA	Australian Natural Resources Atlas
AR&R	Australian Rainfall and Runoff
ARI	Annual Reoccurrence Interval
AS	Australian Standard
AWBM	Australian Water Balance
BOM	Bureau of Metrology
CHPP	Coal Handling and Preparation Plant
DERM	Department of Environment and Resource Management (Qld)
DME	Department of Mines and Energy (Qld, now DERM)
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPP Water	Environmental Protection (Water) Policy 2009
EV	Environmental Values
MIA	Mine Infrastructure Area
Mtpa	Million tonnes per annum
QWQG	Queensland Water Quality Guidelines 2009
ROM	Run of Mine
TLO	Train Load Out
TSF	Tailings Storage Facility
WBM	Water Balance Model
WMS	Water Management Strategy

Executive Summary

The Kevin's Corner Project (MLA 70425) is a proposed 30 Mtpa capacity thermal coal mine located in the Galilee Basin, Central Queensland, approximately 65 km north of the township of Alpha, 110 km south-west of the township of Clermont and approximately 360 km south-west of Mackay. The Project consists of two open cut pits (Central and Northern Open Cut Pit), extending over a total strike length of 6.5 km and three underground longwall operations (Southern, Central and Northern Underground) proposed in three independent mines.

This Surface Water Quality Technical Report provides an assessment of the surface water resources for the proposed Kevin's Corner coal mine in the context of environmental values defined by the *Environmental Protection (Water) Policy 2009 (EPP Water).*

Six watercourses have been defined within or adjacent to the project area which is located in the Belyando/Suttor catchment, a sub-catchment of the Burdekin River. They are Sandy Creek, Little Sandy Creek, Rocky Creek, Middle Creek, Greentree Creek and Well Creek. All other streams located in the project area are tributaries of these watercourses. Sandy Creek is the major watercourse in the project area and flows into the Belyando River.

Environmental values (EVs) for the project area are not specified in Schedule 1 of the EPP Water 2009. As no EVs have been identified by regulatory bodies, EVs for receiving waters in the project area were derived from a desktop analysis of available information on the watercourses within the project area and data on downstream water uses. The local watercourses are ephemeral and represent a slightly to moderately disturbed aquatic habitat; are suitable for visual recreation; have cultural and spiritual values; and support agricultural activities including crop irrigation, stock watering and farm use. Regionally, the Belyando river system also supports secondary contact recreational activities and is used for drinking water from the Burdekin Falls Dam.

Relevant water quality objectives (WQOs) for the study area were identified from Queensland Water Quality Guidelines 2009 (QWQG) to support and protect the identified EVs for the Belyando/Suttor catchment. All streams within or adjacent to the MLA were identified as freshwater streams or stream sections above 150 m in elevation and are classed as 'upland freshwater streams' (ANZECC, 2000). The existing water quality of the watercourses and downstream receiving environment of the Project site was assessed against the WQOs for upland freshwater streams to characterise the baseline water quality conditions. Historic water quality monitoring data at DERM gauging stations and baseline monitoring undertaken as part of this EIS was also used for the assessment. Available data shows that the existing water quality does not meet the WQOs for the majority of water quality parameters. Accordingly, it is recommended that local trigger values are developed in accordance with the procedures described in QWQG 2009 to protect local and regional EVs. Further baseline water quality monitoring is being undertaken to establish a data set for developing site specific water quality trigger values.

The Project has the potential to adversely impact on surface water resources during construction, operation and decommissioning without proper management. During construction activities associated with the construction of mine infrastructure; construction of water management infrastructure; and earth moving activities are the main areas of potential impact. These activities may lead to erosion and sediment mobilisation, altered flow characteristics and contaminant mobilisation. During commissioning, improper disposal of water used in hydrostatic testing has the potential to cause erosion and scouring. During the operational phase of the coal mine, in addition to those during construction activities, potential adverse impacts may arise from water management system infrastructure failures (storages, pipes, embankments) and creek diversions. Impacts may include:

changed flow regimes; discharge of poor quality water; alteration of riparian vegetation; and increased flooding. The decommissioning phase will have similar impacts identified for the construction phase.

Management and mitigation measures are recommended to reduce or eliminate potential impacts identified in this study. They include: implementation of an Erosion and Sediment Control Plan; Stormwater Management Plan; Water Supply Strategy; spill and emergency response procedures; design of infrastructure using appropriate annual reoccurrence interval (ARI); and application of ACARP diversion design guidelines.

A baseline monitoring program and an on-going water quality monitoring program are detailed within this report to assess the impact of the project operations on the receiving environment. Implementation of these monitoring programs will also allow ongoing reviews of the effectiveness of the various management plans and mitigation measures implemented to protect the values of the watercourses in the project area. The baseline monitoring program is in progress and will continue until construction commences. The on-going monitoring program will continue throughout the project life.

Based on the implementation of recommended management and mitigation measures and monitoring programs, the residual risk of the Project having adverse impacts on receiving surface waters is expected to be negligible.

1

Introduction

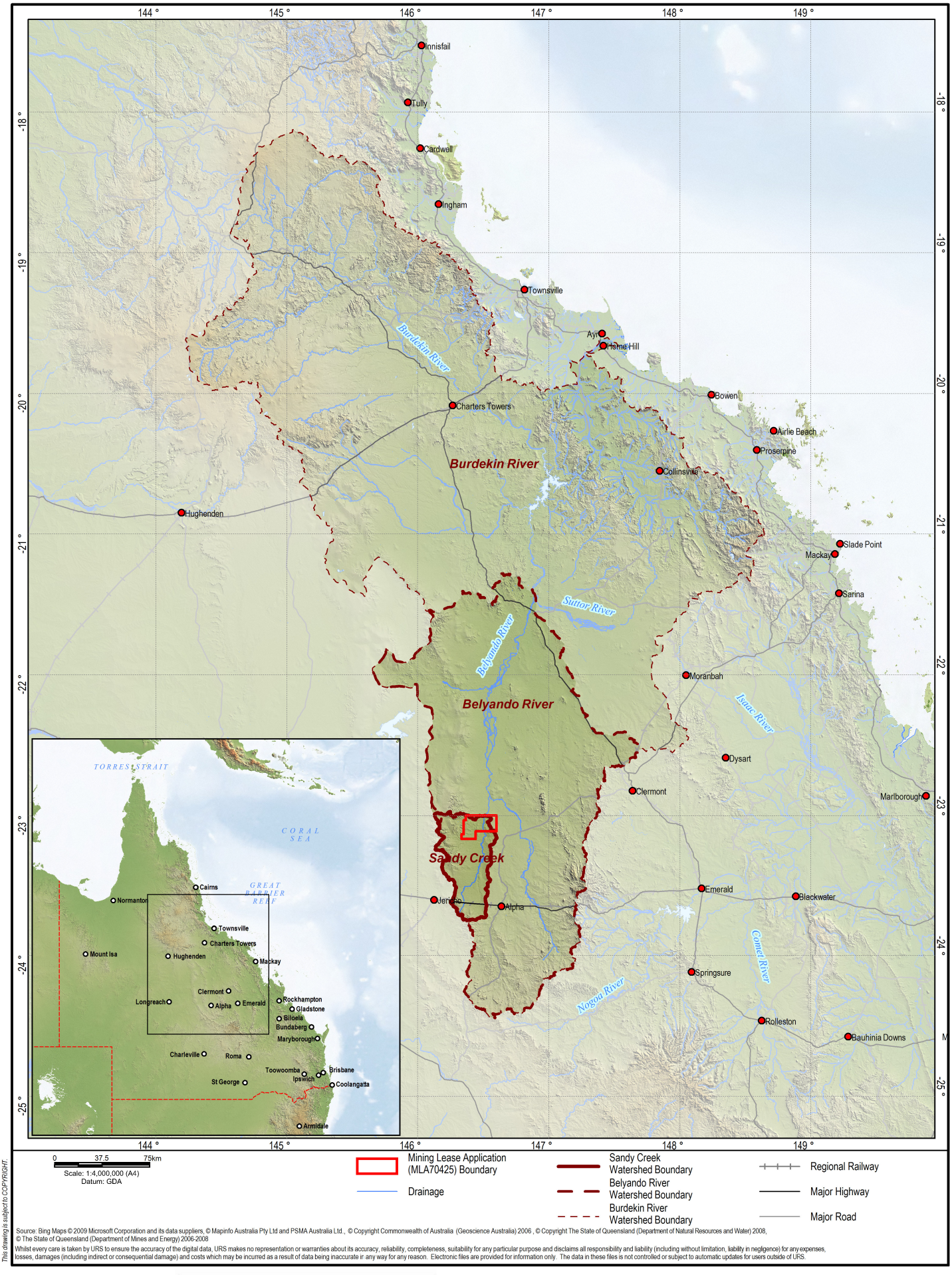
The Kevin's Corner Project (the Project), located in MLA 70425, is a 30 Mtpa capacity thermal coal mine located in the Galilee Basin, Central Queensland, approximately 65 km north of the township of Alpha, 110 km south-west of the township of Clermont and approximately 360 km south-west of Mackay. It is located within the Belyando/Suttor catchment, a subcatchment of the Burdekin River as shown in Figure 1-1.

The Project consists of two open cut pits (Central and Northern Open Cut Pit), extending over a total strike length of 6.5 km which reduces to a steady strike length of 4 km; and three underground longwall operations (Southern, Central and Northern Underground) proposed as three independent mines.

1.1 Methodology

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 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 study area. A description of the baseline hydrological conditions using available data is provided. A water quality assessment using available data for the site was undertaken against relevant water quality objectives (WQO) from the Queensland Water Quality Guidelines 2009 (QWQG).

Potential impacts from the project on the environmental values are identified and details of prevention and mitigation measures to demonstrate appropriate management are provided. A baseline monitoring program and an on-going water quality monitoring program are outlined to derive a set of site specific water quality trigger values and to provide a basis to assess the impact of the project.



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Kevin's Corner Project
Environmental Impact Statement

PROJECT LOCATION

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SURFACE WATER QUALITY TECHNICAL REPORT

Figure: 1-1

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2

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 (EVs) for waters in Queensland and guides the setting of WQOs to protect the environmental values of any water resource.

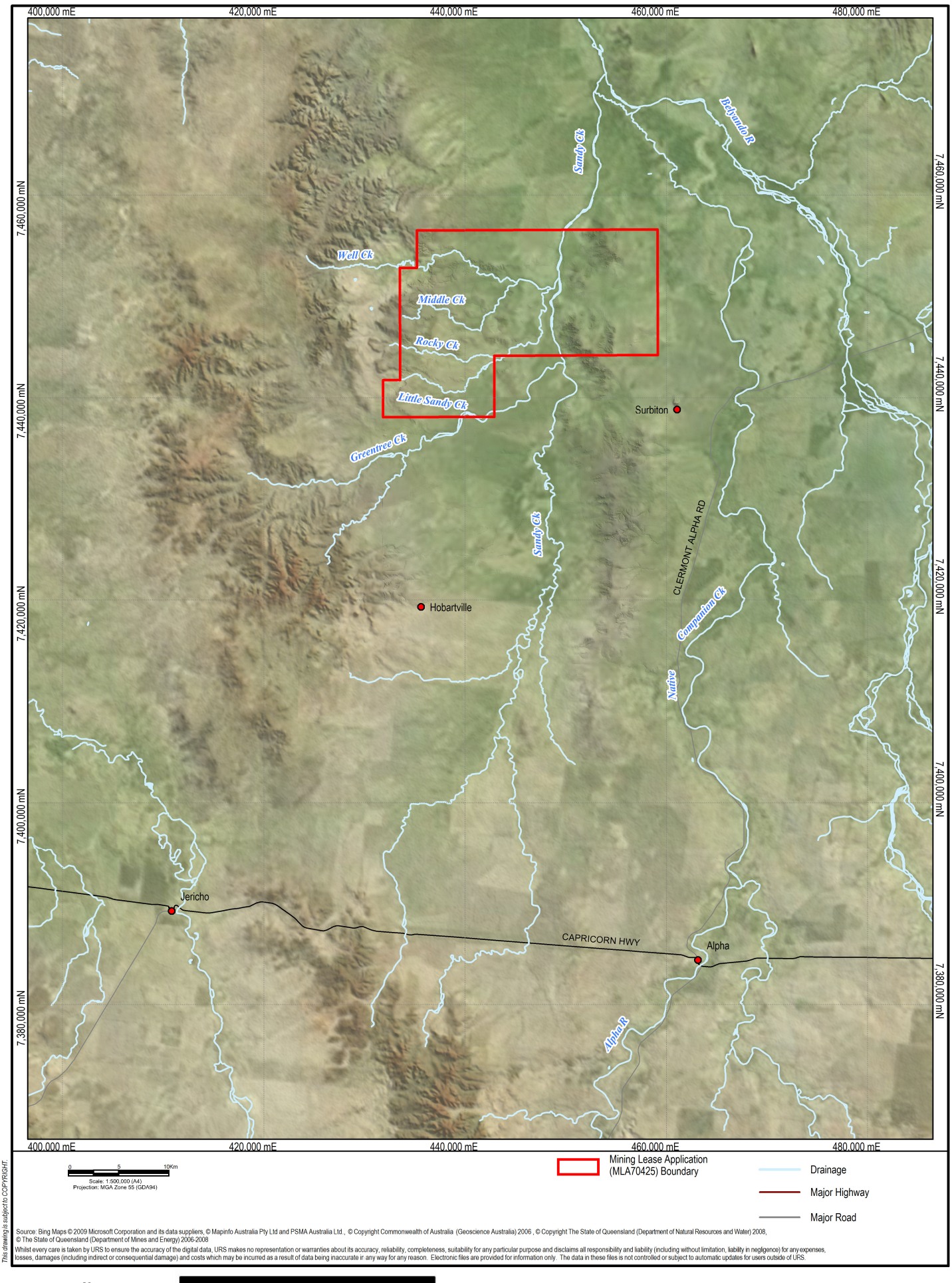
2.2 Existing Environmental Values

Environmental values for the project area have not been specified in Schedule 1 of the EPP Water. As no EVs have been identified by regulatory bodies, environmental values for the project area for the receiving waters were derived from a desktop analysis of available information on the watercourses within the project area and data on downstream water uses.

Six watercourses have been identified within or adjacent to the project area (Figure 2-1). They are Sandy Creek, Little Sandy Creek, Rocky Creek, Middle Creek, Greentree Creek and Well Creek. All other streams located in the project area are tributaries of these watercourses. Sandy Creek is the most major watercourse within the project area and flows into the Belyando River. The Belyando River joins the Suttor River and eventually the Burdekin River at Lake Dalrymple (Burdekin Falls Dam).

All streams within or adjacent to the Project site were identified as upland freshwater streams which are defined as (freshwater) streams or stream sections above 150 m in elevation (ANZECC, 2000).

The EVs that have been identified for the project area are summarised in Table 2-1. It should be noted that EVs are presented on a local scale for the immediate catchment area of MLA 70425 and for a regional scale for the wider catchment area downstream of the site.



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PROJECT LOCATION AND KEY WATERCOURSES

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SURFACE WATER QUALITY TECHNICAL REPORT

Figure: **2-1**

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Table 2-1 Environmental Values for the Receiving Environment

Environmental Values	Local Scale Sandy Creek	Regional Scale Belyando/Suttor River
Aquatic Ecosystem EVs		
Protection of high ecological value aquatic habitat	X	X
Protection of slightly to moderately disturbed aquatic habitat	✓	✓
Protection of highly disturbed aquatic habitat	X	X
Human Use EVs		
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	✓	✓
Protection of cultural and spiritual values	✓	✓
Suitability for industrial use (including manufacturing plants, power generation)	X	X
Suitability for drinking water supply	X	✓
Suitability for crop irrigation	✓	✓
Suitability for stock watering	✓	✓
Suitability for farm use	✓	✓

✓ Denotes that the environmental value is applicable to the watercourse within the study area

x Denotes that the environmental value is not applicable to the watercourse within the study area

2.2.1 Aquatic Ecosystem Environmental Values

The watercourses within the project site are ephemeral in nature and provide seasonal habitat for aquatic fauna and flora. The watercourses are noted to be slightly to moderately disturbed from current grazing and irrigation activities.

2.2.2 Human Use Environmental Values

The surrounding land use in the Belyando/Suttor subcatchment is predominantly grazing with some broad acre cereal cropping. Hence, irrigation and stock watering are the primary uses within the subcatchment. There are areas of conservational value and many of the tributaries are seasonally used as local recreational areas (NQ Dry Tropics).

Belyando River and Sandy Creek have significant cultural and spiritual values for the Wangan/Jangalingou and Bidjara indigenous peoples, as traditional owners of the land.

There are several State Forest areas located south of the project area between Emerald and Alpha which are listed as Protected Areas of Queensland. Additionally, the Cudmore National Park is located outside the Project site to the north-west and the Range National Park is located to the north-east of the Project site, The Cudmore Resource Reserve is located partially within the north-western corner of the Project site.

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Water Supply

3.1 Water Act 2000

The *Water Act 2000* (the Act) provides a basis for the planning and allocation of Queensland water resources. Under the Act the use of water for human activities such as irrigation, stock water, drinking and industry 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 i.e. *environmental flows.* The watercourses affected by the Kevin's Corner mine will be subject to protection under the Act, which will regulate the extraction of water from these watercourses and the division of these watercourses.

3.1.1 Burdekin Basin Water Resource Plan

The *Water Act 2000* allows for the development of *Water Resource Plans* (WRPs) which are, as subordinate legislation, the first level in the water planning process and provide detail on how the social, economic and environmental needs of a catchment may be met through the sustainable management of water. The study area is covered by the *Burdekin Basin Water Resource Plan* which provides regulation for the extraction and use of all water resources in the basin including overland flows and storages as well as groundwater. The Burdekin WRP came into force in 2007.

3.1.2 Burdekin Basin Resource Operations Plan

The *Burdekin Basin Resource Operations Plan* (ROP) came into force in 2009 and details how the objectives of the Burdekin WRP will be met on an operational level. It defines strategies that will ensure the support of 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 Burdekin Haughton Water Supply Scheme and the Bowen Broken Water Supply Scheme operate within the wider Burdekin Basin catchment. There is no major water infrastructure in the Belyando/Suttor subcatchment, however there are a number of private weirs, pumps and off-stream storages licensed for water harvesting, irrigation and stock water. These are summarised in Table 3-1. Licensed irrigators tend to be concentrated in areas with suitable alluvial plains adjacent to the Suttor and Belyando Rivers and their tributaries.

Unallocated water reserves for general purposes (130,000ML) and strategic reserve for state purposes (20,000ML) are in place for the Belyando/Suttor subcatchment.

Table 3-1 Water permit holders within and downstream of Kevin's Corner Project

License Number	Permit Type	Authorised Purpose	Licensee	Watercourse
00933F	Licence to interfere by impounding-Embankment or Wall	Impound Water	KM & WD Appleton	Belyando River
48434F	Licence to take water	Domestic Supply	Southern Excavation Pty Ltd as Trustee	Belyando River
52623F	Licence to take water	Water harvesting	GD & JM Hoch	Belyando River

3 Water Supply

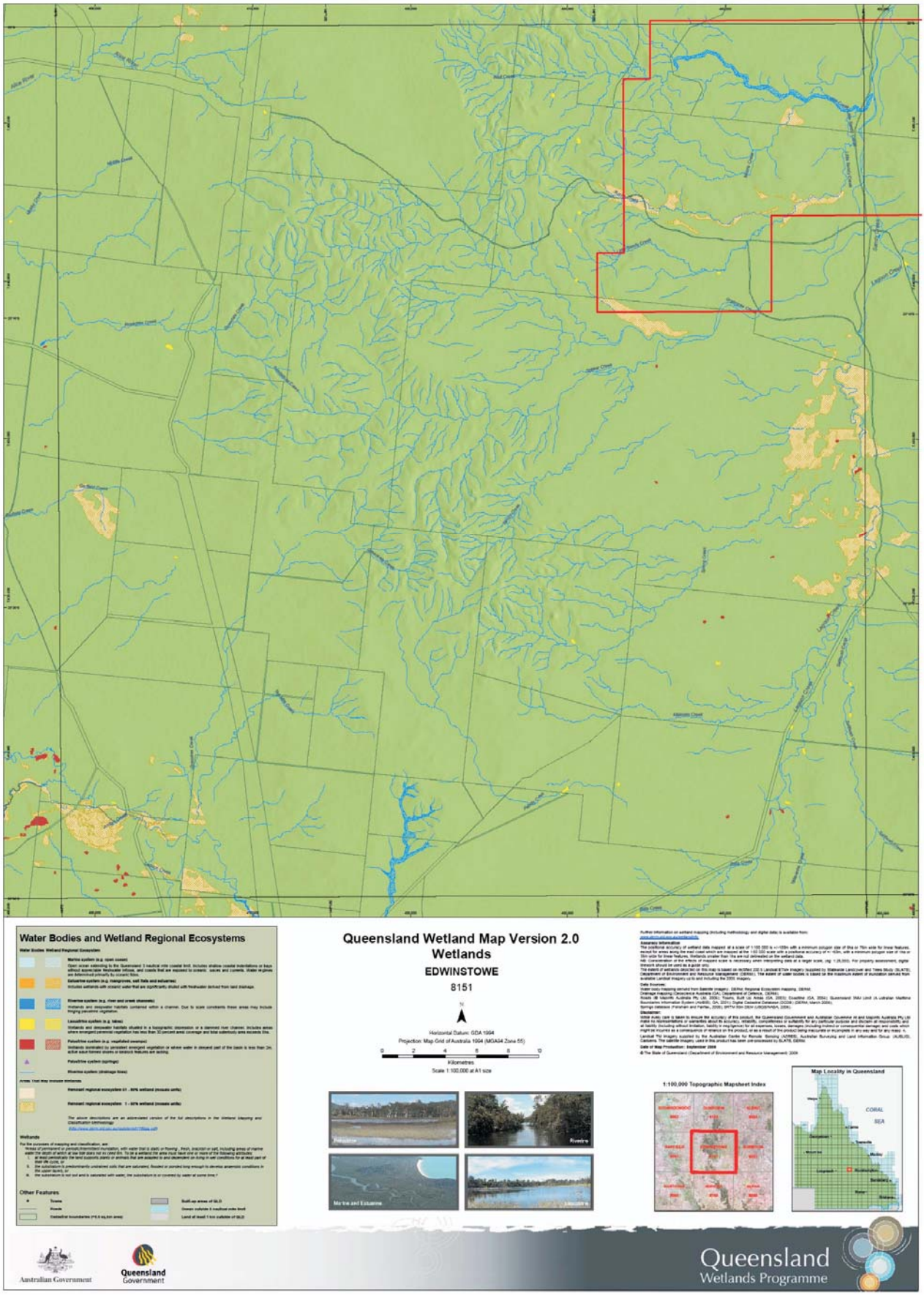
License Number	Permit Type	Authorised Purpose	Licensee	Watercourse
37407F	Licence to interfere by impounding-Embankment or Wall	Impound Water	K Goodwin NK Thompson	Belyando River (Anabranch)
37488F	Licence to interfere by impounding-Embankment or Wall	Impound Water	RH & WTC Rostron	Belyando River (Longreach Channel)
55005A	Licence to take water	Rural	CW & JE Kenny	Belyando River Anabranch
55006A	Licence to interfere by impounding-Embankment or Wall	Impound Water	CW & JE Kenny	Belyando River Anabranch
603215	Permit to Take Water	Construction	Charters Towers Regional Council	Rocky Creek, Burdekin Basin
37295F	Licence to take water	Stock	RH & WTC Rostron	UT Belyando River

Hydrology

4.1 Hydrological Overview of the Study Area

The Project site (MLA 70425) is located within the Belyando/Suttor catchment, a subcatchment of the Burdekin River. Sandy Creek is the main tributary through the site and flows into the Belyando River north of the Project area. The Belyando River joins the Suttor River approximately 150 km north-east of the Project and eventually the Burdekin River at Lake Dalrymple (Burdekin Falls Dam) which is a further 50 km downstream. Several other tributaries flow into Sandy Creek within the mine lease and are shown in Figure 2-1. The Belyando/Suttor catchment produces unreliable stream flow, contributing comparatively less to the overall discharge from the Burdekin Basin than the other subcatchments in the basin (NRM 2002).

The watercourses in the Belyando/Suttor subcatchment provide an important water source for agricultural users and municipal users in the northern reaches. There is one small Lacustrine system (e.g. lakes) in the region of the Project as shown in Figure 4-1. Additionally, remnant regional ecosystems that contain between 1% and 50% wetland are located along Rocky, Little Sandy and Middle creeks (DERM, 2009).



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WETLAND FEATURES WITHIN
KEVIN'S CORNER MINE LEASE
(SOURCE DERM, 2009)

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SURFACE WATER QUALITY TECHNICAL REPORT Figure: **4-1**

File No: **42626660-g-2014.cdr** Drawn: **RG** Approved: **CP** Date: **12-09-2011** Rev.**B** A4

4.2 Climatic Data

4.2.1 Rainfall & Evaporation

Historic climate data was sourced from the from the Bureau of Meteorology SILO Data Drill using 111 years of records (1900 to 2010). The Data Drill is produced by accessing grids of data derived from interpolating the Bureaus records from individual weather recording stations. The interpolations are calculated using splining and Kriging techniques and the resulting Data Drill consists of fully synthetic data. Analysis of the climate data was based on the full length of data available (1889 to 2010). Figure 4-2 shows annual water year totals for the site and Figure 4-3 shows mean monthly rainfall and evaporation.

From Figure 4-2 it can be seen that annual rainfall at the Project 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 Figure 4-3) with monthly rainfall totals greatest in the wet season extending from December through February and peaking in February at 95 mm. Evaporation is always in excess of rainfall and has a similar seasonal distribution peaking in December at 280 mm.

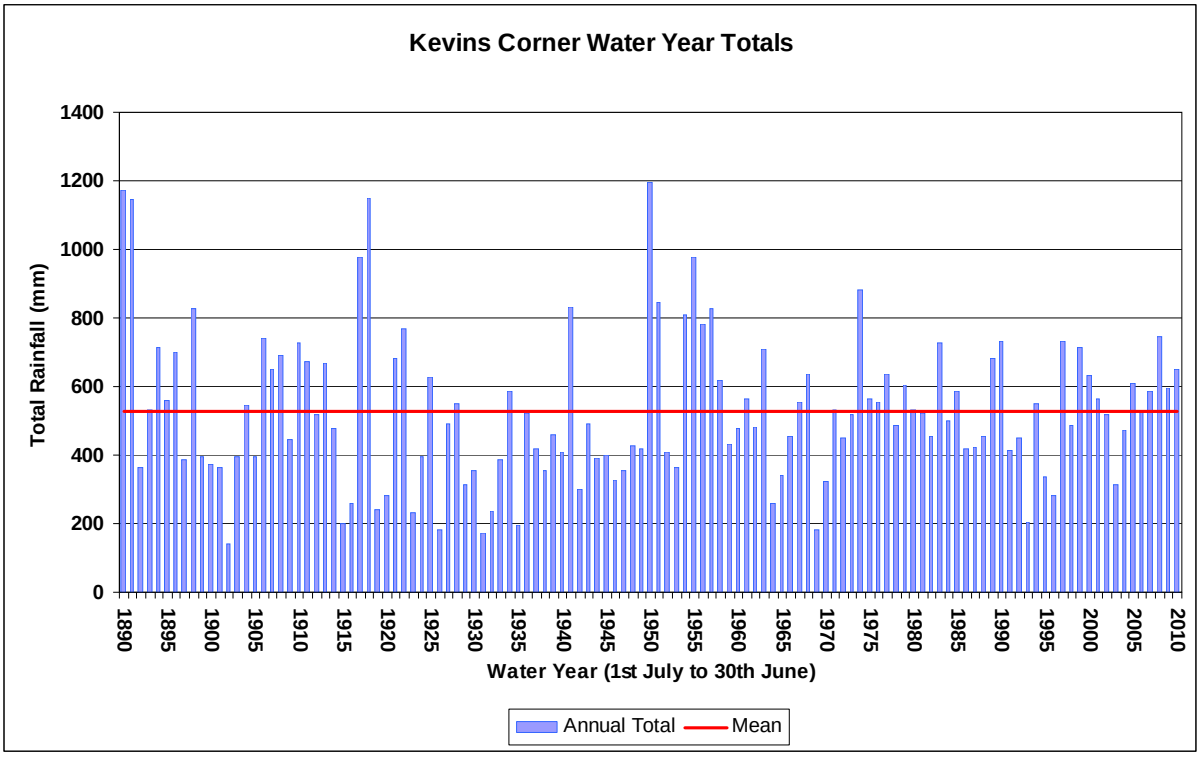


Figure 4-2 Annual Rainfall for Kevin's Corner - SILO Data Drill (1889 to 2010)

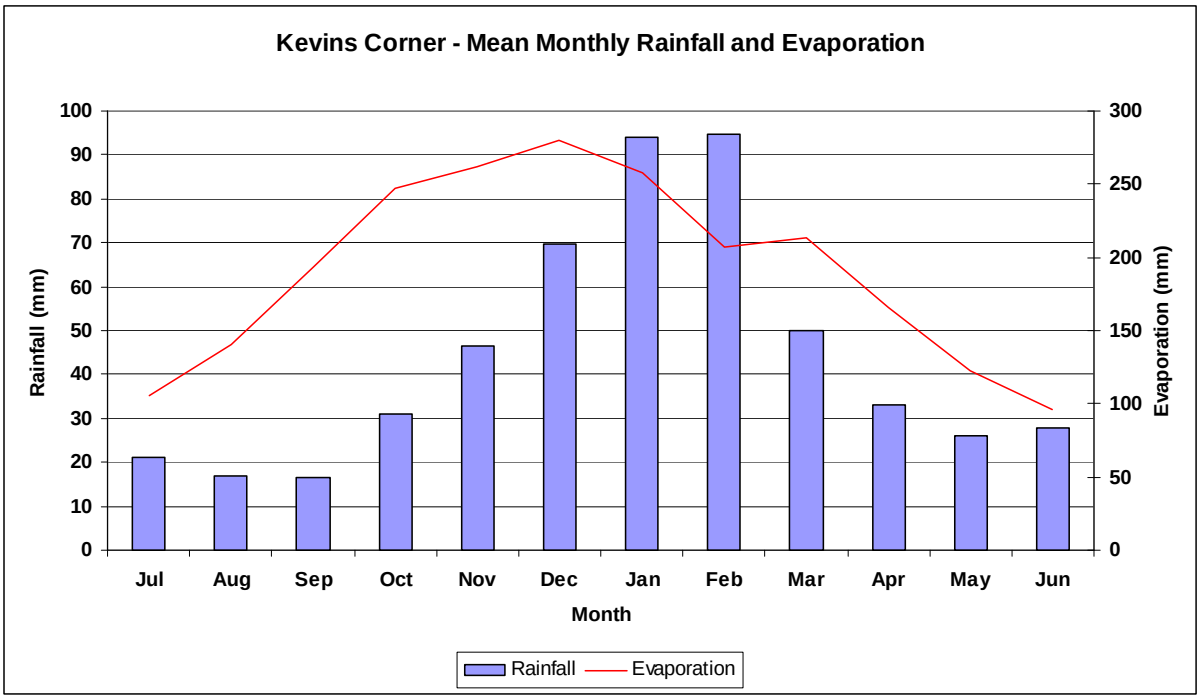


Figure 4-3 Mean Monthly Rainfall and Evaporation for Kevin's Corner (1889 to 2009)

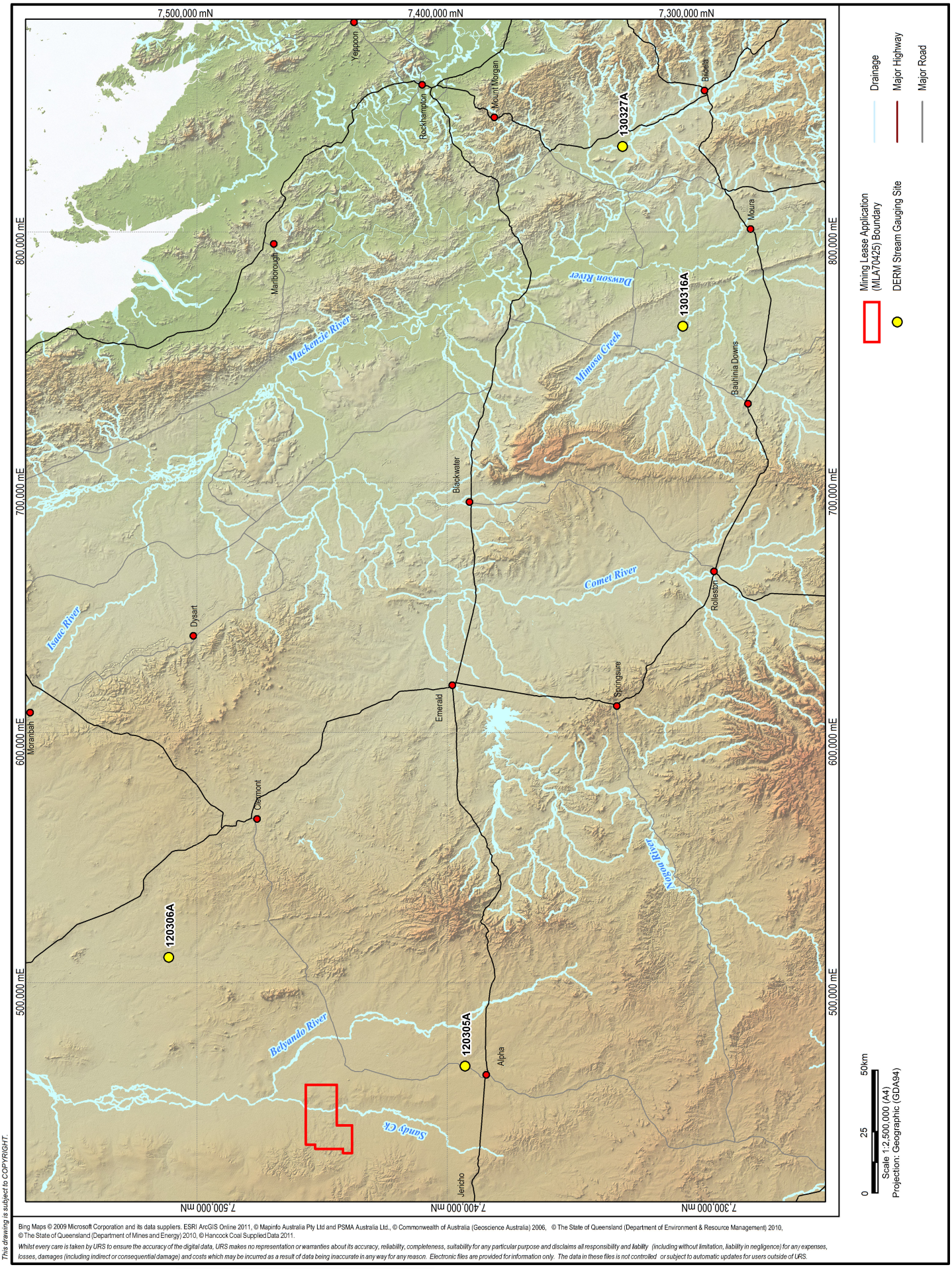
4.2.2 Stream Flows

The Department of Resource Management (DERM) maintains stream flow data for several locations close to the project site; however none are located within the mine lease. Four gauging stations have been identified in the Kevin's Corner Flooding Technical Report as suitable reference sites as shown in Figure 4-4 and summarised in Table 4-1. The selection process was based on an assessment of the quality of the gauge data, reporting catchment area and proximity to the site (Appendix M2 – Kevin's Corner Flooding Technical Report).

River flows in the project 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 4-1 Stream Flow Gauging Stations for Kevin's Corner Baseline Assessment

Gauge Number	Location	Period of Record	Catchment Area (km^2)
120306A	Mistake Creek at Charlton	1968 to 1993	2583
120305A	Native Companion Creek at Violet Grove	1967 to present	4065
1303016A	Mimosa Creek at Redcliffe	1957 to present	2473
1303327a	Callide Creek at Goovigen	1971 to present	4457



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LOCATIONS OF DERM STREAM GAUGING SITES USED FOR HYDROLOGIC STUDY

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SURFACE WATER QUALITY TECHNICAL REPORT

Figure: 4-4

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4.2.3 Existing Creek Characteristics

Topography within the Belyando/Suttor subcatchment differs markedly from other subcatchments in the Burdekin Basin, lacking high mountain backdrops and representing a drier, typically semi-arid western landscape (ANRA 2002). The Belyando River catchment is bounded by the Great Dividing Range in the west with Denham and Drummond Ranges to the east and flows in a northerly direction to join the Suttor River in its lower reaches.

The project area is generally characterised by flat terrain with the highest areas in the west reaching an elevation of approximately 400 m and lower terrain towards the east of the mine lease ranging from 290 m to 350 m. The subcatchments within the project area are comprised almost entirely of open pasture or grazing land with little development.

The main characteristics of the creeks within the lease are summarised in Table 4-2. Channel descriptions and vegetation characteristics are based on watercourse cross-sections and data collected during site visits. All of the streams are ephemeral upland freshwater creeks at elevations above 150 m.

Table 4-2 Key Characteristics of watercourses within Kevin's Corner

Creek	Catchment Area (km^2)	Channel Description	Vegetation	Ecosystem
Sandy Creek	2737.1	Wide shallow channel at the confluence with Lagoon Creek; Changes into a narrow deep channel near confluence with Middle Creek	Little vegetation with wooded overbanks, floodplain covered with dense grass; Sandy Creek bed & banks	Slightly to moderately disturbed
Well Creek	304.7	Deep narrow channel with wide floodplain	Sparse vegetation in upstream reaches; At confluence with Middle Creek more densely wooded overbanks, floodplain covered with thick grass; Sandy Creek bed & banks	
Little Sandy Creek	149.4	Deep narrow channel with wide floodplain; Widens at confluence with Rocky Creek	Sparse tree cover, grass cover over banks and floodplain; Sandy Creek bed & banks	
Middle Creek	53.1	Wide shallow channel and expansive floodplain	Moderate tree cover and grass cover on banks and floodplain; ; Sandy Creek bed & banks	
Rocky Creek	52.72	Deep narrow channel with wide floodplain	Sparse tree cover, grass cover over banks and floodplain; Sandy Creek bed & banks	

Existing Water Quality

5.1 Guidelines

The Australian and New Zealand Environment and Conservation Council Guidelines 2000 (ANZECC 2000) provide guideline values or descriptive statements for environmental values to protect aquatic ecosystems and human uses of waters (e.g. primary recreation, human drinking water, agriculture, stock watering). The ANZECC Guidelines are a broad scale assessment and it is recommended that, where applicable, locally relevant guidelines are adopted.

The Queensland Environmental Protection Authority's (EPA) Queensland Water Quality Guidelines 2009 (QWQG) are intended to address the need identified in the ANZECC Guidelines by:

- Providing guideline values that are specific to Queensland regions and water types.
- Providing a process/framework for deriving and applying local guidelines for waters in Queensland (i.e. more specific guidelines than those in the ANZECC).

Relevant WQOs for the study area were identified from QWQG (2009) to support and protect different environmental values for water in the Belyando/Suttor catchment. All streams within or adjacent to the MLA were identified as 'upland freshwater streams' which are defined as freshwater streams or stream sections above 150m in elevation (ANZECC, 2000). Accordingly, physico-chemical indicators were obtained from the Central Coast Region upland stream values (Table 5-1). Salinity guidelines were obtained from Appendix G of the QWQG. It should be noted that these objectives have been developed at a regional scale.

Table 5-1 Queensland Water Quality Objectives for Central Coast Region Upland Streams (slightly to moderately disturbed systems)

Parameter	Units	Upland Streams	
Ammonia	µg/L	10	
Oxidised Nitrogen	µg/L	15	
Organic Nitrogen[3]	µg/L	225	
Total Nitrogen	µg/L	250	
Filterable Reactive Phosphorus	µg/L	15	
Total Phosphorus	µg/L	30	
Chlorophyll-a	µg/L	n/a	
Dissolved Oxygen[1]	%sat	Lower	Upper
		90	110
Turbidity	NTU	25	
pH[2]	%sat	Lower	Upper
		6.5	7.5
Conductivity	µS/cm	168	
Suspended Solids	mg/L	n/a	
Temperature	°C	Site specific	

Note 1: Note than DO guidelines (%) should only be applied immediately after flow events.

Note 2: During flood events or nil flow periods, pH values should not fall below 5.5 or exceed 9.

Note 3: During periods of low flow and particularly in smaller creeks, build up of organic matter derived from natural sources (e.g. leaf litter) can result in increased organic N levels (400-800 µg/L). This may lead to total N values exceeding the QWQG values. Provided the levels of inorganic N (i.e. Ammonia and oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the guidelines, provided this is due to natural causes.

5.2 Existing Conditions

Based on the findings of the National Land and Water Resources Audit 2000, the Burdekin basin on a whole was reported as having the following water quality characteristics which are also typical of the Belyando/Suttor subcatchment (NRM, 2002):

- Turbidity and nutrients (nitrogen and phosphorus) are 'major issues' as more than 33% of the basin does not meet turbidity or nutrient guidelines for 'good' surface water quality.
- Salinity and pH were found not to be a significant issue with greater than 95% of the basin meeting guidelines for 'good' surface water quality.

5.3 Water Quality Analysis

The existing water quality of the watercourses and downstream receiving environment of the Kevin's Corner project site was assessed to characterise the baseline water quality conditions. The assessment was based on a review of existing water quality monitoring data and monitoring undertaken as part of this EIS against the water quality targets identified in section 2.2.

5.3.1 Methodology

Physico-chemical parameters and heavy metals were assessed against the WQOs using results gathered from baseline monitoring events undertaken by URS and existing DERM gauging stations.

Water Quality Monitoring by URS

Water quality monitoring activities were undertaken by URS between October 2010 and February 2011. Samples were taken where possible at twenty sites during periods of flow within the watercourses following significant rain events. The locations of the monitoring sites are indicated on Figure 5-1 and summarised in Table 5-2.

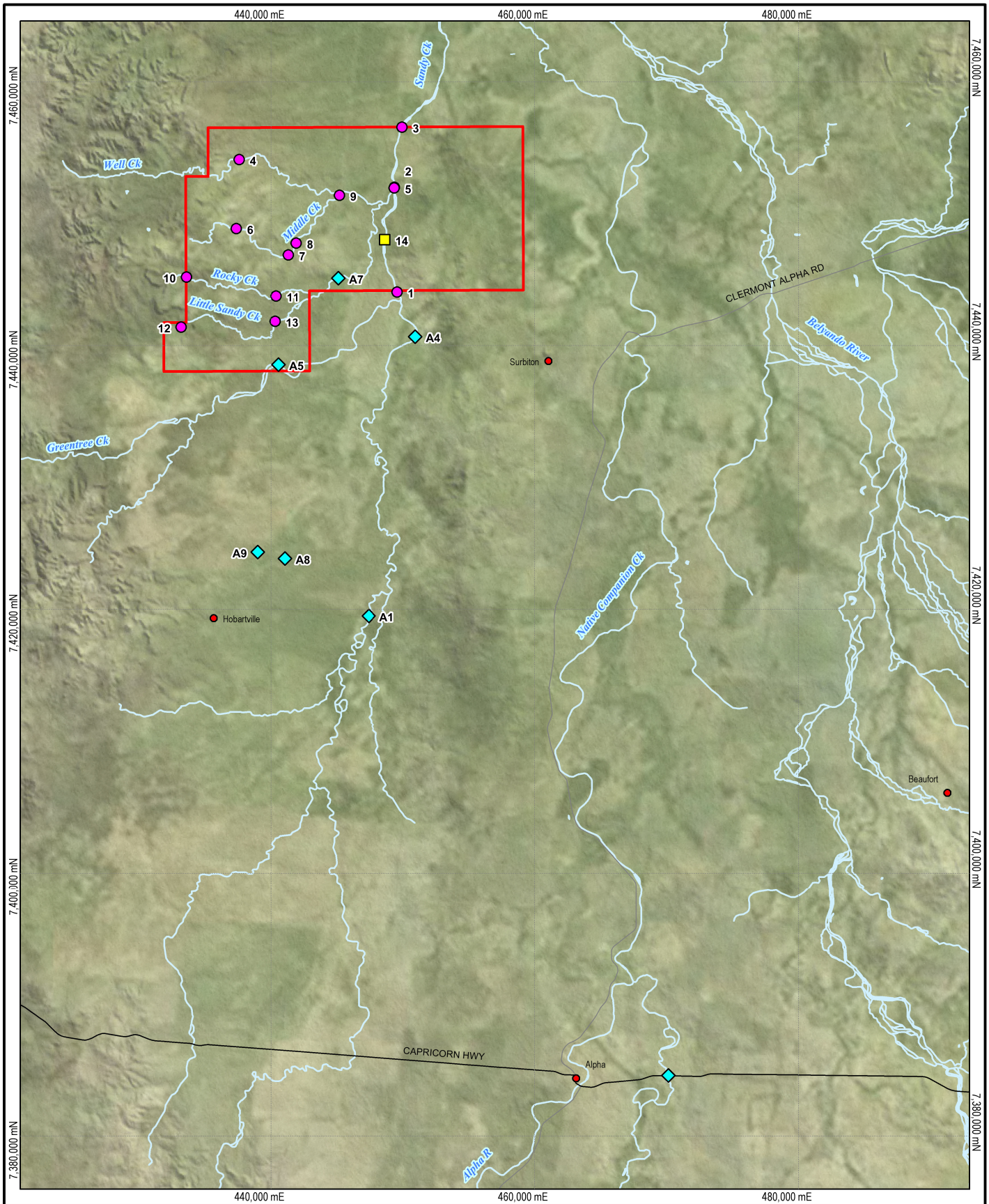
Table 5-2 Monitoring Site IDs and Description

Site ID	Description
1	Lagoon Creek Upstream
2	Lagoon Creek
3	Sandy Creek Downstream
5	Sandy Creek Upstream
6	Middle Creek Upstream
7	Middle Creek
8	Middle Creek
9	Well Creek Downstream
10	Rocky Creek Upstream
11	Rocky Creek Downstream
12	Little Sandy Creek Upstream
13	Little Sandy Creek Downstream
A1	Lagoon Creek Upstream
A4	Lagoon Creek Upstream
A5	Greentree Creek

Site ID	Description
A7	Rocky Creek
A8	Little Sandy Creek Downstream
A9	Spring Creek Upstream
Native	Native Companion Creek at Highway

DERM Gauging Stations

Water quality data was obtained from the DERM WaterShed database for four gauging stations surrounding the project site. The gauging stations are Mistake Creek at Twin Hills (120309A), Mistake Creek at Charlton (120306A), Belyando River at Gregory Development Road (120301B) and Native Companion Creek at the Violet Grove (120305A). These gauging stations are within approximately 100 km of the project site and have similar existing land uses to the project area (Figure 5-2). Data are included from 1967 to 2010.



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Kevin's Corner Project
Environmental Impact Statement

LOCATION OF WATER QUALITY MONITORING SITES

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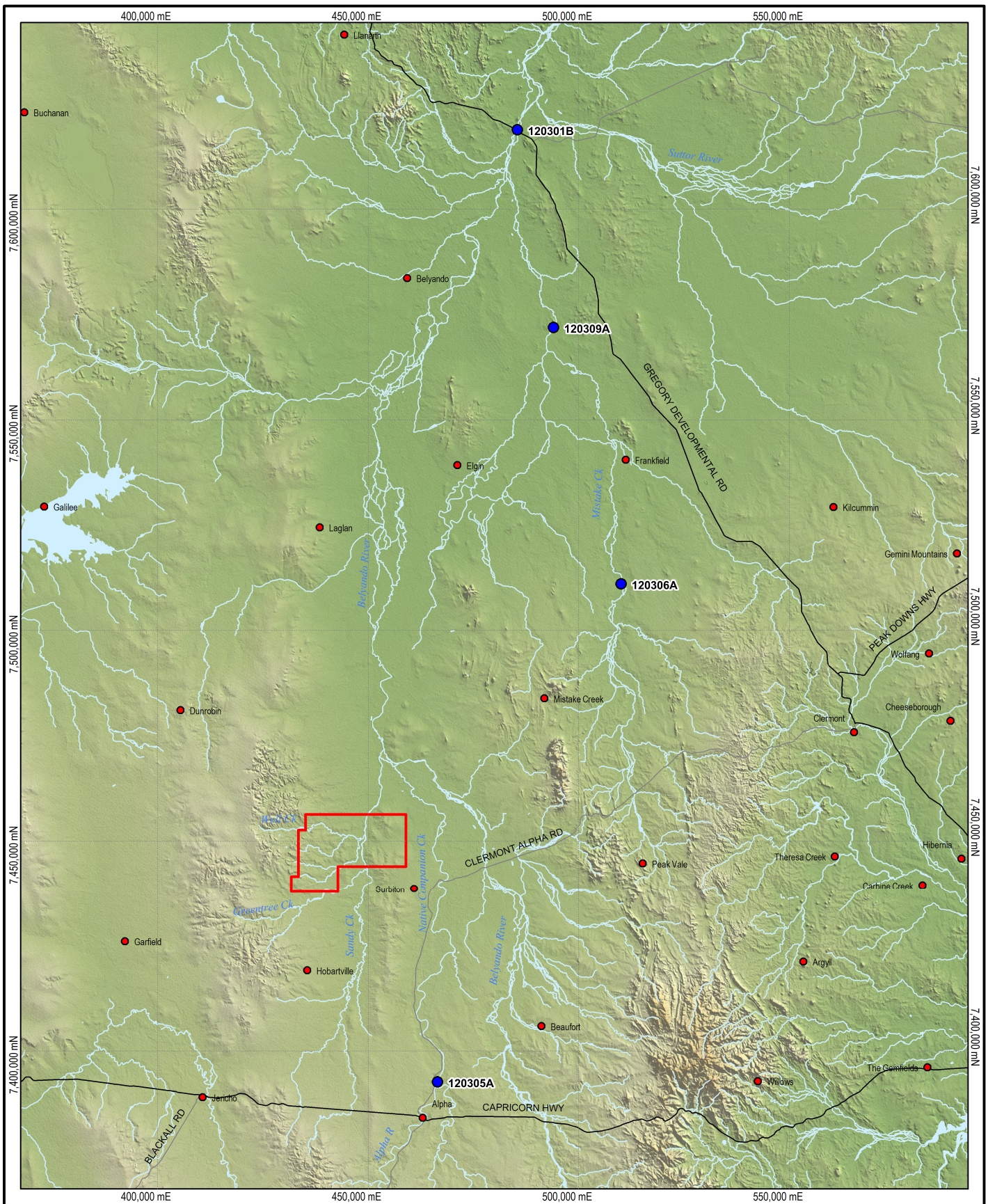
SURFACE WATER QUALITY TECHNICAL REPORT

Figure: 5-1

File No: 42626660-g-2018.wor Drawn: RG Approved: CP Date: 12-09-2011 Rev.B A4



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N W E S

HANCOCK GALILEE PTY LTD

Kevin's Corner Project
Environmental Impact Statement

LOCATIONS OF DERM GAUGING STATIONS

URS

SURFACE WATER QUALITY TECHNICAL REPORT

Figure: 5-2

File No: 42626660-g-2019.wor Drawn: RG Approved: CP Date: 12-09-2011 Rev.B A4

5.3.2 Results

The results from the water quality monitoring undertaken and historic data from the DERM gauges are provided in this section. Table 5-3 comprises the median values for parameters at each of the monitoring locations and DERM gauging stations together with the WQOs for upland freshwater streams in the Central Coast Region. The full data set is provided in Appendix A.

Turbidity

The available water quality data indicates that turbidity values consistently exceed the QWQG (2009) at three of the four gauging stations and all of the monitoring sites, with median values at the sites ranging between 61.9 NTU (Site 11) and 479 NTU (DERM gauge 120301B). Turbidity data was not available for gauge 120306A. Elevated turbidity may be attributable to existing land uses in the catchment including open pasture and grazing which has historically involved widespread clearing and subsequently caused sediment mobilisation in waterways.

Dissolved Oxygen

Median dissolved oxygen (DO) levels were consistently lower than the range stipulated in the QWQG (2009) for all monitoring sites and DERM gauging stations. It should be noted that DO measurements were generally taken up to a week after flow events and may represent lower readings than those observed immediately following a flow event.

pH

The median pH for seventeen of the twenty monitoring sites and all DERM gauging stations were within the WQOs for upland streams in the Central Coast Region. Two of the twenty sites had slightly elevated pH values (Site 12 (7.61) and A9 (8.07)) and one was below the QWQG (2009) (Site 6 (6.21)).

Salinity

The median electrical conductivity (EC) for eighteen of the twenty monitoring sites and all DERM gauging stations meet the QWQG (2009). The guidelines were exceeded at sites 11, 13 and A9 based on the median EC values. Higher EC values are likely to be associated with land degradation, soil erosion and tree clearing from surrounding agricultural activities in the catchment.

Nutrients

Nutrient data was available for the project specific monitoring sites and has not consistently been monitored at DERM gauging stations. Median values for ammonia, total phosphorus, reactive phosphorus and total nitrogen were above the WQOs for upland streams in the Central Coast Region at all monitoring sites. Total phosphorus was also above QWQG (2009) at 120301B, 120305A. The inorganic nitrogen (NH_4) was much lower than total nitrogen at all sites indicating that a significant proportion of the total nitrogen is attributable to organic sources.

Table 5-3 Baseline Water Quality - Median of Sample Results

Sample ID	*Sample size (n)*	Organic N	NH_4 (as N)	Chlorophyll-a	Total P	Reactive P	Total N	Flow	pH	DO	EC	Temp	Turbidity
		mg/L	mg/L	mg/m³	mg/L	mg/L	mg/L	m/s	pH	% Sat	µS/cm	°C	NTU
1	*n = 5*	0.03	0.05	3	0.08	0.01	0.9	0.23	6.92	70.9	152.6	23.2	135.9
2	*n = 5*	0.04	0.04	1.5	0.065	0.02	0.4	0.52	7.22	83.8	133.4	26.0	176.6
3	*n = 6*	0.025	0.02	2	0.03	0.025	0.55	0.51	7.12	77.9	121.9	23.5	142.1
4	*n = 6*	0.04	0.03	1	0.06	0.035	0.45	0.33	7.07	79.1	144.5	25.4	209.0
5	*n = 5*	0.06	0.02	1	0.08	0.03	0.6	0.15	7.23	68.9	106.8	24.2	112.0
6	*n = 4*	0.04	0.03	2.5	0.1	0.02	1.1	0.13	6.21	26.2	112.0	24.7	187.7
7	*n = 3*	0.035	0.02	nd	0.05	0.015	1	0.33	7.09	73.1	84.0	27.8	290.0
8	*n = 5*	0.04	0.03	3	0.15	0.02	0.8	0.40	6.80	74.3	138.0	27.2	227.0
9	*n = 4*	0.055	0.02	1	0.1	0.02	0.7	0.49	7.14	83.2	84.6	25.0	207.8
10	*n = 5*	0.05	0.035	2.5	0.1	0.03	0.6	2.20	7.30	69.7	138.4	25.1	156.9
11	*n = 4*	0.045	0.025	2	0.06	0.01	0.55	0.46	7.49	81.2	176.1	25.4	61.9
12	*n = 3*	0.045	0.03	2	0.11	0.045	0.7	0.29	7.61	84.4	159.8	25.3	155.7
13	*n = 5*	0.295	0.03	1.5	0.125	0.05	0.7	0.16	7.25	57.6	238.0	24.1	120.1
A1	*n = 4*	0.03	0.025	2.5	0.04	0.02	0.95	0.44	7.45	63.5	132.1	25.7	109.5
A4	*n = 4*	0.04	0.03	2	0.085	0.02	1	0.34	7.24	67.1	142.3	26.8	142.1
A5	*n = 5*	0.02	0.04	3	0.065	0.01	0.6	0.23	7.37	77.2	125.8	26.5	100.0
A7	*n = 2*	0.01	nd	2.5	0.2	0.03	0.7	0.58	7.24	79.5	147.9	22.1	282.9
A8	*n = 4*	0.03	0.02	1.5	0.085	0.03	0.75	0.38	7.38	66.8	158.0	25.4	147.0
A9	*n = 2*	0.025	0.025	nd	0.09	0.05	0.75	0.22	8.07	63.3	171.9	31.9	123.0
NATIVE	*n = 3*	0.02	0.05	4	0.2	0.025	0.7	nd	7.19	45.1	160.6	21.7	212
120309A	*1 to 60*	-	-	-	-	-	-	0.087	7.15	5.5	120.5	26.65	162
120306A	*1 to 52*	-	-	-	-	-	-	0.006	-	-	120	26	-
120301B	*3 to 116*	-	-	-	0.1957	-	-	0.546	7.35	6	145	27	479
120305A	*1 to 92*	-	-	-	0.2057	-	-	0.026	7.35	5.75	147.5	25.6	360.5
Water Quality Objectives (QWQG 2009)			0.015	ID	0.03	0.015	0.25	ID	6.5-7.5	90-110	168	site specific	25
ANZECC 2000 Freshwater - 95% protection of species			ID	ID	ID	ID	ID	ID	6.5-7.5	90-110	30-350		2 to 25

nd – not detected; ID – insufficient data to derive guideline

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) were detected at the limit of reporting for three sites (1, 2 and Native) on two separate sampling events. The TPH concentrations recorded are noted to be of low significance given the infrequency of detection and small concentrations present.

Metals

The median metal concentrations were compared against ANZECC trigger values for toxicants at a 95% level of protection for freshwater aquatic species. Dissolved and total aluminium and copper were consistently above the guideline values at all monitoring sites. Dissolved boron and zinc were above trigger values for three of the four DERM gauging sites (120306A, 120301B, 120305A). Dissolved copper was also above guidelines at the Mistake Creek gauge (120306A). Zinc was above trigger values at ten of the twenty monitoring sites and gauging stations 120301B and 120305A. Total chromium exceeded trigger values at sixteen of the twenty monitoring sites but was not consistently monitored at the DERM gauging stations. Median dissolved cadmium concentrations were above trigger values at sites 4 and A4. All other metals were below guidelines at each monitoring site. Elevated metal concentrations may be attributable to existing agricultural activities in the area or may be naturally high.

No other monitoring parameters were elevated above guideline values.

Seasonality

Rainfall averages suggest a distinct wet and dry season, with the majority of rain falling between December and February. However, due to the ephemeral nature of the watercourses in the area, no site specific sampling was possible during the dry season due to the lack of rain and therefore flow in the watercourses. Without a larger data set that represents all seasons no water chemistry conclusions regarding seasonal variation have been made. However, it is noted that any flow within these creeks during the dry season is rare.

5.4 Conclusions

A comparison between available water quality data and the WQOs shows that the baseline data exceeds the objectives for the majority of water quality parameters. Given there is a significant amount of historical water quality data for DERM gauging stations at Mistake Creek at Twin Hills (120309A), Mistake Creek at Charlton (120306A), Belyando River at Gregory Development Road (120301B) and Native Companion Creek at Violet Grove (120305A), it is recommended that local trigger values be developed in accordance with the procedures described in QWQG 2009, using further baseline monitoring data at the twenty monitoring sites. Further details regarding the derivation of site specific guidelines are included in section 7.1 of this technical report.

Impact Assessment & Management Measures

The following section details the major planned activities for the project, through the different stages of construction, commissioning and operation. A qualitative risk assessment was undertaken to explore the potential impacts on surface water resources during each stage of the project. Risk is the chance of an event or activity taking place that will have an impact and it is measured in terms of the potential consequences and the probability that it will occur (AS/NZS ISO 31000:2009).

The detailed risk matrix for the Kevin's Corner Surface Water Activities is provided in Appendix B and the impacts and management and mitigation measures are summarised in the following subsections. Each aspect of construction, commissioning and operation are considered and mitigation measures are identified. The residual risk was assessed to reflect the remaining risk following implementation of the mitigation measures. All mitigation measures discussed are aimed at maintaining or improving water quality within the creek systems.

6.1 Construction Phase

The target commencement date for construction of the Kevin's Corner mine is 2012 and initial coal exports are expected in 2015. The construction workforce is expected to peak at approximately 2500 and decrease down to 1600 with intermittent peaks of 2000 people during operation.

The construction phase will involve the following activities:

- Construction of infrastructure including:
  - Overland conveyors
  - Surface portals
  - Mine administration facilities
  - Workshops
  - Run of mine (ROM) stockpile facilities
  - Coal handling and preparation plant (CHPP)
  - Storage facilities
  - Access and haul roads
  - Rail spur
  - Clean water pipeline from Connors River Dam to be operated by SunWater or an appropriate alternative
  - Accommodation village
  - Light Industrial Area
  - Aerodrome Services
- Construction of mine water management infrastructure such as water pipelines, raw and process water dams, sediment basins and runoff dams, levees, drains and creek diversions.
- Earth moving activities required for the construction phase including:
  - Removal of vegetation
  - Top soil removal and stockpiling
  - Earthworks including cut, fill and compaction
  - Trenching for any underground pipelines

6.1.1 Erosion and sediment mobilisation

Activities

Each of the construction activities highlighted above have the potential to cause mobilisation of sediment and erosion 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 there is the potential for the presence of high levels of metals in soils that may enter watercourses.

These activities were identified as having a high inherent risk based on the qualitative risk assessment as they are likely to occur with moderate effects on biological or physical environment (Appendix A).

Management Measures

Areas of disturbed or exposed soil should be managed to reduce sediment mobilisation and erosion by ensuring:

- Disturbance by heavy earth moving equipment is minimised especially in riparian areas
- The number of passes over water crossings is kept to a minimum
- Topsoil is stripped and stockpiled away from drainage lines to protect it from erosion
- Bunds are constructed to restrict flow velocities across the site
- Vegetation clearing is not carried out during heavy rainfall
- Dust suppression measures are adopted such as water sprays or stockpile covers
- Vehicle washdowns are located away from drainage lines or watercourses
- Construction activities that will affect existing drainage lines and control measures will only be carried out after suitable stormwater management infrastructure has been installed on site as per the construction contractors' Environmental Management Plan (EMP)
- A sediment and erosion control plan is prepared and executed
- Sedimentation dams are constructed to capture potentially impacted turbid water runoff and used preferentially for dust suppression
- Vehicle crossings are adequately designed for a range of flow conditions, including under road drainage
- All crossings will be in accordance with the DERM guideline – Activities in a watercourse, lake or spring carried out by an entity
- Any site dewatering activities will require treatment or appropriate management prior to discharge

Execution of these mitigation measures is expected to reduce the inherent risk from high down to a residual risk level of medium (unlikely to occur with moderate consequences).

6.1.2 Works adjacent to or within drainage lines

Activities

Works adjacent to or within drainage lines are expected to include:

- Construction of site facilities and mine infrastructure including a bridge to support the overland coal conveyor
- Vehicle crossing of watercourses and drainage lines

Potential Impacts

Construction activities at or near drainage features can mobilise sediment and alter flow characteristics. The potential impacts from construction activities can be significant if not effectively managed.

These activities were identified as having a high inherent risk based on the qualitative risk assessment as they are likely to occur with moderate effects on biological or physical environment (Appendix A).

Management Measures

Potential impacts on drainage lines may be mitigated by:

- Diversion of watercourse either by low flow diversion or coffer dam with pumping
- Construction activities that will affect existing drainage channels and control measures must only be carried out after suitable stormwater management infrastructure has been implemented onsite
- Minimal disturbance by heavy earth moving equipment especially in riparian areas
- Groundcovers will be established to rehabilitate areas disturbed by road crossings and slope protection material will be used on road batters
- Mitre drains to be used to divert runoff from road shoulders and table drains into sedimentation dams
- Vehicle crossings should be adequately designed for a range of flow conditions, including under road drainage

Execution of these mitigation measures is expected to reduce the inherent risk from high down to a residual risk level of medium (unlikely to occur would have moderate consequences).

6.1.3 Contaminant mobilisation

Activities

Aqueous waste streams may be produced from the following activities:

- Temporary refuelling facilities
- Temporary chemical storage facilities (including oil and waste oil)
- Temporary vehicle washdown areas
- Construction of permanent fuel and chemical storage facilities

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. Excavation works may also expose groundwater which has high background levels of heavy metals that have the potential to mix with stormwater. These pollutants can both affect the surrounding environment and have the potential to be a public health and safety issue.

Litter and construction wastes have the potential to be washed into watercourses during rain events and impact receiving waters. Waste management is discussed in Section 16 of this EIS. Similarly, a mine sewage treatment plant will be constructed as soon as possible to service the construction contractors' facilities. Further details are provided in Section 16 of this EIS.

These activities were identified as having a high inherent risk based on the qualitative risk assessment as they are likely to occur with moderate effects on biological or physical environment (Appendix A).

Management Measures

Mitigation measures required to reduce these impacts on receiving waters include:

- Temporary and permanent chemical and fuel storage areas to be appropriately bunded in accordance with AS 1940
- All transfers of fuels and chemicals will need to be controlled to prevent spillage outside bunded areas
- Bunds and sumps are frequently drained and treated/disposed of appropriately.
- Contaminants and major spillages will be collected by a licensed waste collection and transport contractor for disposal at an offsite licensed facility.
- Spill cleanup kits in accordance with Australian Standards (AS1940 and AS3780) to be located in appropriate locations, including inside machinery and vehicles
- Refuelling to occur within bunded areas in accordance with AS1940
- In the event of a spill occurring, ensure it is controlled, contained and cleaned up to prevent the mobilisation of pollutants in drainage lines or watercourses
- Site selection of storage and refuelling areas to minimise stormwater inundation and reduce the potential for clean runoff to mix with contaminated water
- Wastewater from washdown areas will be directed through oil and grease separators and effluent directed to construction ponds for reuse.

Implementation of these mitigation measures is expected to reduce the inherent risk from high down to a residual risk level of medium (unlikely to occur with moderate consequences).

6.1.4 Water Supply

Potential Impacts

A lack of water supply may result in inadequate dust suppression, soil compaction and vehicle washdown, resulting in mobilisation of sediment into nearby watercourses impacting on water quality.

These activities were identified as having a high inherent risk based on the qualitative risk assessment as it is possible that it will occur with moderate effects on biological or physical environment (Appendix A).

Mitigation and management strategies

The development, implementation and maintenance of a Water Supply Strategy and Emergency Plan are recommended. Proposed water supplies during construction include water contained in sedimentation dams and groundwater bores. Implementation of sediment and erosion control measures as outlined in section 6.1.1 may also help to reduce water demands.

Implementation of these mitigation measures is expected to reduce the inherent risk from high down to a residual risk level of medium (unlikely to occur with moderate consequences).

6.1.5 Flooding

Potential Impacts

Significant rainfall event during construction may result in out of bank flooding, presenting a risk to workers' health and safety, and can cause erosion and damage to sediment control infrastructure resulting in non compliant off site discharges.

Management strategies

These potential impacts may be mitigated by the following:

- Schedule construction works to minimise exposure to flooding during the wet season (October to April)
- Stormwater management measures such as drainage diversion and flood defence bunds (designed to 1000 year ARI) to be implemented before construction commences
- Emergency response procedures and flood warning system
- Infrastructure should be designed with floor levels above an appropriate AEP flood level
- Monitoring equipment with telemetry system on creeks, dams, discharge points
- Flexible water management system to cater for a variety of conditions and operational needs - including sufficient storage capacity onsite
- Monitoring and maintenance of dams and water management infrastructure (pumps and pipelines)
- Separation of clean and potentially impacted water systems
- Implementation of Standard operating procedures for water management

The application of these mitigation measures will reduce the likelihood of these impacts occurring subsequently reducing the risk from high to medium.

6.2 Commissioning Phase

6.2.1 Hydrostatic Testing

Activities

The integrity of clean water pipelines on site will be verified by undertaking a hydrostatic test to test the strength and integrity of the pipeline using water as a test medium. The testing will occur at different sections of the pipeline at one time based on water availability, elevation changes and weather conditions.

Potential Impacts

The disposal of the water post testing could cause localised erosion and scouring.

These activities were identified as having a medium inherent risk based on the qualitative risk assessment as it is possible that it will occur and would have minor effects on biological or physical environment (Appendix A).

Management Measures

The hydrostatic testing water will be discharged to either an existing storage or newly constructed storage and reused during the remaining construction activities.

Based on this management approach, the likelihood of these impacts is reduced from possible to unlikely, subsequently reducing the residual risk to low.

6.3 Operational Phase

Mining operations at the Kevin's Corner mine will involve the following activities:

- Mine pre-strip activities including vegetation removal, topsoil strip and stockpile, and drill and blast
- Open-cut coal strip mining and overburden removal using dragline and truck-shovel operation
- Underground longwall operations in three independent mine areas
- Progressive rehabilitation of the overburden spoil stockpiles
- Coal handling, preparation (screening and washing) and transportation

6.3.1 Water Management System Failures

Activities

Water management system failures could potentially lead to discharge of potentially turbid water to the receiving environment. 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, drain, bund and/or levee failure (caused by machinery damage, weathering, incorrect placement or during relocation)

Potential Impacts

Failure of the water management system could potentially lead to a non-compliant discharge which has potential environmental impacts for downstream receiving waters, ecosystems and landholders including:

- Physical impact of increasing/changing existing flow regimes in receiving waters
- Discharge of poor water quality of mine water compared to the water quality of the receiving environment
- Alteration of riparian vegetation and aquatic species through changed environmental flows
- Erosion and sedimentation could potentially occur at discharge points

These activities were identified as having a medium inherent risk based on the qualitative risk assessment as it is possible that it will occur and would have minor effects on biological or physical environment (Appendix A).

Management Measures

- Design of water storages using a Water Balance Model 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
- Water storages designed in accordance with DME1995 Technical Guidelines
- Monitoring equipment will be installed to monitor storage volume during operation combined with a water management system to prevent overfilling
- Design and construction supervision of dam embankments undertaken by a Registered Professional Engineer of Queensland (RPEQ)
- Regular dam inspections to be undertaken by RPEQ
- Regular inspections during operation of water storages, tailings dams levels, integrity of embankment and spillways
- Regular pipeline, drain, bund and levee inspections and maintenance will be undertaken during operation

The implementation of these management and mitigation measures is expected to reduce the residual risk down to a low risk.

6.3.2 Erosion and Sediment Mobilisation

Activities

The activities during mine operation that can lead to erosion and sediment mobilisation include:

- Open cut mining operations including topsoil stripping, blasting, overburden removal, handling, stockpiling
- CHPP operations including crushing and stockpiling
- Earthworks including construction of additional haul roads, relocation of access roads, new drainage and levees
- Inadequate erosions protection in drains

Potential Impacts

Erosion and sediment mobilisation can lead to deleterious effects on downstream water quality and aquatic habitats.

These activities were identified as having a medium inherent risk from the qualitative risk assessment as it is possible that it will occur with minor effects on biological or physical environment (Appendix A).

Mitigation and Management Measures

Potential impacts will be mitigated using appropriate design for erosion and scour protection and a comprehensive mine water management plan.

Additionally, swales and buffer strips are proposed to provide stormwater filtration prior to discharge to receiving waters. Swales are open vegetated (generally grass) drains, whilst buffers or filter strips are

grassed surfaces aligned perpendicular to the direction of flow, which ware used to filter particulate matter and associated pollutants from stormwater prior to its entry into adjacent receiving waters. Both swales and buffers provide water treatment utilising the physical filtration of water through the vegetation and depending on the retention time some additional pollutants may be taken up by the vegetation.

Progressive rehabilitation of overburden spoil piles will be undertaken to reduce erosion and sedimentation potential.

Implementation of these mitigation measures are expected to reduce the residual risk down to a low risk (Appendix A).

6.3.3 Creek Diversions

Activities

Sections of Little Sandy Creek and Rocky Creek are proposed to be diverted to allow mining activities and associated mine infrastructure for the project and to maintain existing fluvial processes. The lower sections of Middle Creek will be incorporated into this diversion but will vary minimally from its existing course. The diversion is approximately 6 km long and will be designed in accordance with guidelines developed by the Australian Coal Association Research Program (ACARP) (Bowen Basin River Diversions – Design and Rehabilitation Criteria July 2002). Although the Project site is not located in the Bowen Basin, the guidelines and recommendations are applicable to this Project.

Potential Impacts

Creek diversions have the potential to lead to the following surface water impacts:

- Erosion and sedimentation due to changed channel flow velocities and stream power (measurement of sediment transport capacity). Erosion of the new channel or upstream reaches may be sufficient to alter creek channel form in alluvial sections. Sedimentation can occur downstream of the project, either from quantities of sediment mobilised from the new channel or by changed creek hydraulics as a result of the new channel.
- Flooding impacts may stem from the combined effects of the Little Sandy Creek and Rocky Creek diversions. Flood levels, frequency and the extent of flooding may change in the surrounding stream network and mine area.

These activities were identified as having a high inherent risk based on the qualitative risk assessment as it is possible that it will occur with moderate effects on biological or physical environment (Appendix A).

Management Measures

The Creek diversions will be designed in accordance with the ACARP guidelines which provide upper limits for stream power, stream velocity and shear stress (Table 6-1). Further details are provided in the Flooding Technical Report (Appendix M2 of this EIS).

Table 6-1 Upper limits for Creek Design (ACARP, 2002)

Scenario	Stream Power (W/m²)	Velocity (m/s)	Shear Stress (N/m²)
2 year ARI* (no vegetation)	<35	<1.0	<40
2 year ARI (vegetated)	<60	<1.5	<40
50 year ARI	<220	<2.5	<80

* ARI – Annual Recurrence Interval

The modelling used to evaluate the hydraulics of the proposed diversions provides an assessment of the impacts of on flood levels. The modelling demonstrates that the Rocky and Little Sandy Creek design channels have sufficient capacity to convey up to the 1000 year ARI flood event.

The adoption of these design criteria are expected to reduce the residual risk down to a medium risk (Appendix A).

6.3.4 Flooding

Activities

The establishment of mining infrastructure, mining pits and creek diversions have to potential to cause flooding of project mining areas, flooding of project infrastructure and an increase in regional flooding extents, levels and frequency.

Potential Impacts

Out of bank/flash flood events during the operational phase of the project could result in inundation of the open cut mining pits due to inadequate containment capacity of the designed floodplain. Some pit inflow may occur with the existing creek network and proposed diversion channels above the 1000 year ARI flood event. Water inflow into underground operations (through access points) may also occur during events greater than 1000 year ARI. Surface water infiltration to underground pits is unlikely due to the clay characteristics of the strata and sloping topography above the working areas.

For mine infrastructure, inundation of haul road crossings may occur during events greater than the 1000 year ARI flood. Haul roads would be impassable for a short period of time, however flood depths are likely to subside relatively quickly following cessation of rainfall, so operations should not be significantly impacted.

Management Measures Mitigation and Management Measures

Drainage diversions and levees will be designed for the 1000 year ARI event to prevent flooding during smaller ARI events. Access points for underground operations will be designed above the 1000 year ARI flood levels. Drainage diversions and levees should be regularly inspected and maintained during the operation phase. It is recommended that inspections be carried out on a semi-annual basis and after significant storm events to check for erosion, cracking visible seepage and any other undesirable conditions that might develop. Timely action should be taken to prevent or minimise any actual or potential environmental harm through preventative works.

Emergency response procedures (including evacuation procedures) and a flood warning system should be established and incorporated into the Site Heath, Safety and Environment Plan to protect onsite personnel. Emergency procedures should include strategies for dewatering pits following

events greater than the 1000 year ARI flood. Vulnerable infrastructure should also be designed to a suitable ARI level.

6.3.5 Cumulative Impacts

Several existing coal mines operate in the wider region and a number of new projects are proposed in the area. The projects with a direct geographical relationship to the Project area:

- Alpha Coal Project, Hancock Coal Pty Ltd (HCPL);
- Galilee Basin Transmission Project, Powerlink; and
- Water for Bowen Project, SunWater.

The proposed Alpha Coal mine is directly south (Upstream) of the proposed Project.

Based on the assumption that newly developed projects will implement best practise approaches to stormwater management, the combined impact on the receiving environment is not expected to be amplified in comparison to the impact of the Project as a standalone project.

6.4 Decommissioning Phase

The potential impacts and proposed mitigation measures during the decommissioning phase are largely similar to those identified for the construction phase of the project. Decommissioning activities include:

- Removal of equipment and infrastructure which are of no further economic value, including decontamination works as required
- Rehabilitation (recontouring, topsoil spreading, seeding) of mine voids, water storages, sediment dams which are of no further use. Major surface water diversion works are unlikely to be required post mining.

6.4.1 Sediment mobilisation

Details of the impacts and management measures for sediment mobilisation during decommissioning are highlighted in Section 6.1.1.

6.4.2 Works adjacent to drainage lines

Details of the impacts and management measures for works within drainage lines are outlined in Section 6.1.2.

6.4.3 Contaminant Mobilisation

Details of the impacts and management measures for contaminant mobilisation are outlined in Section 6.1.3.

Monitoring Programs

Two monitoring programs are described in the following section. A baseline monitoring program and an on-going water quality monitoring program are proposed to assess the impact of the project operations on the receiving environment. Both programs are to be undertaken in accordance with the *DERM Monitoring and Sampling Manual 2009* which provides guidance on techniques, methods and standards for sample collection; sample handling; quality assurance and control; and data management.

7.1 Baseline Monitoring Program

The baseline monitoring program has commenced as part of this EIS and is proposed to continue until the mine is operational. As limited site specific background water quality data is available, the monitoring program will be used to establish a data set for developing site specific water quality trigger values (see section 5.4).

7.1.1 Objectives

The objective of the baseline monitoring program is to form a data set for the derivation of site specific water quality guidelines. These guidelines will be used to assess the impacts of mine construction and operation activities on the surrounding environment.

Data collected from reference sites are used to estimate percentile values, which in turn are used to derive guidelines. For slightly to moderately disturbed waters the 20th and 80th percentiles are used. It is recommended that more than 3 reference sites are adopted to ensure that these percentile estimates reflect the true population values.

7.1.2 Reference Sites for Baseline Monitoring and Guideline Derivation

A reference monitoring site is a site considered to be a suitable benchmark for assessment against for similar watercourses. The QWQG stipulate a set of suggested criteria for selection of minimally disturbed reference sites (Table 7-1).

Table 7-1 Reference Site Selection Criteria

Criteria	Freshwaters
1	No intensive agriculture within 20 km upstream. Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category.
2	No major extractive industry (current or historical) within 20 km upstream. This includes mines, quarries and sand/gravel extraction.
3	No major urban area (>5000 population) within 20km upstream. If the urban area is small and the river large this criterion can be relaxed.
4	No significant point source wastewater discharge within 20km upstream. Exception can be made for small discharges into large rivers.
5	Seasonal flow regime not greatly altered. This may be by abstraction or regulation further upstream than 20 km. Includes either an increase or decrease in seasonal flow.

One off-site reference was identified on Native Companion Creek at Violet Grove (E 470,132, N 7,384,603) and meets four of the five criteria. The surrounding land use at the site is comparable to

the project area, being low intensity cattle grazing. Native Companion Creek is also an upland, freshwater, ephemeral stream with an elevation greater than 150 m.

Sixteen sites have been selected as on-site references for the baseline monitoring program. An additional four sites were selected outside the mine lease area (A1, A4, A8 and A9) and may become inaccessible during the sampling program. The twenty sites are situated upstream and downstream of the project area along Lagoon Creek, Sandy Creek, Middle Creek, Well Creek, Rocky Creek, Little Sandy Creek and Spring Creek. The monitoring sites are shown in Figure 5-1 and are tabulated in Table 5-2. All locations meet the criteria for suitable reference sites and are currently undisturbed.

Four DERM gauging sites have also been selected as reference sites to be used in derivation of site specific guidelines. The gauging stations are Mistake Creek at Twin Hills (120309A), Mistake Creek at Charlton (120306A), Belyando River at Gregory Development Road (120301B) and Native Companion Creek at the Violet Grove (120305A). These gauging stations are within approximately 100 km of the project site, have similar existing land uses to the project area and meet the QWQG criteria for reference sites (Figure 5-2). Available data from these sites will be sourced from DERM at the end of the baseline monitoring program.

7.1.3 Parameters for Monitoring

The choice of measurement parameters is based on protection of EVs as identified in section 2.2. The parameters chosen are those that may be influenced by coal mining operations and in turn negatively impact on the EVs. Table 7-2 shows the monitoring parameters to be tested at each baseline monitoring site.

Table 7-2 Parameters for Baseline Monitoring Program

Analyte Group	Parameter	Rationale
Physico-chemical	Alkalinity	Generic parameters for data analysis to indicate general stream condition
	Acidity	
	Electrical Conductivity (field & lab)	
	pH (field & lab)	
	Suspended Solids	
	Turbidity (field)	
	Flow rate	
	Dissolved Oxygen (field)	
	Temperature (field)	
	Oil and Grease	
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	
	Barium	
	Beryllium	
	Boron	
	Cadmium	
	Chromium	
	Cobalt	
	Copper	

Analyte Group	Parameter	Rationale
	Iron	
	Lead	
	Manganese	
	Mercury	
	Nickel	
	Uranium	
	Vanadium	
	Zinc	
BTEX Compounds	Benzene	Indicates hydrocarbon pollution from potential spills
	Toluene	
	Ethylbenzene	
	Xylene	
Total Petroleum Hydrocarbons	C6 to C36	
Nutrients	Ammonia	May vary as a result of contamination from mine activities
	Chlorophyll-a	
	Phosphorus (total)	
	Reactive Phosphorus	
	Total Nitrogen	
	Total Kjeldahl Nitrogen	

7.1.4 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, it is recommended that stream gauging stations with data loggers are used for highly variable parameters including DO, pH and EC. The stream gauging stations can also be used to alert monitoring staff of flow events that may trigger actions and the SHMS flood response, and indicate that a grab sample should be collected.

The proposed monitoring schedule for the baseline program is outlined in Table 7-3 and should be undertaken until construction activities commence.

Table 7-3 Baseline Water Quality Monitoring Schedule

Monitoring Type	Sites	Parameter	Frequency
Event Sampling	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, A1, A4, A5, A7, A7, A8, A9, Native	All parameters indicated in Table 7-2	Fortnightly during and after major rainfall events where flow is sufficient and access is available.

7.2 On-going Monitoring Program

7.2.1 Objectives

An on-going monitoring program will be implemented to measure the impact of mine operations by monitoring watercourses upstream and downstream of the mine site. The data will also allow performance reviews of various management plans and mitigation measures implemented to protect the values of the watercourses in the project area.

7.2.2 Monitoring Locations

The locations for the on-going program are chosen to demonstrate that the quality of water entering the site has had minimal effects due to mining operations and the water leaving the mine site is within all approved quality tolerances. The baseline monitoring sites are proposed to be continued in the on-going program for event based sampling (Figure 5-1 and Table 5-2). These sites represent the key watercourses within the site at locations upstream and downstream of the mine operations. Continuation of the baseline monitoring sites will allow direct comparison of water quality pre-mine and during operations at identical sites. It is noted that some monitoring sites may become inaccessible or inundated as the mine is developed, hence replacement sites with similar characteristics should be established where practicable.

Stream gauging sites are proposed for high risk areas to enable continuous monitoring of highly variable water quality parameters. Stream gauging sites are proposed for upstream and downstream of the lease on Sandy Creek (1 and 3); upstream and downstream of the creek diversions (8 and 13); and upstream and downstream of potential discharge locations on the mine lease (5 and 14). These sites are shown on Figure 5-1.

7.2.3 Parameters for Monitoring

The parameters to be analysed for the on-going monitoring program are identical to the baseline program as outlined in Table 7-2. These water quality parameters are selected based on protecting the EVs of the watercourses and include parameters that may be impacted on by coal mining operations.

7.2.4 Monitoring Schedule

The on-going monitoring program is to be continued as per the baseline program. Sampling events will correspond with rainfall events that generate enough runoff to trigger sampling. Stream gauging stations with probes for pH, EC, DO, TSS, Temperature, Turbidity and Sulphate will be established to log these parameters and alert monitoring staff of flow events when grab samples should be collected.

The proposed monitoring schedule for the ongoing program is outlined in Table 7-3 which should be undertaken during construction activities and throughout mine operation.

Table 7-4 On-going Water Quality Monitoring Schedule

Monitoring Type	Sites	Parameter	Frequency
Stream Gauging Stations	1, 3, 5, 8, 13, 14	pH, EC, DO, TSS, Temperature, Turbidity, Sulphate	Daily when flow is detected
Event Sampling	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, A1, A4, A5, A7, A7, A8, A9, Native	All parameters indicated in Table 7-2	Weekly during and after major rainfall events where flow is sufficient AND At the commencement of any managed release

Summary

This Surface Water Quality Technical Report provides an assessment of the surface water resources in the vicinity of the proposed Project site in the context of environmental values defined by the *Environmental Protection (Water) Policy 2009 (EPP Water).* Six watercourses have been defined within or adjacent to the project area which are Sandy Creek, Little Sandy Creek, Rocky Creek, Middle Creek, Greentree Creek and Well Creek. Sandy Creek is the major watercourse in the project area and flows off the Project area and into the Belyando River 15 km to the North.

No EVs for receiving waters in the project area have been identified by regulatory bodies. Accordingly, EVs were derived from a desktop analysis of available information on the watercourses and data on downstream water uses. The local watercourses represent a slightly to moderately disturbed aquatic habitat; are suitable for visual recreation; have cultural and spiritual values; and support agricultural activities including stock watering and farm use. Regionally, the Belyando river system also supports recreational activities and contributes to raw drinking water supplies at the Burdekin Falls Dam.

Relevant WQOs for the study area were identified from the QWQG for upland freshwater streams. Historic water quality monitoring data at DERM gauging stations and baseline monitoring undertaken as part of this EIS was used to characterise the baseline water quality in comparison with the WQOs. Available data shows that the existing water quality does not meet the WQOs for the majority of water quality parameters. Accordingly, local trigger values should be developed in accordance with the QWQG 2009. Further baseline water quality monitoring should be used to establish a data set for developing site specific water quality trigger values.

The Project has the potential to adversely impact on surface water resources during construction, operation and decommissioning without proper management. During construction activities associated with the construction of mine infrastructure; construction of water management infrastructure; and earth moving activities are the main areas of potential impact. These activities may lead to erosion and sediment mobilisation, altered flow characteristics and contaminant mobilisation. During commissioning, improper disposal of water used in hydrostatic testing of the water pipeline systems has the potential to cause erosion and scouring. During the operational phase of the coal mine, in addition to those during construction activities, potential adverse impacts may arise from water management system infrastructure failures (storages, pipes, embankments and creek diversions). Impacts may include: changed flow regimes; discharge of poor quality water; alteration of riparian vegetation; and increased flooding. During the decommissioning phase will have similar impacts identified for the construction phase.

Management and mitigation measures are recommended to reduce or eliminate potential impacts identified in this study. They include: implementation of an Erosion and Sediment Control Plan; Stormwater Management Plan; Water Supply Strategy; spill and emergency response procedures; design of infrastructure using appropriate annual reoccurrence interval (ARI); and application of ACARP diversion design guidelines.

A baseline monitoring program and an on-going water quality monitoring program are detailed within this report to assess the impact of the project operations on the receiving environment. Implementation of these monitoring programs will also allow ongoing reviews of the effectiveness of the various management plans and mitigation measures implemented to protect the values of the watercourses in the project area. The baseline monitoring program is in progress and will continue until construction commences. The on-going program will continue throughout the project life. Based on the implementation of recommended management and mitigation measures and monitoring

programs, the residual risk of the Kevin's Corner coal mine having adverse impacts on receiving surface waters is expected to be negligible.

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Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Hancock Galilee Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 23 July 2010.

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

This report was prepared between September 2010 and April 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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Appendix A Water Quality Data

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Water Quality Parameters - Median Values
Kevin's Corner 42626665

Sample ID					1	2	3	4	5	6	7	8	9	10	11	12	13	A1	A4	A5	A7	A8	A9	NATIVE	120309A Twin Hills	120306A Mistake_Ck Charlton	120301B Belyando_R	120305A Violet Grove
Number of Samples (n)					***n = 5***	***n = 5***	***n = 6***	***n = 6***	***n = 5***	***n = 4***	***n = 3***	***n = 5***	***n = 4***	***n = 5***	***n = 4***	***n = 3***	***n = 5***	***n = 4***	***n = 4***	***n = 5***	***n = 2***	***n = 4***	***n = 2***	***n = 3***	***1 to 60***	***1 to 52***	***3 to 116***	***1 to 92***
Analyte	**LOR**	**Units**	**Water Quality Objectives (QWQG 2009)**	**ANZECC 2000 - Freshwater - 95%**																								
Alkalinity																												
Bicarbonate Alkalinity as CaCO3	1	mg/L		ne	**46**	**51**	**44.5**	**44**	**43**	**28**	**11**	**31**	**31.5**	**39**	**67**	**53**	**87**	**51**	**52.5**	**36**	**50.5**	**56.5**	**58**	**64**	**53**	**63**	**63.03**	**70**
Carbonate Alkalinity as CaCO3	1	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.1	0.1	0.1	0.1
Hydroxide Alkalinity as CaCO3	1	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Total Alkalinity	1	mg/L		ne	**46**	**51**	**44.5**	**44**	**43**	**28**	**11**	**31**	**31.5**	**39**	**67**	**53**	**87**	**51**	**52.5**	**36**	**50.5**	**56.5**	**58**	**64**	**44**	**52**	**52.5**	**57.4**
BTEX Compounds																												
Benzene	1	µg/L		950	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Ethylbenzene	2	µg/L		80	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
m&p-Xylene	2	µg/L		75	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
o-Xylene	2	µg/L		350	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Toluene	2	µg/L		180	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Total BTEX	9	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Total Xylenes	4	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Major Ions																												
Calcium	1	mg/L		ne	**9**	**9**	**8**	**5.5**	**8**	**3.5**	**2**	**4**	**5**	**5**	**9.5**	**6**	**11**	**10.5**	**10**	**6**	**6.5**	**8.5**	**9.5**	**10**	**9.4**	**11**	**10.5**	**11.3**
Chloride	1	mg/L		ne	**11**	**12**	**13.5**	**16**	**11**	**18.5**	**15**	**18**	**14.5**	**13**	**10.5**	**9**	**10**	**7**	**9**	**14**	**11.5**	**10**	**13**	**10**	**5.8**	**8**	**9.71**	**9.9**
Fluoride	0.1	mg/L		ne	**0.1**	**0.3**	**0.1**	**0.1**	nd	nd	nd	nd	**0.1**	**0.15**	**0.1**	nd	**0.1**	nd	nd	nd	nd	**0.2**	nd	**0.1**	**0.1**	**0.19**	**0.14**	**0.19**
Magnesium	1	mg/L		ne	**4**	**6**	**4.5**	**5**	**4**	**3**	**2**	**3**	**3.5**	**5**	**8**	**5**	**9**	**4**	**4.5**	**4**	**5**	**6**	**6**	**4**	**3.7**	**3.7**	**3.9**	**4.8**
Potassium	1	mg/L		ne	**7**	**6**	**6.5**	**5**	**5**	**4**	**4**	**4**	**5**	**4**	**4.5**	**6**	**6**	**8**	**7.5**	**6**	**5.5**	**6**	**8.5**	**7**	**4.8**	**4.4**	**5.9**	**6**
Sodium	1	mg/L		ne	**10**	**12**	**12**	**13.5**	**12**	**13.5**	**14**	**14**	**13**	**11**	**9.5**	**14**	**17**	**5**	**9**	**9**	**13**	**10.5**	**10.5**	**14**	**7.4**	**8.9**	**11.1**	**9.3**
Sulphate	1	mg/L		ne	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	nd	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3.9**	**3.4**	**2.84**	**1.825**
Total Anions	0.01	meq/l		ne	**1.31**	**1.46**	**1.32**	**1.305**	**1.32**	**0.99**	**0.82**	**1.15**	**1.18**	**1.18**	**1.64**	**1.33**	**2.13**	**1.225**	**1.3**	**1.13**	**1.355**	**1.47**	**1.535**	**1.59**	**1.05**	**1**	**0.995**	**1.385**
Total Cations	0.01	meq/l		ne	**1.46**	**1.59**	**1.435**	**1.415**	**1.48**	**1.075**	**0.97**	**1.2**	**1.245**	**1.28**	**1.695**	**1.35**	**2.25**	**1.29**	**1.38**	**1.2**	**1.445**	**1.53**	**1.625**	**1.64**	-	-	-	-
Metals (Dissolved)																												
Aluminium	0.01	mg/L		0.055	**0.25**	**0.295**	**0.22**	**0.36**	**0.46**	**0.65**	**1.34**	**0.645**	**0.75**	**0.265**	**0.19**	**0.27**	**0.21**	**0.31**	**0.34**	**0.31**	**0.275**	**0.42**	**0.235**	**0.67**	-	-	**0.05**	**0.04**
Arsenic	0.001	mg/L		0.013	**0.001**	**0.001**	**0.001**	nd	**0.001**	**0.002**	**0.001**	**0.001**	nd	nd	nd	**0.001**	**0.001**	**0.0015**	**0.002**	nd	nd	nd	**0.001**	**0.003**	-	-	-	-
Barium	0.001	mg/L		ne	**0.0465**	**0.055**	**0.048**	**0.052**	**0.0585**	**0.0465**	**0.058**	**0.0705**	**0.066**	**0.069**	**0.092**	**0.076**	**0.1295**	**0.061**	**0.05**	**0.0345**	**0.079**	**0.079**	**0.0405**	**0.146**	-	-	-	-
Beryllium	0.001	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Boron	0.05	mg/L		0.37	nd	nd	nd	nd	nd	nd	**0.05**	**0.055**	**0.06**	nd	nd	nd	**0.07**	**0.07**	**0.05**	nd	**0.06**	nd	nd	**0.05**	**0.03**	**0.03**	**0.04**	**0.04**
Cadmium	0.0001	mg/L		0.0002	nd	nd	nd	**0.0002**	nd	nd	nd	nd	nd	nd	**0.0001**	nd	nd	**0.0001**	**0.0002**	nd	nd	nd	nd	nd	-	-	-	-
Chromium	0.001	mg/L		0.001	nd	nd	nd	nd	nd	**0.001**	**0.0015**	**0.0015**	nd	nd	nd	nd	nd	nd	**0.005**	nd	nd	nd	nd	nd	-	-	-	-
Cobalt	0	mg/L		ne	**0.002**	**0.002**	nd	nd	**0.002**	**0.0025**	nd	nd	nd	nd	nd	nd	**0.001**	**0.001**	nd	nd	nd	nd	nd	nd	-	-	-	-
Copper	0.001	mg/L		0.0014	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.0015**	**0.003**	**0.002**	**0.003**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.001**	**0.002**	**0.002**	**0.0015**	**0.002**	-	**0.03**	**0.01**	**0.02**
Iron	0.05	mg/L		ne	**0.54**	**0.535**	**0.43**	**0.47**	**0.485**	**1.55**	**1.07**	**0.74**	**0.62**	**0.225**	**0.4**	**0.25**	**0.245**	**0.375**	**0.43**	**0.455**	**0.29**	**0.41**	**0.41**	**1.01**	**1.775**	**0.9**	**0.37**	**0.05**
Lead	0.001	mg/L		0.0034	nd	nd	nd	nd	nd	nd	**0.001**	**0.001**	**0.0015**	nd	nd	nd	**0.001**	nd	**0.001**	nd	nd	nd	nd	**0.001**	-	-	-	-
Manganese	0.001	mg/L		1.9	**0.062**	**0.028**	**0.032**	**0.094**	**0.022**	**0.1155**	**0.019**	**0.011**	**0.048**	**0.011**	**0.02**	**0.009**	**0.055**	**0.0625**	**0.016**	**0.008**	**0.0195**	**0.023**	**0.009**	**0.155**	**0.02**	-	**0.01**	0
Mercury	0.0001	mg/L		0.0006	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Nickel	0.001	mg/L		0.011	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.0015**	**0.002**	**0.001**	**0.002**	**0.0015**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	-	-	-	-
Uranium	0.001	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Vanadium	0.01	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Zinc	0.001	mg/L		0.008	**0.006**	**0.007**	**0.05**	**0.044**	**0.028**	**0.008**	**0.006**	**0.006**	**0.005**	**0.014**	**0.007**	nd	**0.016**	nd	**0.026**	**0.068**	nd	**0.051**	**0.015**	nd	-	-	**0.01**	**0.01**
Metals (Total)																												
Aluminium	0.01	mg/L		0.055	**0.32**	**1.42**	**0.43**	**0.79**	**0.82**	**0.585**	**4.81**	**0.73**	**4.02**	**0.56**	**0.66**	**0.45**	**0.33**	**0.62**	**2.185**	**0.34**	**0.435**	**0.425**	**0.485**	**1.28**	-	-	-	-
Arsenic	0.001	mg/L		0.013	**0.0015**	**0.001**	**0.001**	**0.001**	**0.0015**	**0.002**	**0.002**	**0.002**	**0.002**	**0.001**	**0.001**	**0.001**	**0.001**	**0.002**	**0.002**	**0.002**	nd	**0.001**	**0.002**	**0.002**	-	-	-	-
Barium	0.001	mg/L		ne	**0.049**	**0.07**	**0.0595**	**0.073**	**0.086**	**0.0625**	**0.07**	**0.084**	**0.074**	**0.089**	**0.102**	**0.102**	**0.172**	**0.0785**	**0.0615**	**0.044**	**0.127**	**0.1055**	**0.054**	**0.141**	-	-	-	-
Beryllium	0.001	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Boron	0.05	mg/L		0.37	**0.055**	**0.065**	**0.05**	**0.055**	**0.06**	**0.055**	**0.06**	**0.065**	**0.065**	nd	nd	nd	**0.06**	**0.065**	**0.07**	**0.05**	**0.06**	**0.05**	nd	**0.05**	-	-	-	-
Cadmium	0.0001	mg/L		0.0002	nd	nd	nd	nd	nd	nd	nd	nd	nd	**0.0001**	nd	nd	**0.0001**	nd	nd	**0.0001**	nd	nd	nd	nd	-	-	-	-
Chromium	0.001	mg/L		0.001	**0.004**	**0.001**	**0.003**	**0.002**	**0.003**	**0.001**	**0.006**	**0.005**	**0.0065**	**0.0015**	**0.001**	nd	**0.0015**	**0.004**	**0.003**	**0.001**	nd	**0.003**	nd	**0.003**	-	-	-	-
Cobalt	0	mg/L		ne	**0.002**	**0.001**	**0.001**	**0.002**	**0.0015**	**0.0035**	**0.002**	**0.002**	**0.0025**	**0.001**	**0.001**	nd	**0.002**	**0.002**	**0.002**	**0.001**	**0.002**	**0.002**	nd	**0.001**	-	-	-	-
Copper	0.001	mg/L		0.0014	**0.0025**	**0.0025**	**0.002**	**0.003**	**0.003**	**0.0025**	**0.004**	**0.003**	**0.0035**	**0.002**	**0.003**	**0.002**	**0.003**	**0.002**	**0.0025**	**0.002**	**0.0035**	**0.003**	**0.0025**	**0.002**	-	-	-	-
Iron	0.05	mg/L		ne	**2.56**	**2.39**	**1.53**	**0.875**	**0.88**	**3.795**	**1.13**	**1.07**	**0.985**	**0.76**	**0.985**	**0.36**	**0.56**	**3.52**	**2.52**	**1.24**	**0.725**	**0.765**	**1.975**	**2.74**	-	-	-	-
Lead	0.001	mg/L		0.0034	**0.002**	**0.002**	**0.0015**	**0.001**	**0.002**	**0.001**	**0.002**	**0.0015**	**0.002**	**0.001**	**0.001**	**0.0015**	**0.001**	**0.003**	**0.002**	**0.001**	**0.002**	**0.0015**	**0.001**	**0.0015**	-	-	-	-
Manganese	0.001	mg/L		1.9	**0.162**	**0.101**	**0.1055**	**0.128**	**0.077**	**0.1895**	**0.021**	**0.018**	**0.09**	**0.075**	**0.057**	**0.049**	**0.072**	**0.11**	**0.0685**	**0.045**	**0.1085**	**0.0645**	**0.028**	**0.144**	-	-	-	-
Uranium	0.001	mg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Vanadium	0.01	mg/L		ne	**0.01**	nd	nd	nd	nd	nd	**0.01**	**0.02**	**0.02**	nd	nd	nd	nd	**0.01**	**0.01**	nd	nd	nd	nd	nd	-	-	-	-
Zinc	0.001	mg/L		0.008	**0.016**	nd	nd	nd	**0.007**	**0.0155**	**0.01**	**0.0115**	**0.014**	**0.006**	nd	**0.008**	**0.0225**	**0.006**	nd	nd	nd	**0.01**	**0.01**	**0.008**	-	-	-	-
Natural Attenuation Parameters																												
Nitrite + Nitrate as N	0.01	mg/L	0.015	ne	**0.03**	**0.04**	**0.025**	**0.04**	**0.06**	**0.04**	**0.035**	**0.04**	**0.055**	**0.05**	**0.045**	**0.045**	**0.295**	**0.03**	**0.04**	**0.02**	**0.01**	**0.03**	**0.025**	**0.02**	-	-	-	-
Nutrients																												
Ammonia as N	0.01	mg/L	0.01	ne	**0.05**	**0.04**	**0.02**	**0.03**	**0.02**	**0.03**	**0.02**	**0.03**	**0.02**	**0.035**	**0.025**	**0.03**	**0.03**	**0.025**	**0.03**	**0.04**	nd	**0.02**	**0.025**	**0.05**	-	-	-	-
Chlorophyll-a	1	mg/m³	na	ne	**3**	**1.5**	**2**	**1**	**1**	**2.5**	nd	**3**	**1**	**2.5**	**2**	**2**	**1.5**	**2.5**	**2**	**3**	**2.5**	**1.5**	nd	**4**	-	-	-	-
Phosphorus (total)	0.01	mg/L	0.03	ne	**0.08**	**0.065**	**0.03**	**0.06**	**0.08**	**0.1**	**0.05**	**0.15**	**0.1**	**0.1**	**0.06**	**0.11**	**0.125**	**0.04**	**0.085**	**0.065**	**0.2**	**0.085**	**0.09**	**0.2**	-	-	**0.1957**	**0.2057**
Reactive Phosphorus as P	0.01	mg/L	0.015	ne	**0.01**	**0.02**	**0.025**	**0.035**	**0.03**	**0.02**	**0.015**	**0.02**	**0.02**	**0.03**	**0.01**	**0.045**	**0.05**	**0.02**	**0.02**	**0.01**	**0.03**	**0.03**	**0.05**	**0.025**	-	-	-	-

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Sample ID					1	2	3	4	5	6	7	8	9	10	11	12	13	A1	A4	A5	A7	A8	A9	NATIVE	120309A Twin Hills	120306A Mistake_Ck Charlton	120301B Belyando_R	120305A Violet Grove
Total Kjeldahl Nitrogen as N	0.1	mg/L	na	ne	**0.9**	**0.4**	**0.55**	**0.45**	**0.6**	**1.1**	**1**	**0.8**	**0.65**	**0.5**	**0.5**	**0.6**	**0.6**	**0.9**	**1**	**0.6**	**0.7**	**0.7**	**0.75**	**0.7**	-	-	-	-
Total Nitrogen as N	0.1	mg/L	0.25	ne	**0.9**	**0.4**	**0.55**	**0.45**	**0.6**	**1.1**	**1**	**0.8**	**0.7**	**0.6**	**0.55**	**0.7**	**0.7**	**0.95**	**1**	**0.6**	**0.7**	**0.75**	**0.75**	**0.7**	-	-	-	-
Physico-Chemical Parameters																												
Acidity as CaCO3	1	mg/L		ne	**6**	**5**	**4**	**4.5**	**4**	**9**	**6**	**5**	**4**	**3**	**4**	**4**	**4**	**5**	**5**	**4**	**6.5**	**4**	**3**	**6**	-	-	-	-
Electrical Conductivity (Lab)	1	µS/cm		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**110**	**135**	**145.4**	**144.5**
pH	0.01	ph unit		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**7.5**	**7.4**	**7.5**	**7.335**
Suspended Solids	1	mg/L		ne	**35**	**32**	**28.5**	**19**	**26**	**31.5**	**12**	**13**	**18.5**	**23**	**78**	**48**	**21**	**20**	**34.5**	**21**	**82**	**26.5**	**28.5**	**33**	**80**	**50**	**118**	**110**
Turbidity	0.1	ntu		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**100**	**100**	**100**	**189.5**
Total Petroleum Hydrocarbons																												
C10-C14 fraction	50	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
C10-C36 fraction	200	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
C15-C28 fraction	100	µg/L		ne	nd	**120**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
C29-C36 fraction	50	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
C6-C36 fraction	220	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
C6-C9 fraction	20	µg/L		ne	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
Oil & Grease	5	mg/L		ne	**5**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**5**	-	-	-	-
Sum of TPH C10 - C36	50	µg/L		ne	nd	**120**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-
In-Situ Measurements (URS)																												
Flow	-	m/s	na	na	0.23	0.52	0.51	0.33	0.15	0.13	0.33	0.40	0.49	2.20	0.46	0.29	0.16	0.44	0.34	0.23	0.58	0.38	0.22	nd	0.087	0.006	0.546	0.026
pH	-	pH units	6.5-7.5	6.5-7.5	6.92	7.22	7.12	7.07	7.23	6.21	7.09	6.80	7.14	7.30	7.49	7.61	7.25	7.45	7.24	7.37	7.24	7.38	8.07	7.19	7.15	-	7.35	7.35
Dissolved Oxygen	-	% Saturation	90-110	90-110	70.9	83.8	77.9	79.1	68.9	26.2	73.1	74.3	83.2	69.7	81.2	84.4	57.6	63.5	67.1	77.2	79.5	66.8	63.3	45.1	5.5	-	6	5.75
Conductivity	-	µS/cm	168	30-350	152.6	133.4	121.9	144.5	106.8	112.0	84.0	138.0	84.6	138.4	176.1	159.8	238.0	132.1	142.3	125.8	147.9	158.0	171.9	160.6	120.5	120	145	147.5
Temperature	-	℃	site specific	site specific	23.2	26.0	23.5	25.4	24.2	24.7	27.8	27.2	25.0	25.1	25.4	25.3	24.1	25.7	26.8	26.5	22.1	25.4	31.9	21.7	26.65	26	27	25.6
Turbidity	-	NTU	25	2 to 25	135.9	176.6	142.1	209.0	112.0	187.7	290.0	227.0	207.8	156.9	61.9	155.7	120.1	109.5	142.1	100.0	282.9	147.0	123.0	212	162	-	479	360.5

Exceeds the ANZECC/ARMCANZ 2000 Trigger values for freshwater ecosystems - Level of protection 95% species

Above limit of reporting (LOR)

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B

Appendix B Risk Assessment for Surface Water Impacts

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Hazard Matrix

Kevin's Corner EIS - Surface Water Risk Assessment

Aspect	Potential Impact	Likelihood	Consequence	Inherent Risk Rating	Mitigation Strategy	Likelihood	Consequence	Residual Rating
Construction Phase								
Erosion and Sediment Mobilisation	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 blown by wind into surface water bodies. Additionally there is the potential for the presence of high levels of metals in soils that may enter watercourses. Site excavation works may expose groundwater containing high levels of dissolved metals	4 - Likely	3 - Moderate	High	- Disturbance by heavy earth moving equipment is minimised especially in riparian areas - The number of passes over water crossings is kept to a minimum - Topsoil is stripped and stockpiled away from drainage lines to protect it from erosion - Bunds are constructed to restrict flow velocities across the site - Vegetation clearing is not carried out during heavy rainfall - Dust suppression measures are adopted such as water sprays or stockpile covers - Vehicle washdowns are located away from drainage lines or water courses - Construction activities that will affect existing drainage lines and control measures will only be carried out after suitable stormwater management infrastructure has been installed on site as per the construction contractors' Environmental Management Plan (EMP) - A sediment and erosion control plan is prepared and executed - Vehicle crossings are adequately designed for a range of flow conditions, including under road drainage - Any site dewatering activities will require treatment or appropriate management prior to discharge	2 - Unlikely	3 - Moderate	Medium
Works adjacent to or within drainage lines	Earthworks for watercourse crossings and vehicle access crossings altering flow characteristics	4 - Likely	3 - Moderate	High	- Diversion of watercourse either by low flow diversion or coffer dam with pumping - Construction activities that will affect existing drainage channels and control measures must only be carried out after suitable stormwater management infrastructure has been implemented onsite - Minimal disturbance by heavy earth moving equipment - Vehicle crossings should be adequately designed for a range of flow conditions, including under road drainage	2 - Unlikely	3 - Moderate	Medium
Contaminant mobilisation	Adverse impacts on human health or receiving environment from runoff containing oily wastewater from miscellaneous plant and equipment and washwater; contaminated runoff from chemical storage areas; or potentially contaminated drainage from fuel and oil storage areas.	4 - Likely	3 - Moderate	High	- Temporary and permanent chemical and fuel storage areas to be appropriately bunded as per AS 1940 - Bunds and sumps are frequently drained and treated/disposed appropriately - Spill cleanup kits in accordance with Australian Standards (AS3780) to be located in appropriate locations, including inside machinery and vehicles - Refuelling to occur within bunded areas; - n the event of a spill occurring, ensure it is controlled, contained and cleaned up to prevent the mobilisation of pollutants in drainage lines or watercourses. - Site selection of storage and refuelling areas to prevent stormwater inundation	2 - Unlikely	3 - Moderate	Medium
Water Supply	Inadequate water supply for effective dust suppression, soil compaction and washdown.	3 - Possible	3 - Moderate	High	- Develop, implement and maintain a Water Supply Strategy including emergency supply options.	2 - Unlikely	3 - Moderate	Medium
Flooding	Significant rainfall event during construction causing erosion and damage to sediment control infrastructure and resulting in non compliant off site discharges.	3 - Possible	3 - Moderate	High	- Schedule construction works appropriately during wet season and where practicable limit works within flood plain. If not practicable ensure flood risk assessment has been conducted. - Implement stormwater management measures including drainage diversions and bunding - Emergency response procedures for flood events	1 - Rare	3 - Moderate	Medium
Improper disposal of construction waste	Litter and other construction waste washing into watercourses during rain events impacting on receiving waters.	3 - Possible	2 - Minor	Medium	Develop, implement and maintain a Waste Management and Disposal Plan throughout the construction phase	2 - Unlikely	2 - Minor	Low
Commissioning Phase								
Hydrostatic Testing		3 - Possible	2 - Minor	Medium		2 - Unlikely	2 - Minor	Low
Operation Phase								
Water Management System Failures (storages, embankments, pipes, bunds, levees)	Non-compliant discharge offsite causing: • Physical impact of increasing/changing existing flow regimes in receiving waters • Poor water quality of mine water compared to the water quality of the receiving environment • Alteration o riparian vegetation and aquatic species through changed environmental flows • Erosion and sedimentation could potentially occur at discharge points	4 - Likely	2 - Minor	Medium	- Design of water storages using water Balance Model 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 - Water storages designed in accordance with DME1995 Technical Guidelines - Monitoring equipment will be installed to monitor storage volume during operation combined with a water management system to prevent overfilling - Design and construction supervision of dam embankments undertaken by a Registered Professional Engineer of Queensland (RPEQ) - Regular dam inspections to be udertaken by RPEQ - Regular inspections during operation of water storages, tailings dams levels, integrity of embankment and spillways - Regular pipeline, drain, bund and levee inspections and maintenance will be undertaken during operation	2 - Unlikely	2 - Minor	Low
Erosion and Sediment Mobilisation	Permanent structures and exposed areas may result in localised erosion and sediment mobilisation leading to deleterious effects on water quality and aquatic habitats	4 - Likely	3 - Moderate	High	- Stormwater management measures to include localised erosion control and energy dissipation measures - routine inspection and maintenance of existing erosion and sediment control measures - revegetation of disturbed areas where practicable	2 - Unlikely	3 - Moderate	Medium
Contaminant mobilisation	Spillage of diesel, lubricants and greases from storage areas or machinery (mobile and fixed plant) mixing with stormwater runoff and discharging into watercourses.	4 - Likely	3 - Moderate	High	- Temporary and permanent chemical and fuel storage areas to be appropriately bunded as per AS 1940 - Bunds and sumps are frequently drained and treated/disposed appropriately - Spill cleanup kits in accordance with Australian Standards (AS3780) to be located in appropriate locations, including in machinery and vehicles - Refuelling to occur within bunded areas; - In the event of a spill occurring, ensure it is controlled, contained and cleaned up to prevent the mobilisation of pollutants in drainage lines or water courses. - Site selection of storage and refuelling areas to prevent stormwater inundation	2 - Unlikely	3 - Moderate	Medium
Non-compliant discharges	Discharge of mine water exceeding environmental authority limits resulting in an environmental impact on receiving waters or downstream water users	4 - Likely	3 - Moderate	High	- Monitoring equipment with telemetry system on creeks, dams, discharge points - Flexible water management system to cater for a variety of conditions and operational needs - including sufficient storage capacity onsite - Monitoring and maintenance of dams and water management infrastructure (pumps and pipelines) - Separation of clean and dirty water systems - Standard operating procedures for water management	2 - Unlikely	3 - Moderate	Medium

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Aspect	Potential Impact	Likelihood	Consequence	Inherent Risk Rating	Mitigation Strategy	Likelihood	Consequence	Residual Rating
Creek Diversions	• Erosion and sedimentation due to changed channel flow velocities and stream power (measurement of sediment transport capacity). Erosion of the new channel or upstream reaches may be sufficient to alter creek channel form in alluvial sections. Sedimentation can occur downstream of the project, either from quantities of sediment mobilised from the new channel or by changed creek hydraulics as a result of the new channel. • Flooding impacts may stem from the combined effects of the Little Sandy creek and Rocky creek diversions. Flood levels, frequency and the extent of flooding may change in the surrounding stream network and mine area.	4 - Likely	3 - Moderate	High	The Creek diversions will be designed in accordance with the ACARP guidelines which provide upper limits for stream power, stream velocity and shear stress	2 - Unlikely	3 - Moderate	Medium
Flooding	Significant rainfall event causing failure of erosion and sediment control infrastructure resulting in non compliant off site discharges.	3 - Possible	3 - Moderate	High	- Monitoring and maintenance of erosion and sediment control features - Emergency response procedures and flood forecasting where practical	1 - Rare	3 - Moderate	Medium
Lack of water supply	Inadequate water supply for effective dust suppression, soil compaction and washdown.	3 - Possible	3 - Moderate	High	- Develop, implement and maintain a Water Supply Strategy including emergency supply options.	2 - Unlikely	3 - Moderate	Medium
Improper disposal of operational wastes	Litter and other operational waste can be washed into watercourses during rain events and impact receiving waters	3 - Possible	2 - Minor	Medium	Develop, implement and maintain a Waste Management and Disposal Plan throughout the operation	2 - Unlikely	2 - Minor	Low
Decommissioning Phase								
Erosion and Sediment Mobilisation	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 or generated may also be blown by wind into surface water bodies. Additionally there is the potential for the presence of high levels of metals in soils that may enter watercourses.	4 - Likely	3 - Moderate	High	- Implement and maintain a Decommissioning Environmental Plan. Apply sediment and erosion control measures prior to earthworks. - Adopt control to minimise risk of heavy metal runoff to surface waters	2 - Unlikely	3 - Moderate	Medium
Contaminant mobilisation	Spillage of diesel, lubricants and greases from storage areas or machinery (mobile and fixed plant) mixing with stormwater runoff and discharging into watercourses. Site excavation works may expose groundwater containing high levels of dissolved metals or hydrocarbons	4 - Likely	3 - Moderate	High	- Temporary and permanent chemical and fuel storage areas to be appropriately bunded as per AS 1940 - Bunds and sumps are frequently drained and treated/disposed appropriately - Spill cleanup kits in accordance with Australian Standards (AS3780) to be located in appropriate locations, including in machinery and vehicles - Refuelling to occur within bunded areas; - In the event of a spill occurring, ensure it is controlled, contained and cleaned up to prevent the mobilisation of pollutants in drainage lines or water courses. - Site selection of storage and refuelling areas to prevent stormwater inundation - Any site dewatering activities will require treatment or appropriate management prior to discharge	2 - Unlikely	3 - Moderate	Medium
Improper disposal of waste	Litter and other demolition waste can be washed into watercourses during rain events and impact receiving waters	3 - Possible	2 - Minor	Medium	Develop, implement and maintain a Waste Management and Disposal Plan throughout decommissioning	2 - Unlikely	2 - Minor	Low
Works adjacent to or within drainage lines	Infilling on site surface water bodies or drainage lines can lead to potential loss of water storages and can adversely impact ecological habitats.	4 - Likely	3 - Moderate	High	- Decommissioning works that will affect existing drainage channels and control measures must only be carried out after suitable stormwater management is implemented - Minimal number of passes by heavy earth moving equipment	2 - Unlikely	3 - Moderate	Medium
Flooding	Significant rainfall event causing failure of erosion and sediment control infrastructure resulting in non compliant off site discharges.	3 - Possible	3 - Moderate	High	Schedule decommissioning work appropriately during wet season, working outside of flood plain until a flood risk assessment has been conducted.	1 - Rare	3 - Moderate	Medium
Lack of water supply	Inadequate water supply for effective dust suppression, soil compaction and washdown.	3 - Possible	3 - Moderate	High	- Develop, implement and maintain a Water Supply Strategy including emergency supply options.	2 - Unlikely	3 - Moderate	Medium
Incomplete rehabilitation	Excessive erosion and sediment mobilisation causing turbid and sediment laden runoff to enter receiving water bodies	4 - Likely	2 - Minor	High	Preparation and implementation of a Decommissioning Rehabilitation Plan including revegetation of riparian zones, slopes and other areas prone to erosion	3 - Possible	2 - Minor	Medium

			Consequence				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Catastrophic
Probability Factor	Almost Certain	5	High	High	Extreme	Extreme	Extreme
	Likely	4	Moderate	High	High	Extreme	Extreme
	Possible	3	Low	Moderate	High	Extreme	Extreme
	Unlikely	2	Low	Low	Moderate	High	Extreme
	Rare	1	Low	Low	Moderate	High	High

Level	Consequence	Environmental Impact
1	Insignificant	Trivial Environmental impact
2	Minor	Unreasonable interference with the environment (results in minor illness ro injury)
3	Moderate	Clearly visible impact to aquatic ecosystem. Requires localised remediation (results in illness or injury)
4	Major	Damage to the environment that requires significant remediation (results in a serious illness or injury)
5	Catastrophic	Environmental damaage is irreversible, of high impact or widespread (results in death)

Level	Likelihood	Frequency Examples
1	Rare	WILL ONLY occur in exceptional circumstances
2	Unlikely	Could occur but not expected
3	Possible	Could occur at some time
4	Likely	Will probably occur in most circumstances
5	Almost Certain	Expected to occur in most circumstances

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