6 Surface Water Resources

6.1 Surface Water Resources

6.1.1 Existing Environment

The Project Site consists of mining areas (Daunia ML 1781 and Daunia East ML 70115), and infrastructure areas (Red Mountain ML 70116).

The mining areas are drained by two unnamed drainage paths. The unnamed drainage paths were named Daunia and Daunia East for the purposes of this assessment. The two unnamed drainage paths are ephemeral and drain to the Isaac River.

The infrastructure area is drained by New Chum Creek. New Chum Creek flows south-west through Red Mountain ML 70116 and then onto the Poitrel Mine (Poitrel ML4749). It then flows approximately 8 km to its discharge point into the Isaac River. The Poitrel Mine has an approved, recently constructed, diversion of New Chum Creek. There is also a proposed levee on the Isaac River associated with the Poitrel Mine.

The Isaac River is an ephemeral waterway which ultimately drains to the Fitzroy River as shown in **Figure 6-1**. The total catchment area of the Isaac River is 22,400 km^2. The catchment area of the Isaac River upstream of the Project Site is 3,640km^2.

6.1.1.1 Regional Surface Water Hydrology

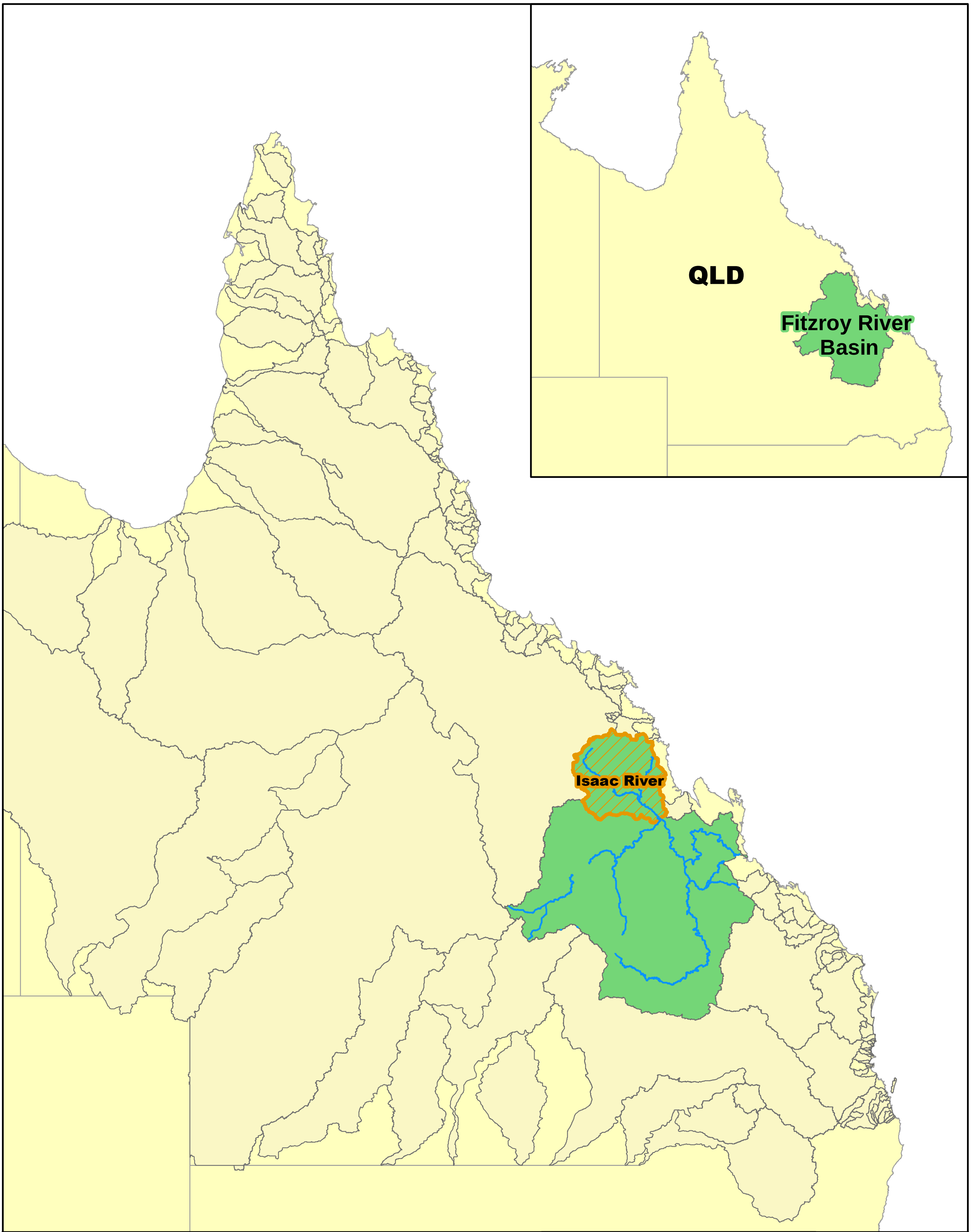
The Project Site mining areas cover approximately 26 km^2 and are drained by two unnamed drainage paths, Daunia and Daunia East, to the Isaac River. Daunia begins at the northern end of the Daunia ML and flows south to the Isaac River. Daunia East begins in the Daunia East ML then flows through the southern area of the Daunia ML towards the Isaac River (**Figure 6-2**). The catchment areas of Daunia and Daunia East are 18 km^2 and 25 km^2 respectively, whereas the Isaac River catchment upstream of the Project Site is 3,640 km^2. The mining areas of the Project Site account for only 0.7 per cent of the catchment contributing to flows at the Project Site.

Hydrological characteristics (stream length and catchment area) of significant waterways and drainage paths within the Project Site and its vicinity are presented in **Table 6-1**. The only significant waterway within the vicinity of the Project Site is the Isaac River, which is an ephemeral water course.

Table 6-1 Hydrological Characteristics of Waterways and Drainage Paths

Stream Name	Stream Length (km)	Catchment Area (km^2)
Isaac River (to the Project Site)	120	3,640
Daunia (unnamed drainage path)	8	18
Daunia East (unnamed drainage path)	10	25
New Chum Creek	20	47

There are three Department of Natural Resources and Water (DNRW) gauging stations on the Isaac River in the vicinity of the Project Site. **Table 6-2** provides a summary of their location and history. There is no historical monitoring data for the two unnamed drainage paths, Daunia and Daunia East.



LEGEND

- Fitzroy Basin Rivers and Streams
- Isaac River
- Fitzroy River

μ

FIGURE 6-1

DAUNIA COAL MINE

SURFACE WATER RESOURCES

0 80 160 240 320 400

Kilometres

Scale 1:10,000,000 on A4

Projection: Australian Map Grid - Zone 55 (AGD84)

BMA

BHP Billiton Mitsubishi Alliance

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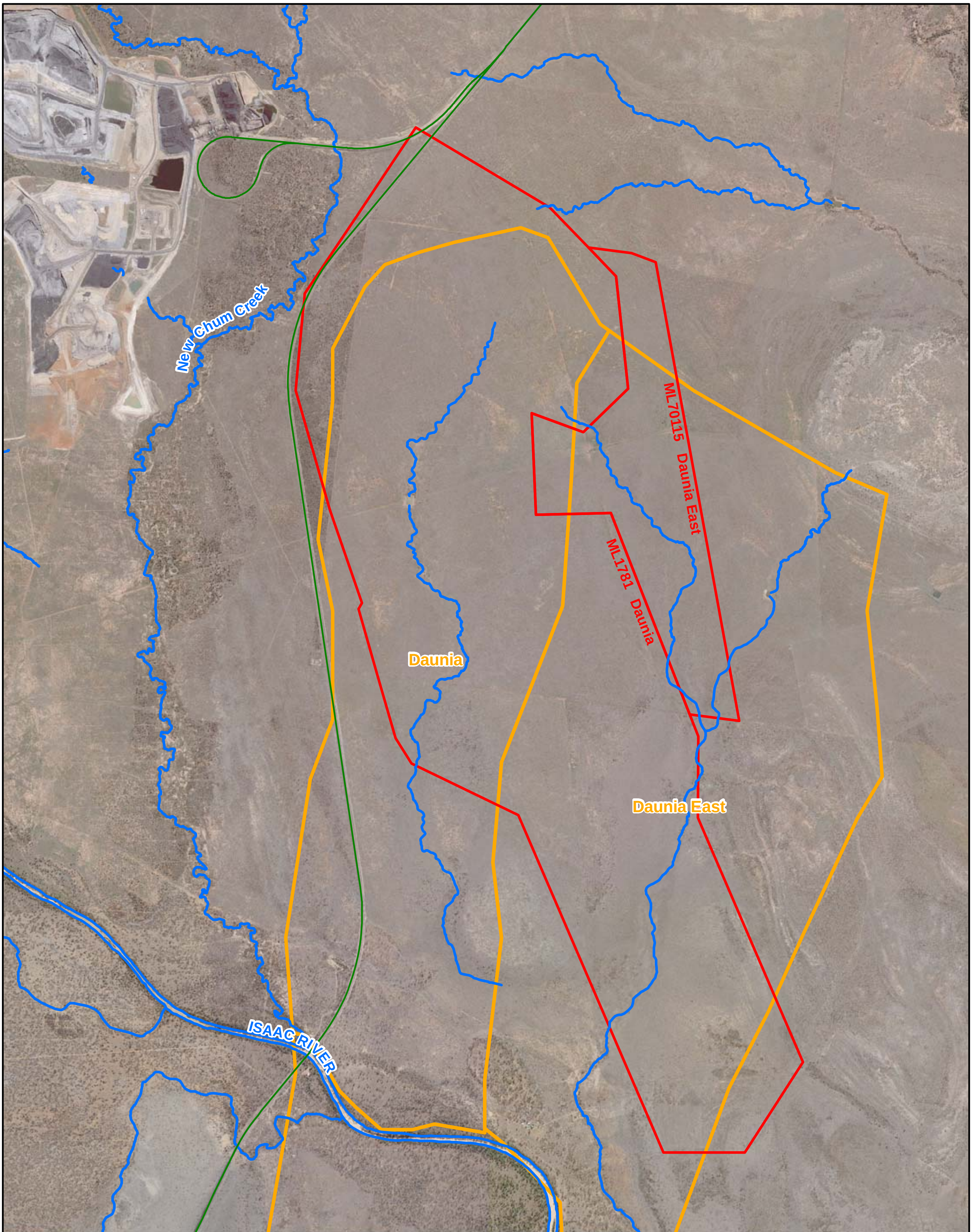

LEGEND

- Mining Lease
- Catchment

FIGURE 6-2

DAUNIA COAL MINE EIS

SURFACE WATER DRAINAGE

0 0.5 1 1.5 2

Kilometres

Scale 1:50,000 on A4

Projection: Australian Map Grid - Zone 55 (AGD84)

BHP Billiton Mitsubishi Alliance

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Table 6-2 DNRW Gauging Station Details

DNRW Station 130402A – Isaac River at Burton George	
Site Commenced	01/05/1964
Site Ceased	30/09/1988
Grid Reference	Latitude 21:37 Longitude 148:07
Max gauged stage (m)	1.4
Catchment Area (km^2)	551.0
DNRW Station 130414A – Isaac River at Goonyella	
Site Commenced	24/05/1983
Site Ceased	Current
Grid Reference	Latitude 21:51 Longitude 147:58
Max gauged stage (m)	6.5
Catchment Area (km^2)	1214.0
DNRW Station 130410A – Isaac River at Deverill	
Site Commenced	20/05/1968
Site Ceased	Current
Grid Reference	Latitude 22:10 Longitude 148:22
Max gauged stage (m)	11.410
Catchment Area (km^2)	4092.0

The Deverill gauge (130410A) is the closest gauge to the Project Site and is located approximately 18 km downstream of the Project Site. The Deverill gauge was used to produce calibrated hydrologic models for the Poitrel Coal Mine EIS (2005). Information from the gauge was used to characterise the flow in the Isaac River at the Project Site. A summary of large historical flows at the Deverill gauge is provided in **Table 6-3**.

Table 6-3 Isaac River Largest Recorded Flood Flows at Deverill

Date of Event	Peak Flow (m^3/s)	Volume (ML)
06/04/1989	2,137	267,000
08/01/1991	2,429	543,620
02/03/1988	2,638	321,000
15/02/2008	2,141	481,000

Average monthly flows for the Deverill gauge are displayed in **Figure 6-3**. The majority of flows through the Isaac River occur between the months of December to March.

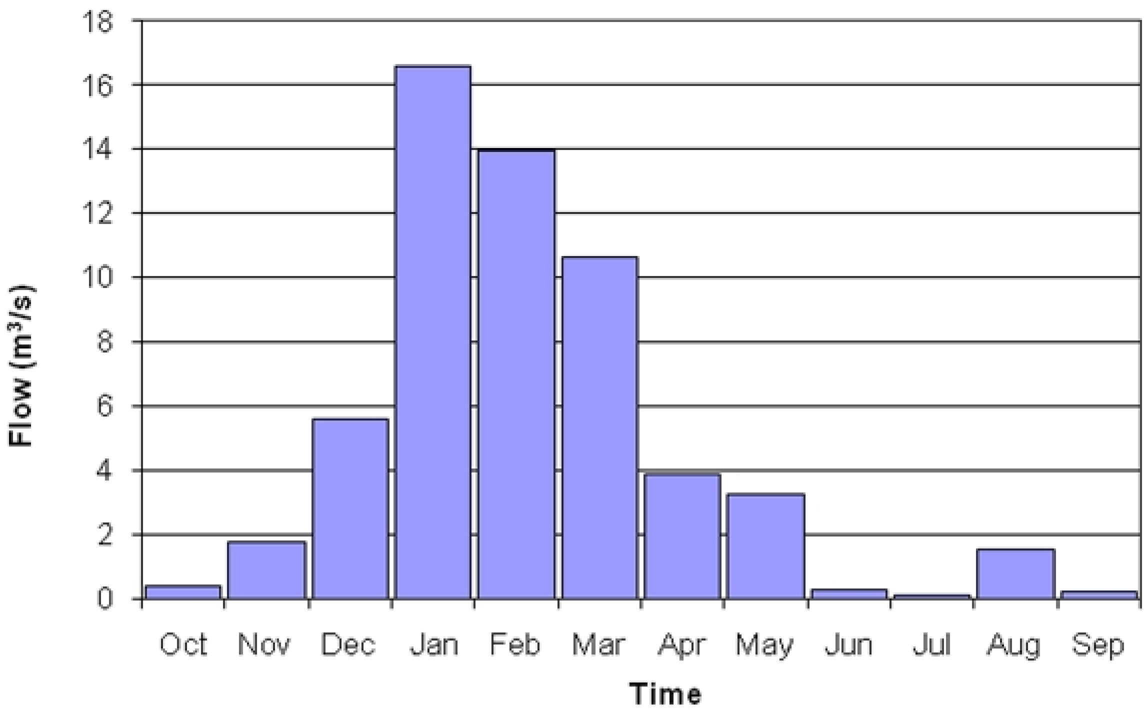


Figure 6-3 Average Monthly Flows at Deverill Stream Gauge (NRW, 2007)

6.1.1.2 Isaac River Catchment Hydrology

The Isaac River flows past the western and southern boundary of the Project Site, coming within 1 km of the Project Site boundary. Upstream of the Project Site, the Isaac River has a catchment area of approximately 3,640 km^2. Historical flow data for the Isaac River at the Project Site was not available, therefore recorded flow data from the Deverill gauge (130410A) was used to determine flows at the Project Site.

A RAFTS hydrologic model for the Isaac River catchment was used to characterise the flows in the Isaac River. The RAFTS model uses rainfall patterns and depths as well as physical catchment characteristics to estimate catchment flow. The catchment characteristics are described by parameters such as catchment area, average slope and resistance. Catchment response to rainfall was described in the form of a loss model with initial and continuing rainfall losses.

The hydrologic model was calibrated to the largest recorded flood event for the Deverill gauge, which was the 1988 event. The parameters used to calibrate the hydrologic model to the 1988 event are outlined in **Table 6-4**. **Figure 6-4** shows the comparison of the hydrographs for the recorded 1988 event and that predicted by the hydrologic model.

Table 6-4 Isaac River RAFTS Model Parameters

Manning's *n*	0.045
Initial Loss	15 mm
Continuing Loss	3.2 mm
Catchment Slope	1.0 %

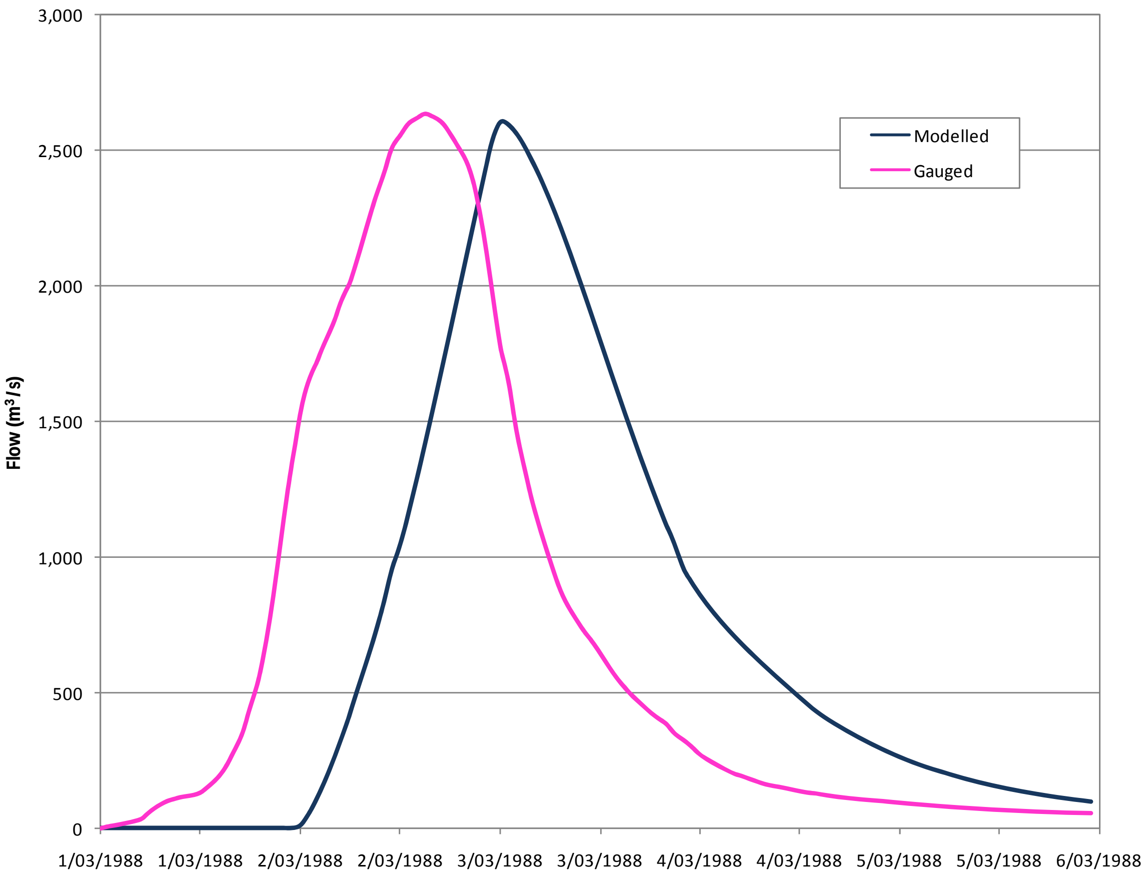


Figure 6-4 Hydrologic Model Calibration 1988 Event at Deverill Gauge (130410A)

The calibration process indicated that a good calibration was achieved for the peak flows and volume for the 1988 event at the Deverill gauge.

The design rainfall depth and patterns were determined for the Isaac Catchment for the 100 year Average Return Interval (ARI) flood event. Due to the size of the catchment there was expected to be spatial variation in the rainfall across the catchment, as it would not rain uniformly across the catchment. To account for this spatial variation an areal reduction factor (ARF) was applied to the design rainfall depth.

The model parameters determined from the calibration, along with 100 year ARI design rainfall depths, patterns and ARF were applied to the hydrologic model to determine the predicted 100 year ARI event peak flow. The hydrologic model was run for a number of storm durations to determine the critical duration. The critical duration was the storm duration that produced the peak flows. The RAFTS hydrologic model indicated a 100 year ARI event peak flow at 3,560 m^3/s with a critical duration of 24 hours. This included an ARF of 0.82 for the 100 year ARI 24 hour event.

To validate the parameters developed for the hydrologic model, a flood frequency analysis (FFA) was undertaken on the Deverill gauge to determine the 100 year ARI event peak flow. The catchment area to the Devervill gauge was 4,092 km^2, therefore, the predicted flow was proportioned by catchment area to approximate the flow at the Project Site. The FFA analysis was undertaken and fitted to a Generalised extreme value distribution which represented the most appropriate distribution for the stream flow records.

The FFA indicated a 100 year ARI peak flow at the Project Site at 3,110 m^3/s. Comparison between the hydrologic model and the FFA indicates a good agreement between the hydrologic model (3,560m^3/s) and the FFA (3,110 m^3/s) for the 100 year ARI event. The hydrologic model predicted the peak flow approximately 12 per cent higher than the FFA. This was considered appropriate for use as the hydrologic model with predict a conservative result for the flooding.

The hydrologic model was therefore considered appropriate to be used for input into a hydraulic model to determine regional flooding characteristics.

6.1.1.3 Project Site Catchment Hydrology

Similarly to the Isaac River, no historically recorded stream flow data is available for the unnamed drainage paths Daunia and Daunia East. The model parameters from the calibrated Isaac River hydrologic model were used to estimate the 100 year ARI event peak flows for Daunia and Daunia East. **Table 6-5** outlines the model parameters used for the Project Site.

Table 6-5 Project Site Model Parameters

Manning's *n*	0.045
Initial Loss	15 mm
Continuing Loss	2.5 mm
Catchment Slope	0.65%

The predicted flows for Daunia and Daunia East for the 100 year ARI event at the confluence with the Isaac River are 76 m^3/s and 99 m^3/s respectively, with a critical duration of 9 hours.

There were no historically recorded stream flow data available for New Chum Creek. The flows in New Chum Creek have been calculated by Connell Hatch (2008). The 100 year ARI event peak flow was predicted to be 156 m^3/s.

6.1.1.4 Existing Flooding Characteristics – Mining Areas

Regional flooding is dominated by the Isaac River. Flooding in the mining areas is potentially affected by regional flooding from the Isaac River and local flooding from the unnamed drainage paths, Daunia and Daunia East. Therefore the hydraulic model accounts for regional flooding from Isaac River and local flooding from Daunia and Daunia East. In contrast, where New Chum Creek crosses the Project Site it is well upstream from the confluence with the Isaac River and will only be impacted by local flooding. Therefore a separate localised hydraulic model of New Chum Creek was created for the infrastructure area of the Project Site.

The existing regional flooding characteristics were determined using a hydraulic model, MIKE21. MIKE21 is a two dimensional package developed by the Danish Hydraulics Institute (version 2007). The MIKE21 model represents the model area topography as a terrain grid, with the following parameters input to the model to define flow behaviour:

- design inflow time series; and
- terrain resistance (entered as Manning's roughness).

The terrain for the hydraulic model represents the topography of the model area including rivers, creeks, roads, railway and variation in terrain elevation. The terrain for the hydraulic model was developed as a 6 m grid from a digital elevation model produced from a photogrammetric survey.

The terrain resistance is represented as Manning's n which was applied based on land use, with these parameters determined from aerial photography. A Manning's n of 0.045 for rural pasture was applied to the hydraulic model.

Hydraulic modelling of the existing Project Site also accounted for changes associated with the Poitrel Mine. This includes the recently constructed New Chum Creek diversion and the proposed Isaac River levee.

The existing inundation for the 100 year ARI event is presented in **Figure 6-5**. This figure indicates that flooding in the vicinity of the Project Site is dominated by the Isaac River. Flooding within the Project Site is not significant and is limited to the southern section of the site. The flooding within the Project Site is due to the limited capacity of the drainage paths on site rather than flooding from the Isaac River. Due to the insignificant flooding for the 100 year ARI event, smaller ARI events were not modelled for the Project Site.

6.1.1.5 Existing Flooding Characteristics – Infrastructure Area

The existing flooding characteristics for the Infrastructure Area were determined using a hydraulic model, TUFLOW. TUFLOW is a fully linked 1D/2D hydrodynamic software package. The TUFLOW model represents the model area topography as a terrain grid, with the following parameters input to the model to define flow behaviour:

- design inflow time series; and
- terrain resistance.

The terrain resistance was applied based on land use, with these parameters determined from aerial photography and a site investigation. A Manning's n of 0.06 for rural pasture and 0.08 for New Chum Creek was applied to the hydraulic model.

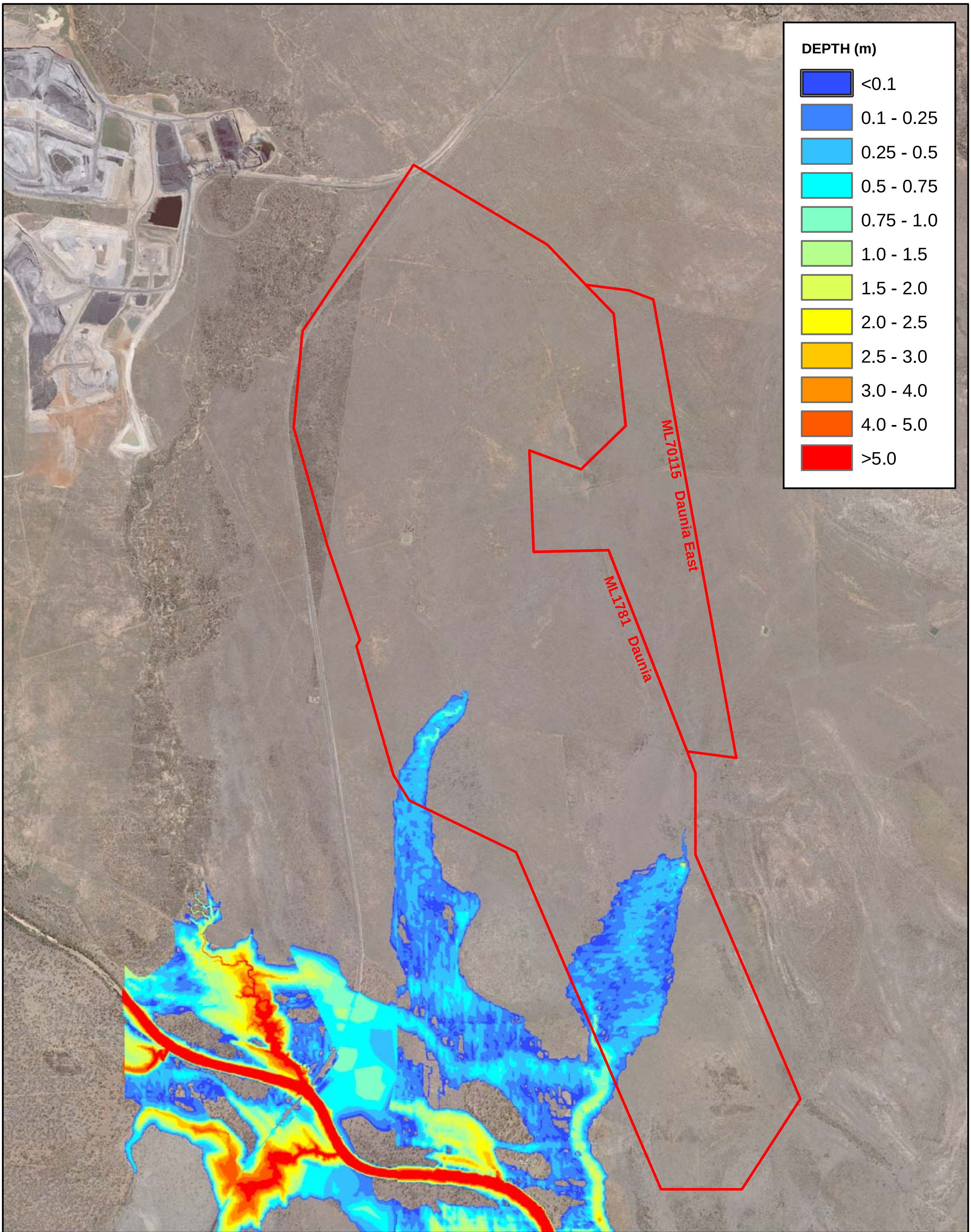
The existing inundation for the 100 year ARI event is presented in **Figure 6-6**. This figure indicates the flooding from the 100 year ARI event in New Chum Creek includes flooding in the channel and the floodplain.

6.1.1.6 Existing Water Users

A search was undertaken of the DNRW database on surface water extraction licences in the vicinity of the Project Site, which indicated that there are two Water Licences attached to a single property downstream of the Project Site. The details on these licences are contained in **Table 6-6**. Both licences are for the taking of water from the Isaac River at a location within 3 km of the Project Site.

Table 6-6 Details of Existing Surface Water Extraction Licences

Lot / DP	Purpose
Lot 18 SP113322	Water harvesting
Lot 18 SP113322	Water harvesting



LEGEND

Mining Lease

FIGURE 6-5
DAUNIA COAL MINE EIS

100 YEAR ARI EVENT - EXISTING CASE
INUNDATION MAP MINING AREAS

0 0.5 1 1.5 2

Kilometres

Scale 1:50,000 on A4

Projection: Australian Map Grid - Zone 55 (AGD84)

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6.1.2 Potential Impacts

The Project has the potential to impact surface water resources in the vicinity of the Project Site including:

- changes to flooding characteristics;
- changes to water availability; and
- impacts on water quality.

6.1.2.1 Impacts on Regional Surface Water Hydrology

The mining areas of the Project Site cover 26 km^2 compared with the 3,640 km^2 catchment area of the Isaac River upstream of the Project Site. Removing the mining areas from this catchment will reduce the upstream Isaac River catchment by 0.7 per cent, therefore flows in the Isaac River will be reduced very marginally and will have negligible impact downstream of the Project Site. The Project will thus not impact the water extraction licences in the vicinity of the Project Site.

6.1.2.2 Flooding Impacts – Mining Areas

The flooding predicted in the mining areas of the Project Site results from local flooding caused by the two drainage paths that flow through the site. The runoff from the Project Site will be managed as outlined in the **Section 6.1.2.4**.

The Isaac River flooding does not affect the Project Site therefore flood protection is not required for the Project operations.

As discussed in **Section 6.1.2.1**, the Project will remove 0.7 per cent of the upstream Isaac River catchment. This means there will be a reduction in peak flow in the Isaac River at the Project Site which would result in a very minor reduction in flood levels in the area.

6.1.2.3 Local Flooding Impacts – Infrastructure Area

The Project includes a proposed haul road crossing of New Chum Creek on the Poitrel mining lease (ML70116). The culvert design has been undertaken by Connell Hatch (2008). The proposed culvert configuration is 3 x 2.4 m diameter reinforced concrete pipes (RCP) for the channel crossing and a floodplain crossing with a configuration of a causeway and 9 x 1.8 m diameter RCPs. This crossing of New Chum Creek is predicted to increase flood levels. The predicted flooding impacts from the crossing are shown in **Figure 6-7**. This figure shows there are some localised increases in flood levels at the mining lease boundary. The flooding impacts only occur up to 400 m upstream of the mining lease boundary.

6.1.2.4 Site Water Management

The water management for the Project Site will be undertaken using the following principles:

- undisturbed area runoff from the mining areas of the Project Site and its vicinity will be diverted away from disturbed areas by diversion drains, which will drain to the Isaac River;
- undisturbed area runoff from the infrastructure area of the Project Site will be diverted away from disturbed areas into New Chum Creek;
- disturbed area runoff will be captured in sediment dams and used preferentially for dust suppression or as process water in the CHPP; and
- an ability to transfer water between the mine and the CHPP to optimise the use of water on site.

Components of the Water Management System

The key elements of the water management system are:

- sediment dams;
- Process Water Dam; and
- pit water storage.

Rainfall runoff on the Project Site will be managed by a series of sediment dams, pit storage and diversion drains. Water collected in the mine pits will be pumped to sediment dams to maximise pit operability. Disturbed area runoff will also be directed to sediment dams.

The key features of the water management system enable the most fit for purpose use of water in the operations. The water from the sediment dams will be used to satisfy site water demands, including dust suppression, and transferred to the Process Water Dam to be used for process water in the CHPP. Raw water from BMA surface water allocations will be piped to the Project Site to supply clean water demands and to supplement site water demands as required.

There will be little risk of water discharges occurring from the Project Site to the Isaac River, except in an emergency or when a rainfall event exceeds the 10 year ARI event, 24 hour design criteria. Under such circumstances, controlled discharges may be made, resulting in negligible changes in the water quality of the Isaac River, as there would be significant flood flows in the river. Water quality impacts are discussed further in **Section 6.2**.

Sediment Dams

Sediment dams serve to remove sediment from disturbed area runoff, including runoff from spoil dumps.

The proposed design criteria of the sediment dams are:

- retain the flow from a 10 year ARI event, 24 hour storm for the catchment for sufficient time to settle 0.05 mm diameter (coarse silt) particles; and
- maximise the length of the dam relative to the width of the dam to maximise hydraulic retention time and deposition.

The sediment dams will also provide storage for pit water. Water from the pit will be pumped to the sediment dams to ensure the operability of the pits is maximised. Uncontrolled discharges from the sediment dams to

The methodology used to develop the water balance model was based on a stochastic rainfall generation. The purpose of the stochastic rainfall generation is to develop a range of climate sequences for the mine life based on the recorded historical rainfall data of the area. The stochastic rainfall data was generated from recorded historical data using the Stochastic Climate Library for 100 replicates of 20 year sequences of daily rainfall. This method allows assessment of a wide range of rainfall sequences which may be experienced in the mine life and the calculation of a range of exceedance probabilities.

The stochastic rainfall data for the Project Site was developed based on the rainfall gauges Isaac Rainfall gauge (034030) outlined in **Table 6-7**.

Table 6-7 Rainfall Gauge for Stochastic Rainfall Generation

Gauge No.	Gauge Name	Period of Record	Data Application	Comments
034030	Isaac	1963-1997	Daily Project Site rainfall	11 km south-east of (downstream) of Project Site

The water balance model generates runoff based on a conceptual soil storage capacity and base flow index. The soil storage capacity represents the depth of soil storage which must be filled before runoff occurs. This soil storage capacity was applied based on land use. The base flow index designates the rainfall that becomes surface runoff and a proportion that goes to groundwater. **Table 6-8** outlines the conceptual soil storage capacities and baseflow index for Project Site.

Table 6-8 Conceptual Soil Storage Capacity Parameters

Land Use	Soil Storage Capacity (mm)	Baseflow Index (%)
Mining Pits	35	90
Out of pit Spoil Dump	80	90
In pit Spoil Dump	80	90
Undisturbed area	120	5
Haul Roads/Ramps	35	0
Rehabilitated Spoil Dump	200	90

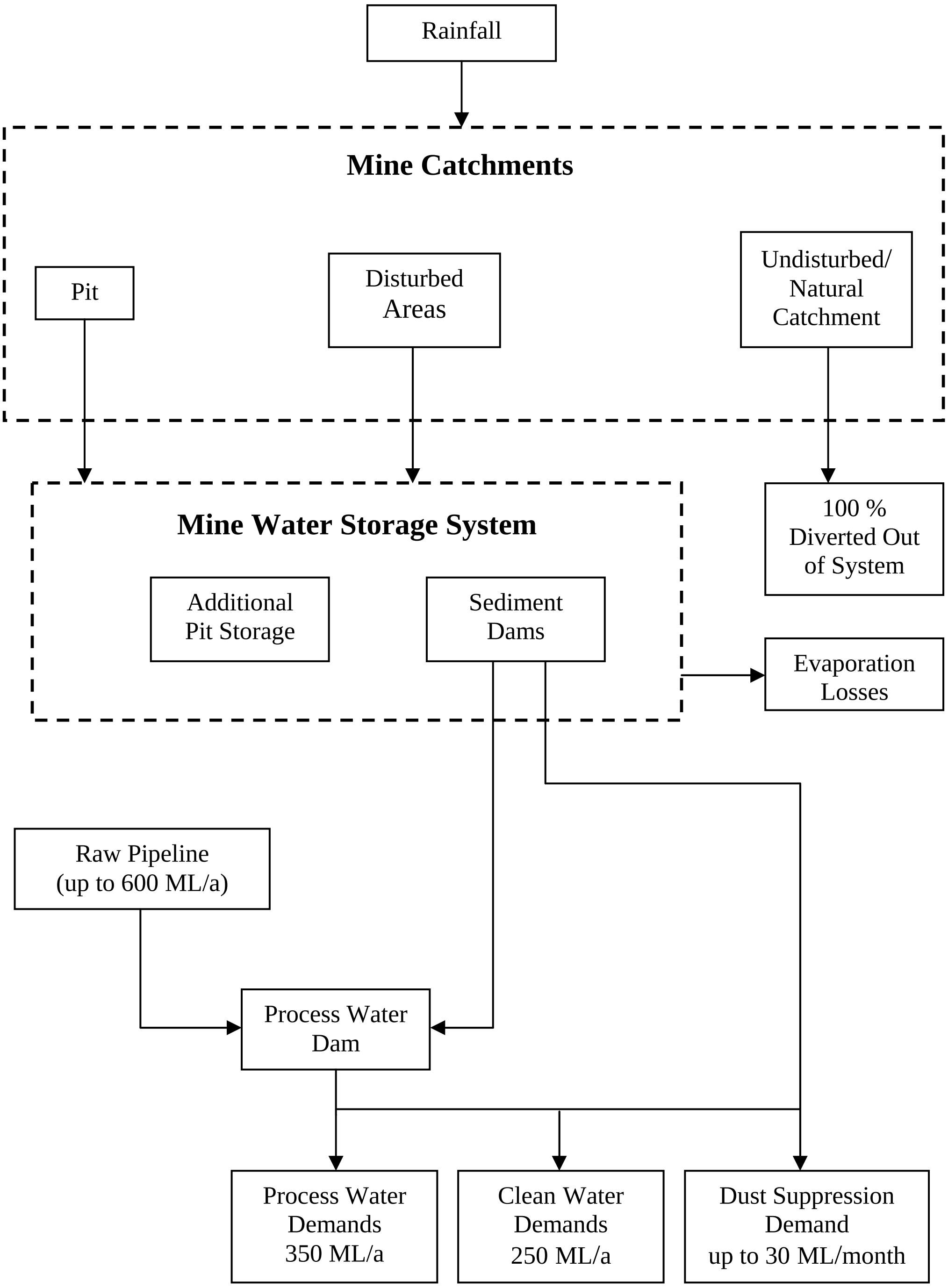

Figure 6-8 Water Balance Model Schematisation

Table 6-9 outlines the water balance model inputs and demands assumed for the Project.

Table 6-9 Water Balance Modelling Inputs and Demands

	Variable	Description
INPUTS	Rainfall	Isaac gauge (034030) and Moranbah Water Treatment Plant gauge (034038)
	Runoff	Rainfall converted to runoff via conceptual soil storages dependant on land uses on the site.
	Groundwater	Groundwater seepage into pit was ignored based on the low inflows predicted.
	Raw Water Pipeline	Water to be used for clean water demands and to be used to supplement site demands as required.
DEMANDS	Evaporation	Monthly average total evaporation was developed for the gauge at Moranbah Water Treatment Plant (034038). This gauge covers the historical period of 1986 to 2004.
	Storage seepage	Ignored for conservatism.
	CHPP	Demand commences at start of Year 1 Production. Assumed constant at 350 ML/a for life of mine.
	Dust Suppression	Assumed to be constant for conservatism, demand predicted to be up to 30 ML/month.
	Potable Water & Clean Water	250 ML/a allows for potable water demands and water for flocculent make-up, gland seals and fire water.

The water balance model calculates water movement for the operations on a daily resolution and is based on the mine sequence plans as shown in **Figure 3-6** to **Figure 3-10**.

The storages of the Mine Water Management System have been sized either for operational or runoff control depending on their purpose. A summary of the storages and their sizing is shown in **Table 6-10**.

All storages will be more than 60 cm deep, the minimum depth recommended to minimise mosquito breeding (Queensland Health, 2002).

Table 6-10 Summary of Mine Water Management System Storages

Storage	Design Criteria	Minimum Volume (ML)
Process Water Dam	Operation	1,500
Sediment Dams (Total capacity required all sediment dams)	Operation Runoff control Design Storm = 10 year ARI 24hr	2,900
Pit Storage		> 50,000

Water Balance Results

The water balance model was used to predict the reliability of the demands for the operations including the clean water, process water and dust suppression demands from varying water sources. The model also predicts the adequacy of the site storage to manage extreme rainfall events. The model was run for the 20 year mine sequence which equates to 7,300 days.

Figure 6-9 shows the 50 per cent and 99 per cent exceedance probability of the storage volume for the Process Water Dam. This figure shows the Process Water Dam is predicted to have water at least 99 per cent of the time. Similarly, there is a 50 per cent probability that the level in the Process Water Dam will remain above 400 ML.

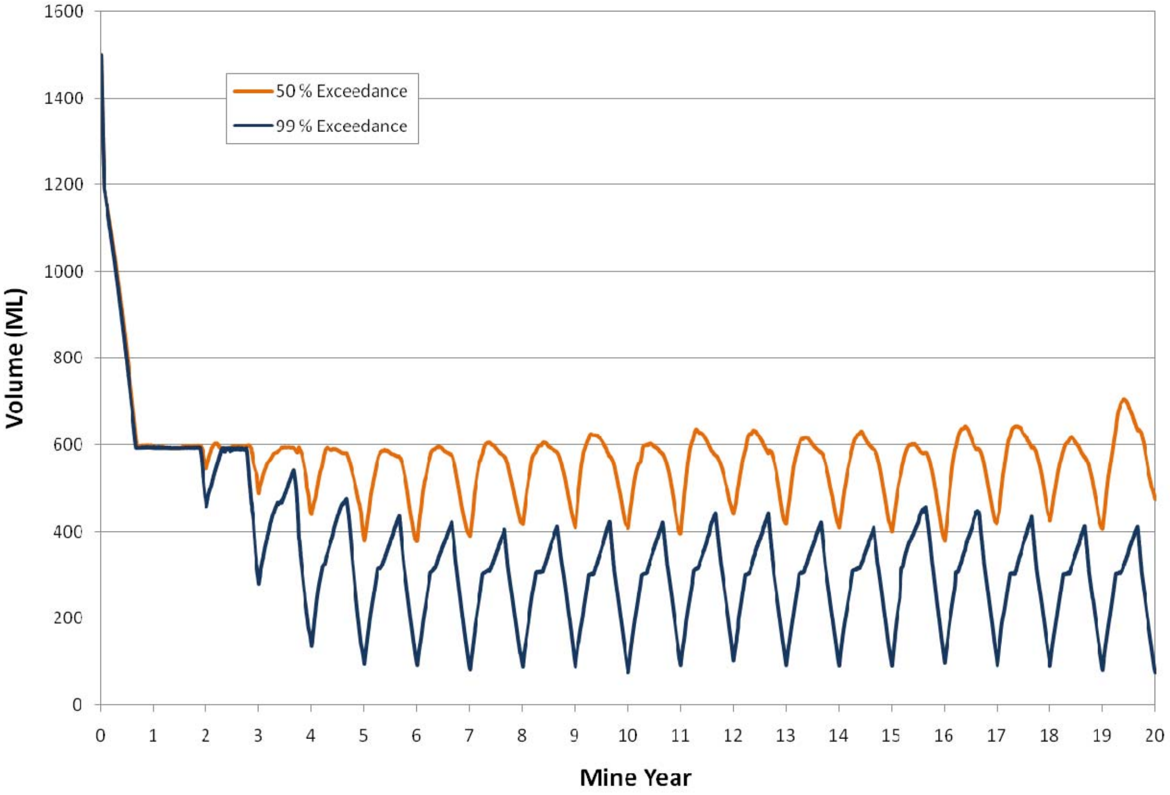

Figure 6-9 Process Water Dam Storage Volume

Table 6-11 outlines a summary of the reliability of the site demands. **Figure 6-10** presents the results of the dust suppression demands for the Project Site. The figure shows the cumulative number of days the dust suppression demand was not fully satisfied for the 50 per cent and 5 per cent exceedance probability.

Table 6-11 Reliability Demand for Site

Demands	Number of Days Demand Not Fully Supplied		Number of Days Demand Supplied (%)		Total Mine Life Volume Deficit (ML)	
	50% Exceedance	5% Exceedance	50% Exceedance	5% Exceedance	50% Exceedance	5% Exceedance
Clean Water	0	0	100	100	0	0
CHPP Demand	0	0	100	100	0	0
Dust Suppression	140	620	98	92	150	600

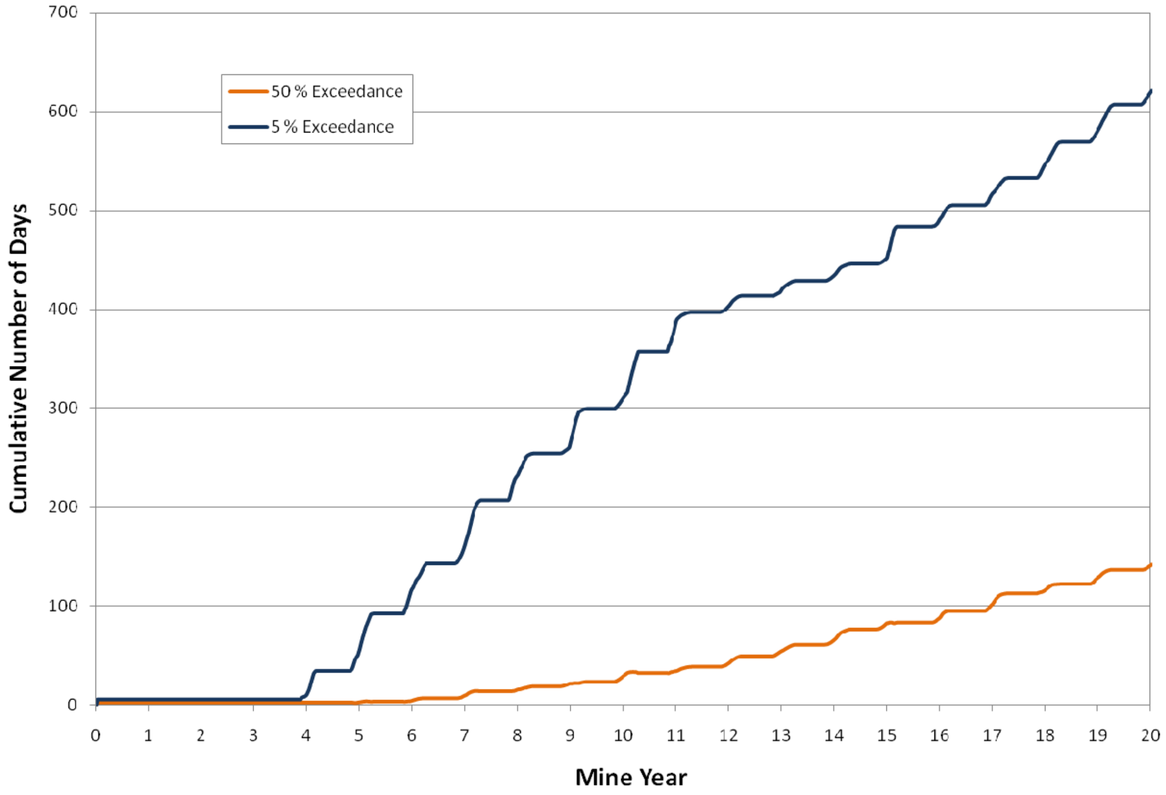

Figure 6-10 Cumulative Number of Days Dust Suppression Demand Not Fully Satisfied

This table and figure shows the clean water and CHPP demands are fully satisfied for 100 per cent of the days of the operation. They also illustrate the reliability to supply the dust suppression demands. The dust suppression demand only has a shortfall for 2 per cent and 8 per cent of days for the 50 per cent and 5 per cent exceedance probability, respectively. This means there is only a 5 per cent probability that the operation will not be able to fully satisfy the dust suppression demands for at least 92 per cent of the days of operation. Also the deficit volume for dust suppression demand is small, with the median (50 per cent exceedance probability) at 150 ML over the 20 year mine life compared to a maximum of 30 ML/month demand, therefore the Project operations are considered to have sufficient water supply. The operations will primarily be sustained by water captured on site and then supplemented by the raw water to be piped to the Site from BMA allocations.

Figure 6-11 shows the predicted releases from the Project Site for the 1 per cent and 5 per cent exceedance probability. This figure shows there are infrequent releases from the Project Site and it illustrates that there is predicted to be only a 1 per cent probability of having seven releases and just a 5 per cent probability of having two small releases less than 20 ML. These releases would easily be managed by optimising the storage volumes on site and then finally transferring water to the mining pits.

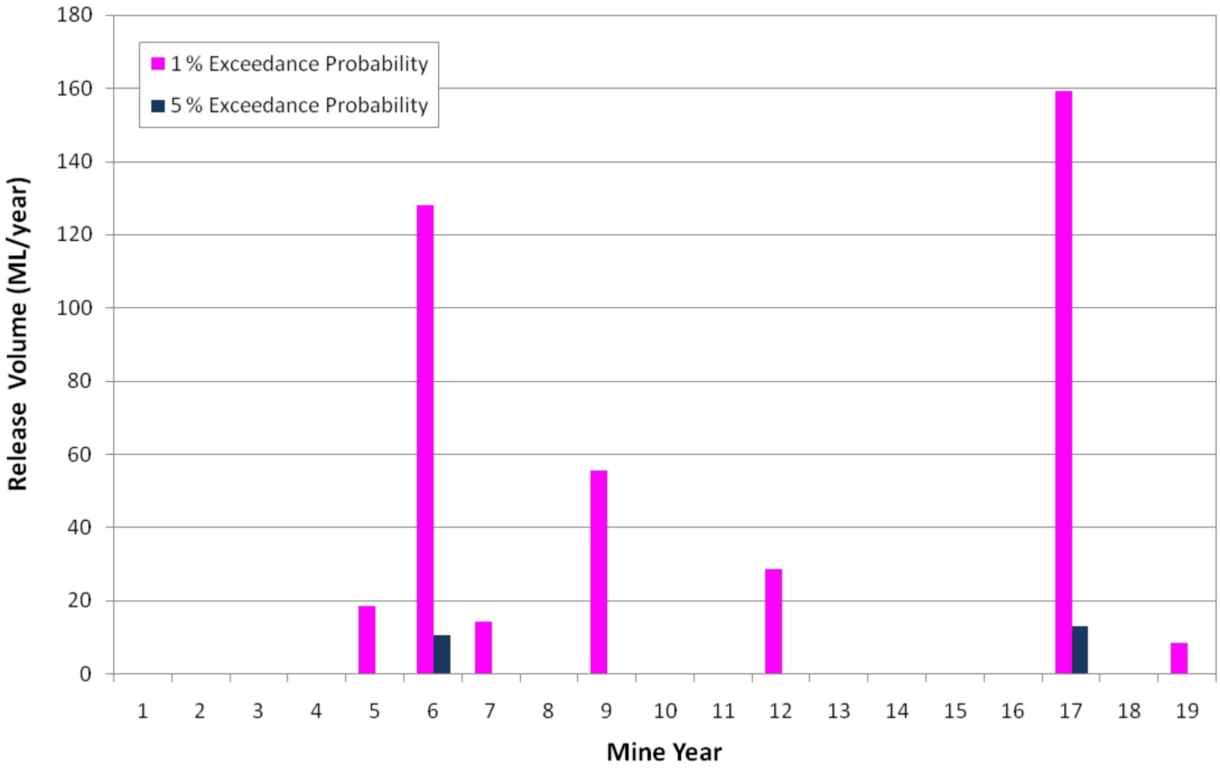

Figure 6-11 Releases from the Project Site

The water balance model predicts that the maximum volume of water to be stored in the mining pits as a result of a major rainfall event is 2,000 ML. This volume is in addition to the water stored in the sediment dams and the Process Water Dam and will be easily contained within the pit storage.

6.2 Surface Water Quality

6.2.1 Ephemeral Waters

New Chum Creek, in the infrastructure area, and the unnamed drainage paths, Daunia and Daunia East, in the mining areas of the Project Site are ephemeral, only flowing or containing water after rainfall or flow events. Ephemeral waters are variable in their water quality due to the irregularity and intensity of flow/rainfall events. The variability in the rainfall/flow-drought cycle of ephemeral waterways can lead to variations in the physical and chemical properties of the water compared with more permanent water bodies. Variations in water quality may exist over small spatial scales resulting from differing land management practices, and local industry discharging or releasing waters into ephemeral streams. Therefore, the current *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC Guidelines) (ANZECC 2000) are often not suitable for ephemeral environments. Two characteristics that often typify ephemeral waterways are high turbidity and high sediment loads. Large flow events will generally carry a large sediment load and this sediment load can be intensified by a long dry period.

From an ecological perspective the period for which waters within ephemeral waterways are connected, the frequency of connectivity, and the physical/chemical properties of these waters are important factors to the survival of aquatic communities.

Table 6-14 Water Quality data from New Chum Creek (source BMA - Poitrel Mine)

Site Location	Date	pH	Conductivity µS/cm	Suspended Solids mg/L
Downstream - New Chum Creek	20/12/2007	7.99	351	332
Downstream - New Chum Creek	10/01/2008	7.93	237	202
Downstream - New Chum Creek	19/03/2008	8.52	2510	23
Downstream - New Chum Creek	20/03/2008	8.42	2310	21
Downstream - New Chum Creek	25/03/2008	8.28	2190	No Data
Downstream - New Chum Creek	7/04/2008	8.54	2420	No Data
Downstream - New Chum Creek	8/04/2008	8.56	2345	No Data
Downstream - New Chum Creek	9/04/2008	8.34	2260	No Data
Downstream - New Chum Creek	10/04/2008	8.43	2250	No Data
Downstream - New Chum Creek	11/04/2008	8.54	2310	No Data
Downstream - New Chum Creek	14/04/2008	8.45	2340	No Data

Further water quality information was collected during a single monitoring event on 8 – 12 April 2008. This included 2 sites on New Chum Creek within the infrastructure area and 6 sites within the mining area of the Project Site. Information from this monitoring event is presented in the following section.

6.2.3.2 Project Site Mining Areas

The mining areas of the Project Site are drained by two unnamed drainage paths, Daunia and Daunia East. These two drainage paths merge downstream, off lease, before flowing into the Isaac River. The catchments for these drainage paths are described in **Section 6.1**. A typical photograph of a section of these drainage paths is shown in **Figure 6-12**

The mining areas of the Project Site have a history of grazing. These practices can lead to a decline in soil structure, surface crusting and soil compaction. These soil characteristics can increase soil exposure (through a reduction in vegetation) and reduce water infiltration. These two factors can increase the level of runoff and reduce available water.

Figure 6-12 Typical drainage path section on the Project Site mining areas

No previous water quality data is available for drainage paths Daunia and Daunia East. A single monitoring event was therefore undertaken during 8 to 12 April 2008. The monitoring locations are shown in **Figure 6-13**.

The following field water quality parameters were determined *in situ* at eight sites within the Project Site:

- Temperature (ºC)
- pH
- Dissolved Oxygen (‘parts per million’ and % saturation)
- Electrical Conductivity (µS/cm)
- Turbidity (NTU)

No water quality data was recorded at Site 6, which was dry during the monitoring event.

Each of the water quality parameters were determined using a TPS multi-parameter water quality probe and logger. The measurements were obtained in accordance with the manufacturer’s guidelines. The measurements were taken near the centre of the water source at each site, at a depth of approximately 15 cm. Where data readings fluctuated without stabilising within 5 minutes, multiple records were obtained for later analyses.

The results of the field water quality sampling at the Project Site are shown in **Table 6-15** and represented graphically in **Figure 6-14** to **Figure 6-18**.

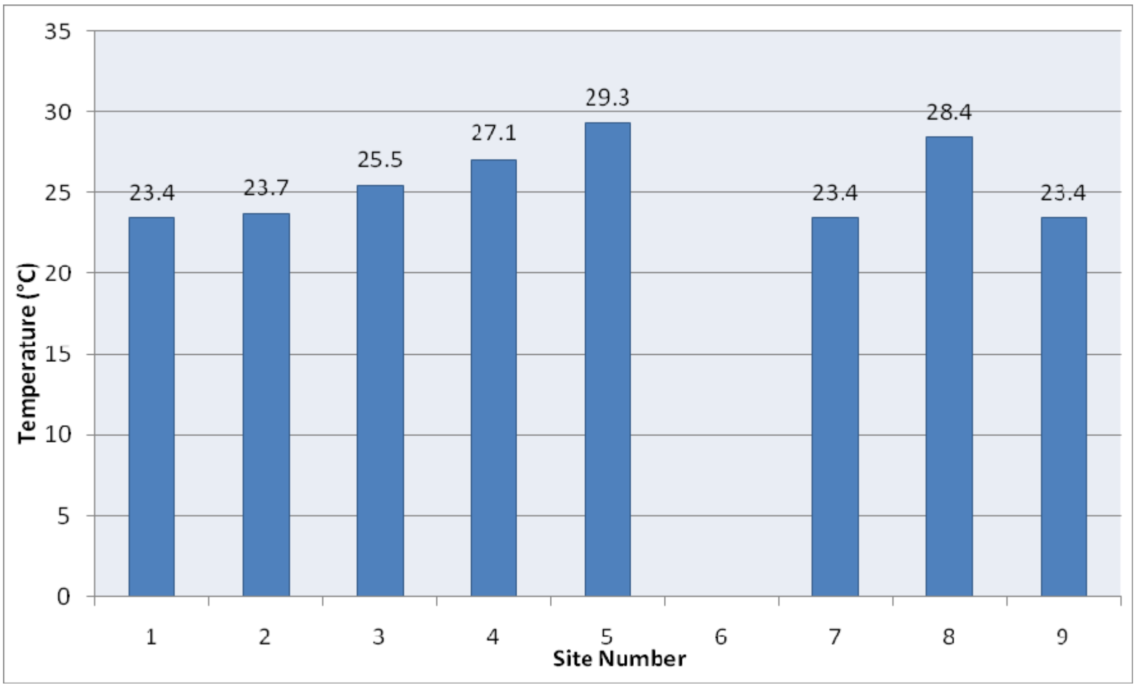

Figure 6-14 Temperature results for Sites 1 – 9

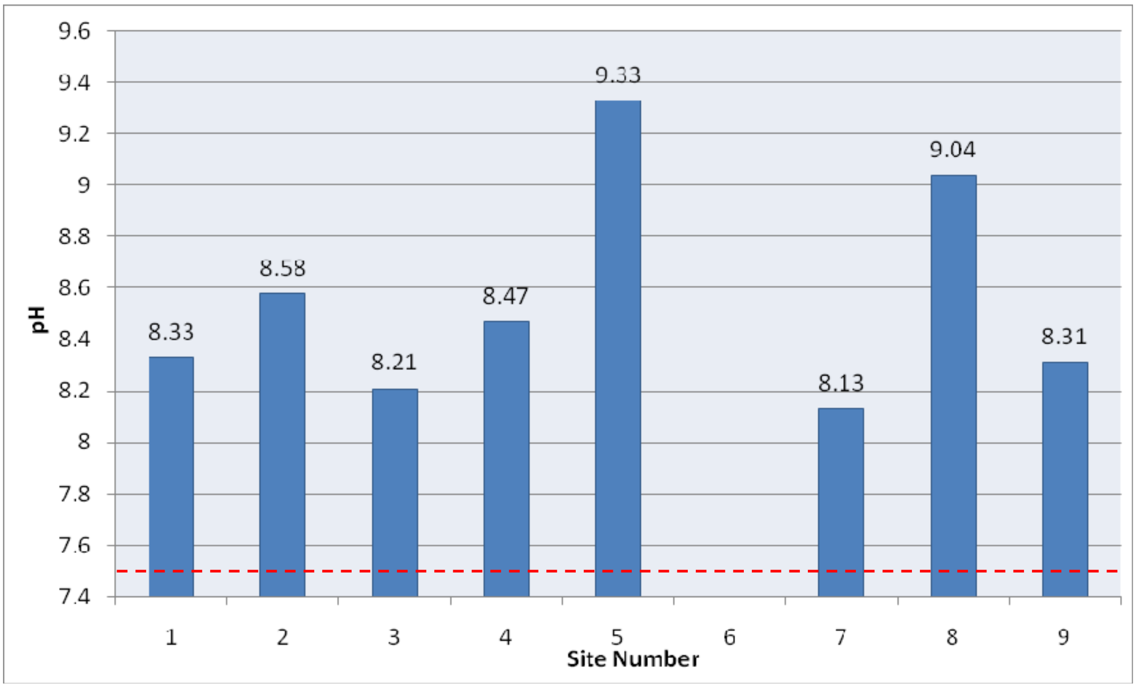

Figure 6-15 pH results for Sites 1 – 9 (Red dotted line indicates QWQGs upper exceedance value)

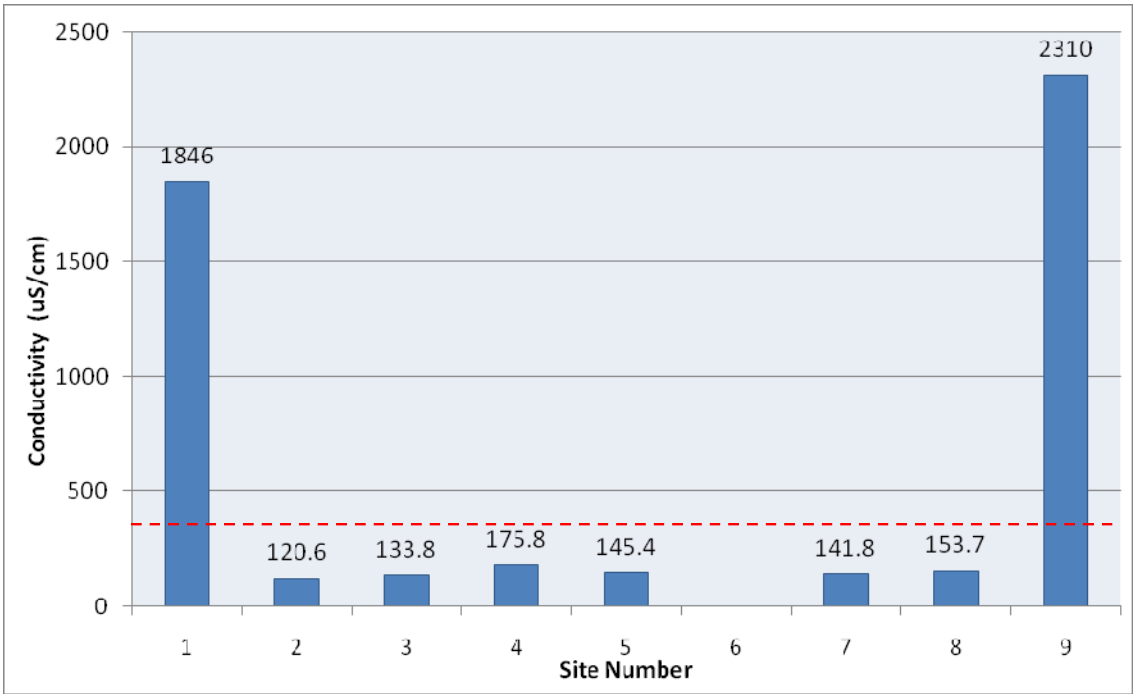

Figure 6-16 Conductivity results for Site 1 – 9 (Red dotted line indicates upper QWQG exceedance value)

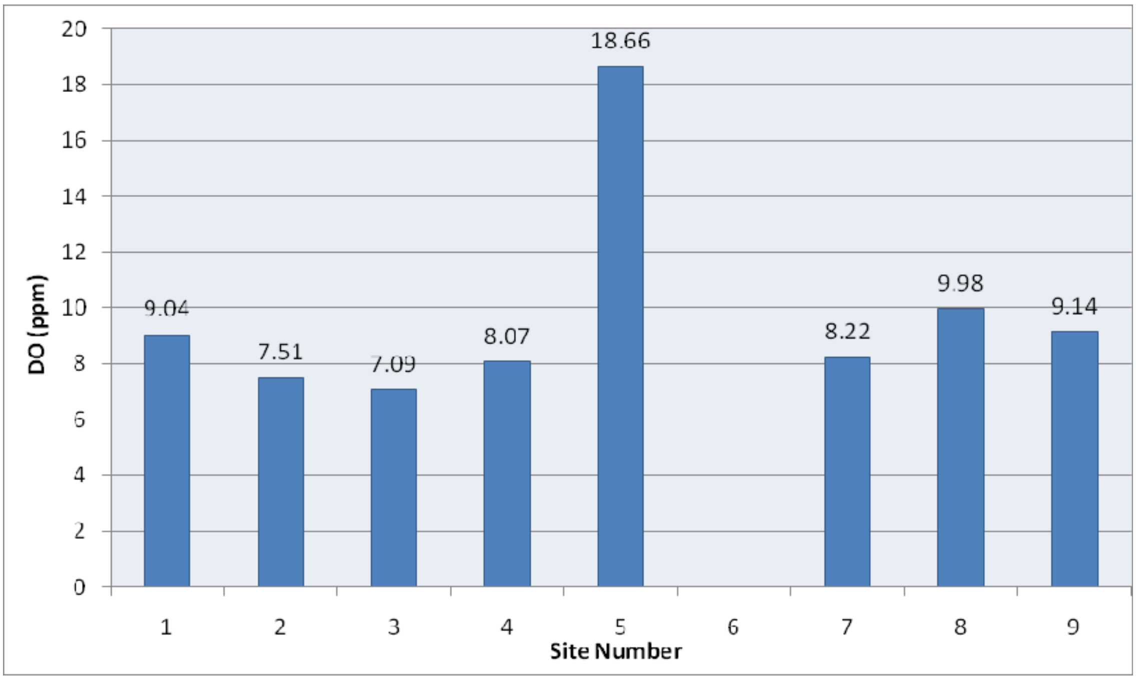

Figure 6-17 Dissolved oxygen results for Sites 1 – 9

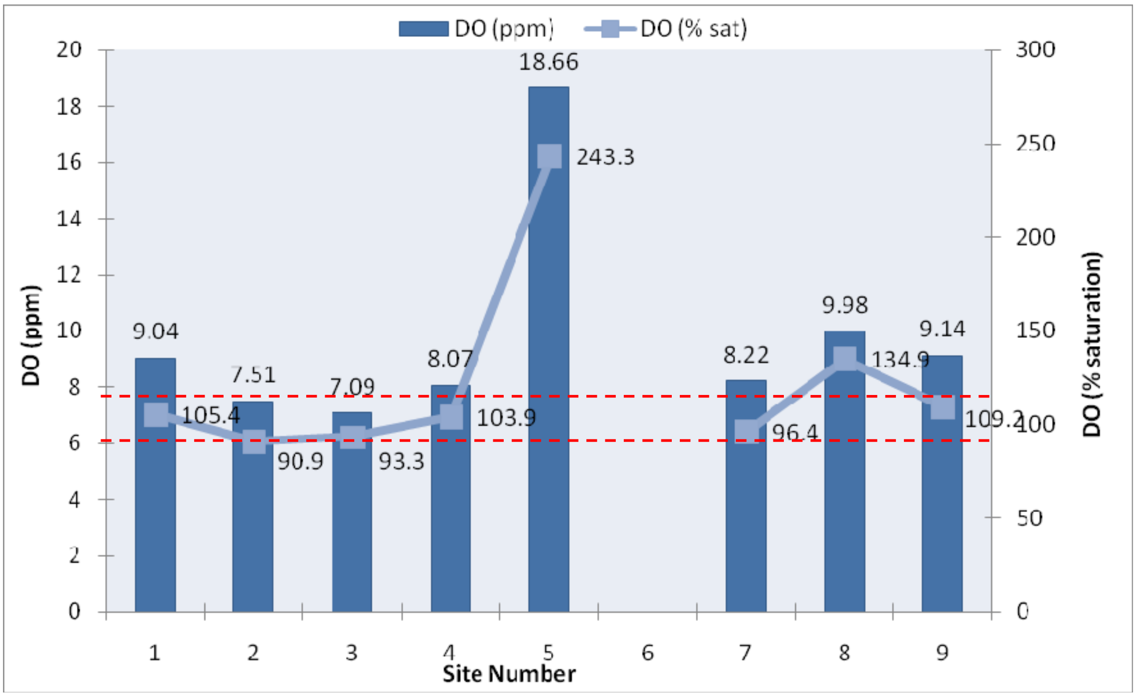

Figure 6-18 DO (ppm) comparison with DO (% saturation) for Sites 1 – 9 (Red dotted line indicates QWQG exceedance value for % saturation)

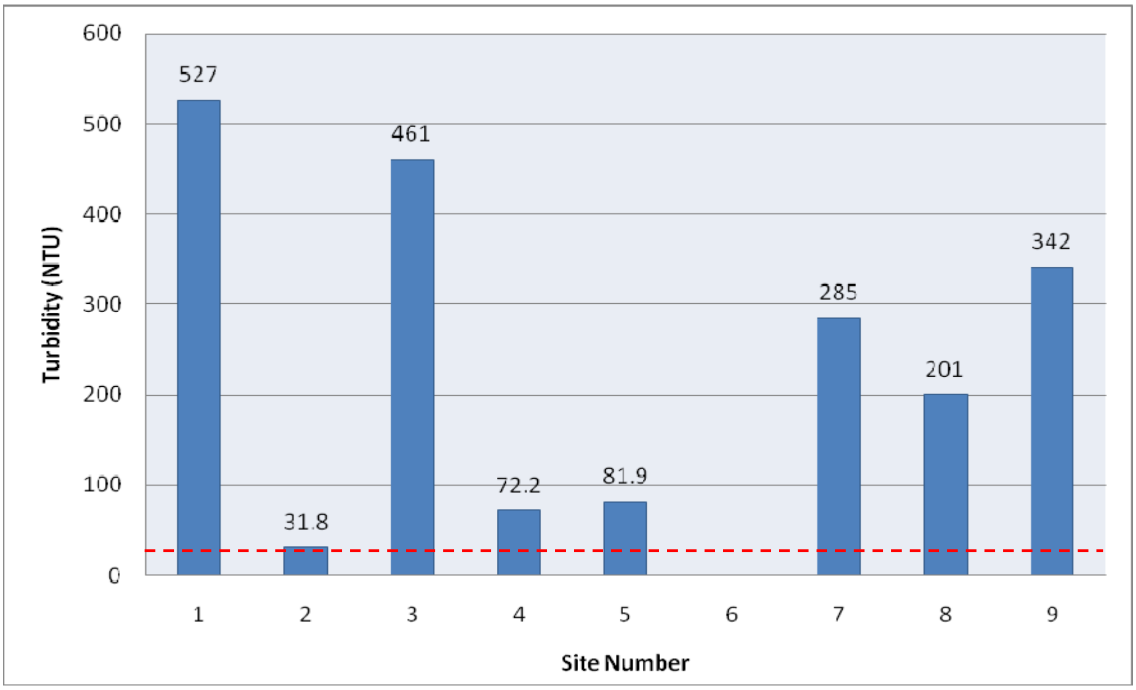

Figure 6-19 Turbidity results for Sites 1 – 9 (Red dotted line indicates upper QWQG exceedance value)

Table 6-17 Water quality data for the Isaac River

Isaac River - US	**pH**	**Conductivity (µS/cm)**	**Temperature (°C)**
Average	7.68	842.63	19.3
Median	7.27	677	19.2
No. of Data Points	21,472	27,156	31,380
Guideline Value	6.5 – 7.5	720	N/A
Isaac River - DS	**pH**	**Conductivity (µS/cm)**	**Temperature (°C)**
Average	7.78	952.87	20.1
Median	7.78	833	19.8
No. of Data Points	19,480	29,295	33,201
QWQG Guideline Value	6.5 – 7.5	720	N/A

Note: data points cover the period between 29/10/2007 to 25/09/2008 from BMA Poitrel Mine Monitoring.

The average and median values for water quality for Isaac River are above the guideline value. The pH values are consistent with the long term data set obtained from DNRW. Mean conductivity data measured by BMA (953 µS/cm) is significantly higher than the long term mean measured at the DNRW Deverill Gauge (463 µS/cm).

6.2.3.4 Other Sources of Water Quality Data

A State of the Rivers (SoR) report was completed in November 2005 for the Fitzroy and Isaac Rivers and Capricorn Coastal Tributaries (State of the Rivers, 2005). Although the SoR does not directly address water quality, it does give an indication of the health of the catchment area. Two sites were located on North Creek, to the east of the Project Site, and both fall into the Isaac Northern and Central Floodplains sub-catchment. The results detail that 35 per cent of the stream length was in good condition, 38 per cent was in moderate condition, 24 per cent was in poor condition and 3 per cent was in very poor condition.

6.2.3.5 Surface Water Quality Summary

The mining area of the Project Site has been highly disturbed by grazing and the encroachment of the exotic species, Buffel Grass (*Cenchrus ciliaris)*. The effect of grazing has exposed soils to sheet erosion across the site and this has added to the high turbidity concentrations within the drainage paths. Further to this, recent rainfall events in January and February have resulted in the high turbidity levels recorded across the Project Site. High turbidity within the Project Site was expected. Due to the morphological structure of Buffel Grass, the soil surface area that can be impacted on by water has increased. This can lead to increase runoff during rainfall event.

In the infrastructure area of the Project Site, the release of water down New Chum Creek by an upstream user during the sampling period does not reflect the natural water quality conditions, although it does reflect the current condition of this creek. Turbidity, pH and conductivity are all higher than the QWQG guideline for the two sites located in New Chum Creek (Site 1 and 9). The QWQGs must be taken in context for ephemeral streams. The guidelines have not been specifically developed for such ephemeral environments.

Typical Environmental Authority release criteria for EC and pH are:

- EC < 2500 µS/cm
- pH 6.5 – 9

These criteria are consistent with minimising impacts on the ephemeral waters in question, based on the water quality data reviewed and collated in the EIS. They are also consistent with the aquatic ecology environmental values identified in **Section 9**.

6.2.4 Potential Impacts

6.2.4.1 Construction

During Project construction, the primary impacts will relate to the physical disturbance of land in the Project Site, runoff from disturbed areas, reduction in catchment area and the subsequent potential impacts on water quality within the remaining unnamed drainage paths, New Chum Creek and the Isaac River.

The contribution from the mine will reduce the Isaac River catchment by 0.7 per cent. The loss of catchment area will reduce the available water flowing down stream and impact on water quality. The reduction in water flowing to the remaining sections of the unnamed drainage paths will result in smaller volumes entering the system. This will reduce the amount of flow within the system and therefore the flushing capacity of the system. Stagnating water can cause changes in water quality (i.e. variability in dissolved oxygen and pH concentrations and increased temperature). The degree to which the catchment area will be reduced is dependent on the stage of the mine. The lower half of the lease is not planned to be mined until 15-20 years into the life of the mine and as such should remain in its current condition until mining progresses into this area. The ecological value of the habitats represented in the aquatic flora and fauna section demonstrate low regional significance and impacts from changes in water quality on these habitats should not cause a significant impact.

The reduction in catchment area will reduce the amount of available land for natural runoff. Given the previous and current land uses of the Project Site and its current condition, sediment runoff may be reduced within the catchment area.

The key activities that will require mitigation measures to prevent or minimise adverse water quality impacts are presented as follows:

- Hydrocarbon spills from the CHPP area, vehicles, and other plant and equipment contaminating surrounding water with chemicals, hydrocarbons, oil and grease.
- Clearing of vegetation and stripping of topsoils.
- Handling and storage of fuels during construction.
- Short term decreases in water quality from rainfall events and construction related activities (i.e. soil disturbance and construction runoff such as hydrocarbons).
- Any releases of water from the site from site sedimentation dams.

6.2.4.2 Operation
The operational activities which have the potential to compromise water quality conditions at the Project Site include the following.

- Runoff from the Project Site resulting in increased sediment and pollutant loads into the waterway.
- Operation and management of bunded fuel tanks, dangerous goods containers, hazardous chemicals and workshop wastes (filters, batteries) plus handling and storage of fuels on site.

Water releases into waterways will only be undertaken by the Proponent in an emergency or when a rainfall event exceeds the 1 in 10 year ARI event, 24 hour design criteria. Under such circumstances, controlled discharges may be made, resulting in negligible changes in the water quality of the Isaac River, as there would be significant flood flows in the river.

6.2.5 Mitigation Measures
Mitigation measures have been devised to provide protection of the surface water quality and associated environmental values for the Project.

6.2.5.1 Construction
The following management mitigation measures will be implemented.

- Sediment control measures will be established to reduce the amount of runoff from areas that have had vegetation removed.
- Bunding and appropriate storage of fuels and other hazardous/ flammable materials in accordance with of AS1940:2004 (Section 5.8 Bunds and Compounds).
- Refuelling locations and handling of fuels shall be undertaken away from all waterways including creeks and drainage paths.
- A Mine Water Management Plan will be developed for the Project to ensure the protection of surrounding waterways from mine activities.
- A water quality monitoring program will be developed for the construction phase of the Project. The program will ensure that the Mine Water Management Plan is effective and downstream water quality (physico-chemical parameters) are not adversely effected.
- Work methods will be developed and included in the Contractor Environmental Management Plans. These methods will detail appropriate control and mitigation measures for the Project.

6.2.5.2 Operation
The controls to mitigate any environmental impacts from operational activities will need to be detailed in the EM Plan. The types of mitigation measures that will need to be implemented are outlined below.

- A Mine Water Management Plan will be developed for the operational phase of the Project to ensure the protection of surrounding waterways during operation.
- Sediment dams, environmental dams and pit water storage will be used as part of the Mine Water Management Plan.
- The separation of water based on quality.

  - Clean – areas of the Mining Lease (ML) that are not impacted by mining operations. Water in this area will be diverted around the operational areas so that it does not come into contact with contaminants. Drains will be constructed as per industry practice.
  - Disturbed – Areas within the ML that have been disturbed by mining operations. These areas may generate sediments but are generally free of containments. These areas include rehabilitated areas, topsoil dumps and access roads for light vehicles. The water will be diverted to sediments dams where the sediment can be removed before any flows into natural waterways occur.
  - Operational – these areas are defined as potentially contaminated and include areas such as coal stockpiles, infrastructure areas, processing and waste rock dumps. This water will be contained within the mine water dam and will, preferably, be reused.
- A water quality monitoring program will be developed for the operational phase of the Project. The program will ensure that the Mine Water Management Plan is effective and downstream water quality is not significantly affected, and meet the proposed Environmental Authority conditions in **Appendix P**.
- Appropriate sediment management controls will be implemented in areas with exposed soils.
- On-going revegetation / maintenance of areas impacted by construction and operational activities will be undertaken in order to reduce the amount of exposed soil.
- Management of bunded fuel tanks, dangerous goods containers, hazardous chemicals and workshop wastes (filters, batteries) plus handling and storage of fuels during operation will be implemented.
- Spill recovery equipment should be available when working adjacent to rivers and drainage paths. If a spill occurs, work is to stop immediately and the spill appropriately cleaned up as per best practice methods.
- Refuelling locations and handling of fuels shall be undertaken away from creeks and drainage paths.

With the introduction of a Mine Water Management Plan and the appropriate bunding of fuels and chemicals, impacts on water quality from the Project will be reduced considerably. There will be little change to the water quality of the Isaac River downstream of the Project Site.