BIG ISLAND MINING PTY LTD

ABN 12 112 787 470

Dargues Reef Gold Project

SURFACE WATER Assessment

Prepared by

SEEC

(Strategic Environmental and Engineering Consulting)

SEPTEMBER 2010

Specialist Consultant Studies Compendium
Volume 1, Part 4

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SURFACE WATER

Assessment

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EXECUTIVE SUMMARY

This report constitutes a surface water assessment for the proposed Dargues Reef Gold Project. The Project is an underground mining development near Majors Creek, NSW, to be operated by Big Island Mining Pty Ltd. This assessment includes a review of the existing surface water conditions and hydrology at the Project Site and within its local context. It also includes an assessment of the potential impacts of the Project on surface water conditions and recommendations for water management to mitigate or address these impacts.

The impact assessment suggests that there would be little or no negative impact downstream of the Project Site. Impacts on surface waters would be limited to a small section of a third-order creek (Spring Creek) that flows through the Project Site. Groundwater modelling suggests baseflows in Spring Creek and Majors Creek would be impacted. However, Big Island Mining Pty Ltd propose to ‘return’ the baseflows to Majors Creek downstream of the Project Site to minimise the extent of riparian impacts and to reduce potential impacts to downstream water users.

A water balance is included in this report to determine how available water sources might meet anticipated water demands, and how any shortfall might be addressed. Three sources have been identified for Project water including dewatering of groundwater inflows into the void, capture and reuse of surface runoff in harvestable-right dams, plus pumping from old mine workings on the site which are presently flooded with groundwater.

Modelling included with the water balance indicates there is sufficient water to meet the Project demands plus provide water to the downstream receiving waters (i.e. into Majors Creek) at a rate commensurate with potential losses in baseflow due to groundwater ingress into the underground void.

Included in this report is an assessment of the potential impacts of the Project, measured against the Water Quality and River Flow Objectives for the Moruya River. As part of this, water quality modelling was conducted using MUSIC to determine what structural measures might be required to mitigate potential impacts and assess their effectiveness.

Providing best-practice water management techniques are adopted, we conclude there is a low probability that the Project would negatively impact surface water.

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1. INTRODUCTION

1.1 BACKGROUND

SEEC (Strategic Environmental and Engineering Consulting) have been commissioned by Big Island Mining Pty Ltd ("the Proponent") to provide a surface water assessment for the Dargues Reef Gold Project near Majors Creek, NSW ("the Project") (**Figure 1**).

This report provides background on the surface water environment in the vicinity of the Project Site (see Section 3), provides a water balance and assesses the anticipated residual surface water-related impacts associated with the Project. An integrated conceptual water management strategy is also included detailing recommended management and mitigation measures to address potential surface water-related concerns.

In conducting this assessment we have:

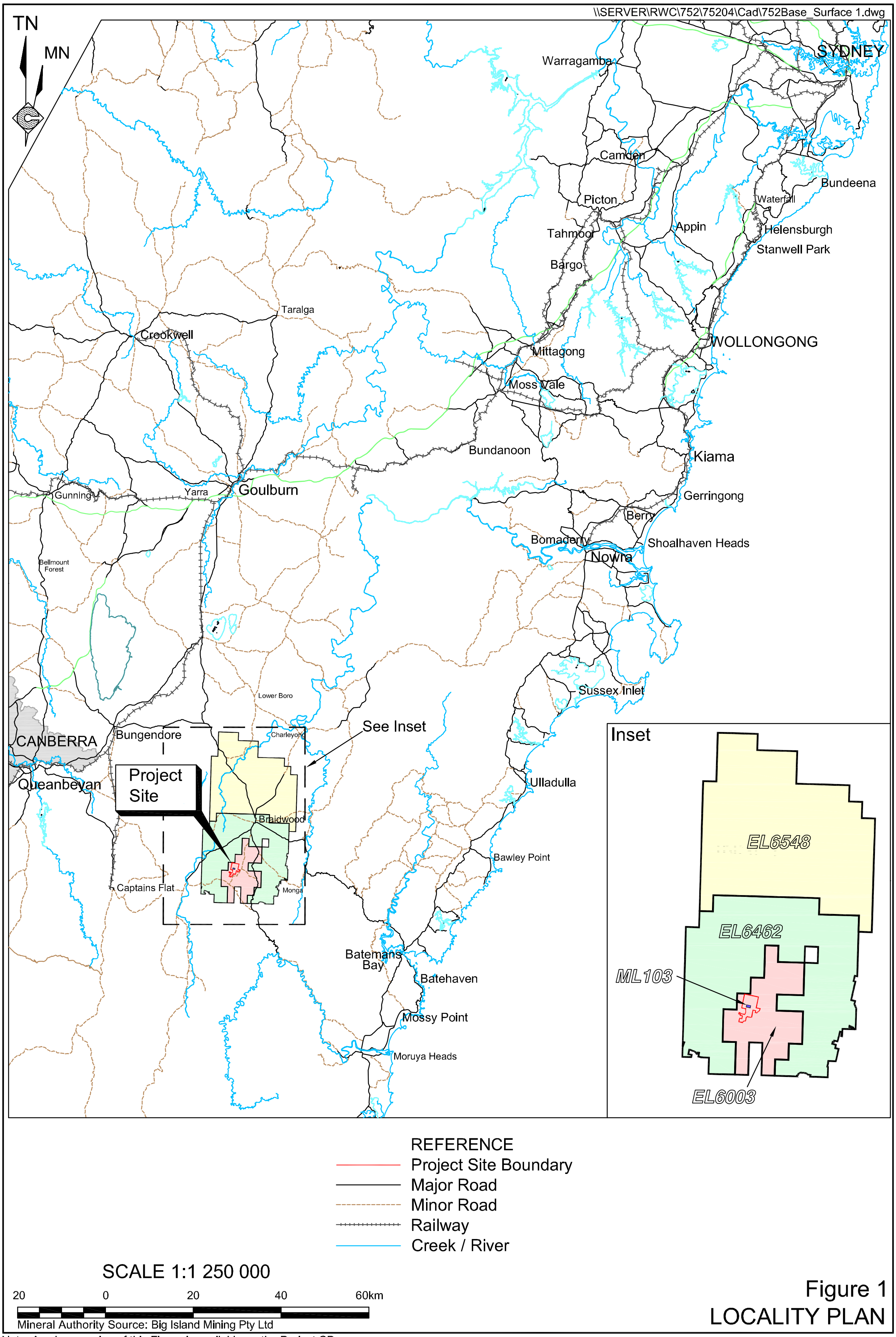
- Conducted a review of the existing surface water conditions within the Project Site and within its local context.
- Conducted an extensive field survey of the landforms and soils of the site and its surrounds.
- Investigated the existing site hydrology and runoff/infiltration characteristics.
- Assessed the potential impacts of the proposed development on the local surface water conditions, including downstream impacts.
- Prepared a water balance for the site identifying supply/demand figures for the mine's operational phase.

Field surveys were conducted by SEEC staff on 13th January 2010 and 17th February 2010 to investigate the Project Site's natural water cycle conditions, topography, landforms and soils and to collect representative soil samples for laboratory testing as part of the Soils Assessment prepared by SEEC. That report, referred to hereafter as SEEC (2010), is presented as Part 8 of the *Specialist Consultant Studies Compendium*.

1.2 DOCUMENT REFERENCES

The following documents have been referred to in the preparation of this Surface Water Assessment:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) plus the Water Quality and River Flow Objectives for the Moruya River.
- Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2E (DECC, 2008a).
- NSW State Rivers and Estuaries Policy (NSW Water Resources Council, 1993).



Note: A colour version of this Figure is available on the Project CD

2. PROJECT DESCRIPTION

The Project would include the following components (**Figure 2**).

- Extraction of waste rock and ore material from the Dargues Reef deposit using underground sublevel open stope mining methods with a suitable crown pillar to prevent surface subsidence.
- Construction and use of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, fuel store, ventilation rise and power and water supply.
- Construction and use of a processing plant and office area which would include an integrated Run-of-Mine (ROM) pad/temporary waste rock emplacement, crushing and grinding, gravity separation and floatation circuits, Proponent and mining contractor site offices, workshop, laydown area, ablutions facilities, stores, car parking, and associated infrastructure.
- Construction and use of a tailings storage facility.
- Construction and use of a water management system, including construction and use of eight dams and associated water reticulation system, to enable the harvesting and supply of water for mining-related operations. It is noted that the proposed water harvesting operations would be consistent with the Proponent's harvestable right.
- Construction and use of a site access road and intersection to allow site access from Majors Creek Road.
- Transportation of sulphide concentrate from the Project Site to the Proponent's customers via public roads surrounding the Project Site using covered semi-trailers.
- Construction and use of ancillary infrastructure, including soil stockpiles, core yards, internal roads and tracks and surface water management structures.
- Construction and rehabilitation of a final landform that would be geotechnically stable and suitable for a final land use of nature conservation and/or agriculture.

It is noted that during the life of the Project the Proponent proposes to undertake additional exploration drilling to further define identified mineralisation and identify additional mineralisation. Extraction of those resources does not form a part of this application. As a result, a subsequent application for approval to extract any identified resources may be prepared once sufficient information is available to adequately identify the proposed activities.

3. STUDY AREA AND PROJECT SITE

Big Island Mining Pty Ltd hold a total of some 396ha, although most surface activity associated with the Project is concentrated in a much smaller area, as shown in **Figure 2**. For the purposes of this Surface Water Assessment, the Project Site comprises all land held by the Proponent. By contrast, the Study Area covers the Project Site and surrounding catchments and downstream watercourses. It is noted that the main focus is those areas that would be directly affected by the Project.

We estimate that the footprint of the major Project surface features cover approximately 50ha. Any assessment of water flow and water quality impacts makes reference to downstream lands, although those lands were not investigated in detail.

4. ENVIRONMENTAL SETTING

4.1 TOPOGRAPHY

Within the Study Area topography varies from gently-inclined ridges (slopes less than 5% or 1:20 (V:H)) to steep gullies and incised drainage lines (slopes up to 50% or 1:2 (V:H)) (**Figure 3**). Steeper slopes are generally convex – i.e. steeper in footslope positions surrounding drainage lines than in upper slope positions near ridgelines. Elevation within the Study Area ranges from about 675m AHD to about 730m AHD.

4.2 DRAINAGE

4.2.1 Regional Drainage

The majority of the Study Area lies in the upper reaches of the Majors Creek catchment, which ultimately drains into the Deua River, part of the Moruya River system. The watershed boundary between the Shoalhaven and Deua River catchments traverses a ridge in the northern section of the Project Site. All of the proposed mine-related infrastructure including the access road is sited within the Deua River catchment.

4.2.2 Study Site Drainage

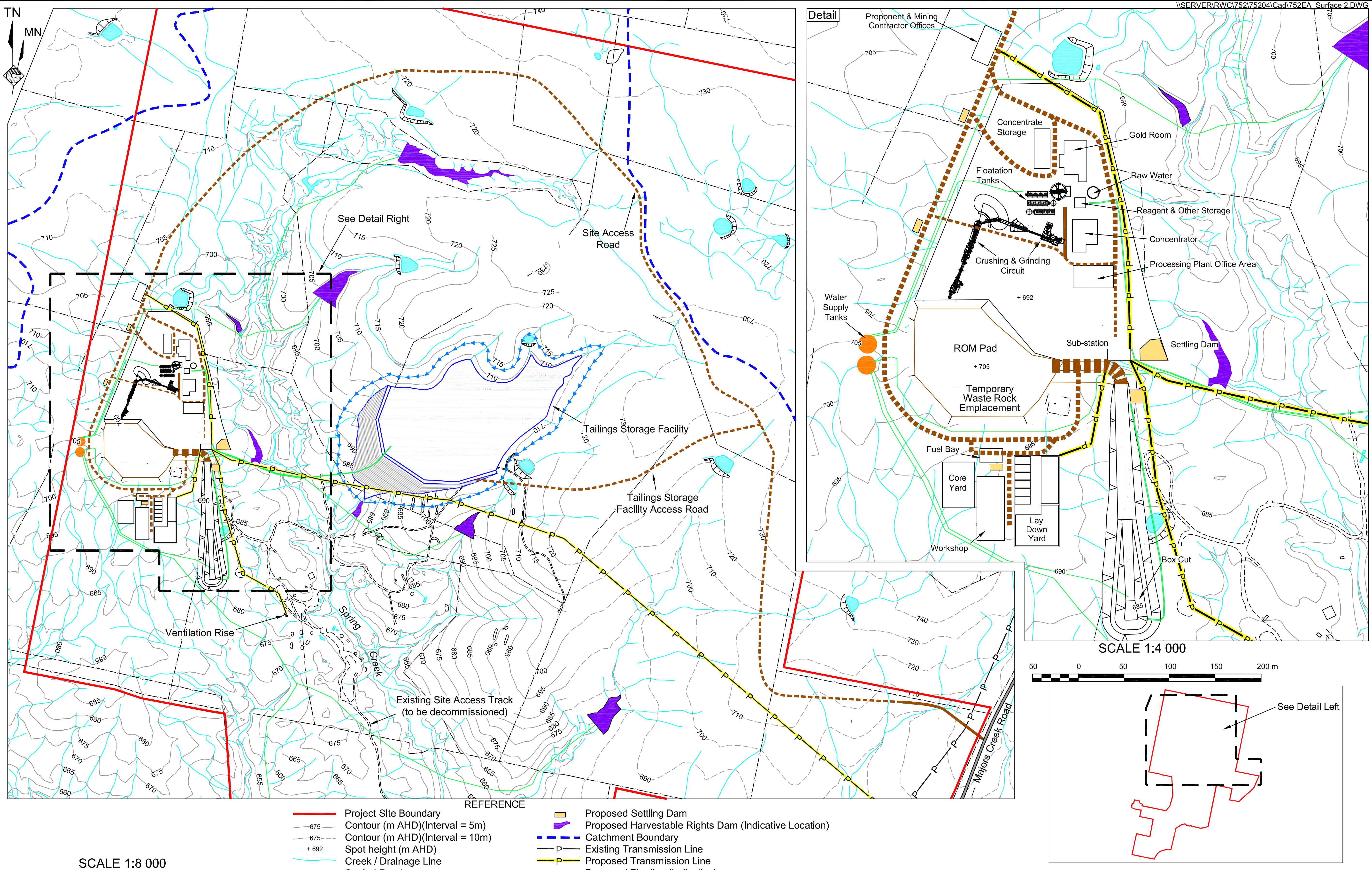
Surface drainage follows a dendritic pattern, with the majority of the Study Area draining into Spring Creek, which runs through the Study Area as shown in **Figure 3**. Most drainage lines are significantly incised, with slope gradients increasing in mid- and lower-slope areas (i.e. convex slopes). This suggests that drainage line erosion is a natural and active force within this landscape.

There is also evidence of accelerated erosion as a result of past land use activities, with several major gullies on Spring Creek and its larger tributaries. Significant human-induced gully erosion along Spring Creek has partially stabilised as a result of recent, improved land-use practices and conservation works by the Soil Conservation Service.

Although not flowing at the time of our inspections, we are advised Spring Creek is spring-fed, with water surfacing in the base of Spring Creek at GR 0749119, 6063864 (GDA94). This location is shown in **Figure 3**. Measured base flow in this creek is typically approximately 0.3L/s.

4.2.3 Existing Dams

At present there are 14 farm dams within the Project Site. The locations of these dams are shown in **Figure 4** and estimated sizes provided in **Table 1**. All dams appear to hold water and show little or no signs of leakage or wall failure. Existing dams would be decommissioned as required as new dams are constructed to ensure that the total dam capacity at any one time never exceeds the harvestable right. Further details are included in **Sections 4.3** and **5** of this report.



SCALE 1:8 000
100 0 100 200 300 400 m
Base Map Source: Geo-spectrum (Australia) Pty Ltd

REFERENCE

- Project Site Boundary
- Contour (m AHD)(Interval = 5m)
- Contour (m AHD)(Interval = 10m)
- Spot height (m AHD)
- Creek / Drainage Line
- Sealed Road
- Unsealed Road
- Existing Dam/Water Storage
- Proposed Settling Dam
- Proposed Harvestable Rights Dam (Indicative Location)
- Catchment Boundary
- Existing Transmission Line
- Proposed Transmission Line
- Proposed Pipeline (Indicative)
- Proposed Road/Track (Sealed/Unsealed)
- Fence (note: fences not co-incident with cadastral boundaries)

Figure 2
PROJECT SITE LAYOUT

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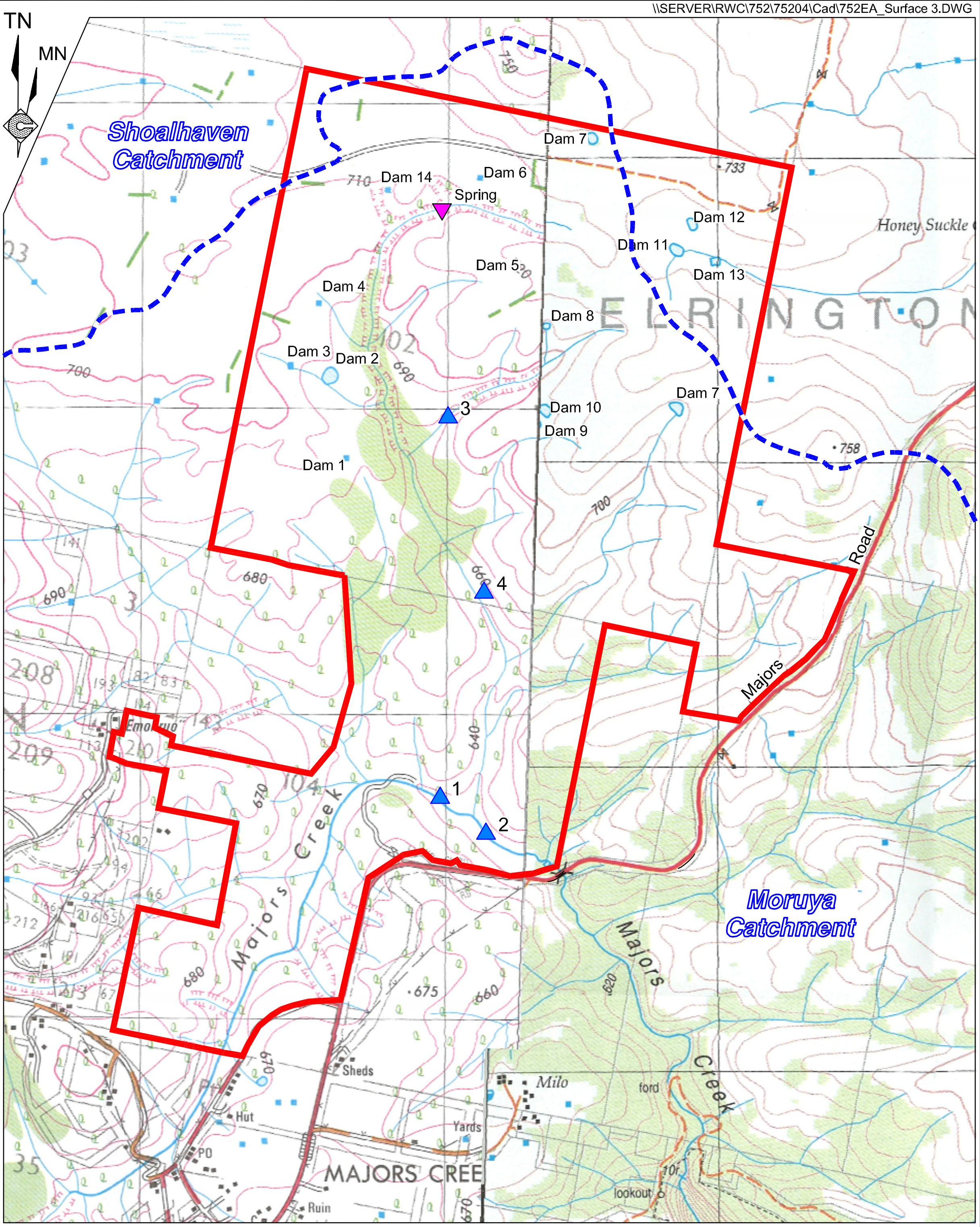


REFERENCE
Project Site Boundary
Catchment Boundary
Dam / Water Storage
Spring
1 Proposed Surface Water Monitoring Location

SCALE 1:20 000

200 0 200 400 600 800 1000 m

Base Map Source: Bendoura and Monga 1:25 000 Topographic Maps

Figure 3
PROJECT SITE TOPOGRAPHY AND DRAINAGE

Table 1
Estimated Sizes of Existing Dams

Existing Dam number (as shown on Figure 3)	Approximate Surface Area (m^2)	Estimated volume (ML)
1	300	0.36
2	800	1.68
3	350	0.42
4	500	0.75
5	600	0.9
6	650	0.975
7	300	0.36
8	250	0.3
9	200	0.24
10	500	0.75
11	400	0.6
12	350	0.42
13	200	0.24
14	650	0.975
	TOTAL	**8.97ML**

4.3 HARVESTABLE RIGHT

Present NSW legislation permits landholders to capture or harvest and use a proportion of the total runoff from their land without requiring a licence. Two factors determine the harvestable right for a piece of land; namely:

- the property's geographical location (which determines the harvestable right multiplier value); and
- the size of the property.

A land owner's harvestable right permits construction of dams up to the harvestable right capacity with out the requirement for further approvals from NSW Office of Water, provided the dams or basins are either "off-line" from natural watercourses or are positioned on first- or second-order streams only. However, approvals may be required for construction of the dams from other government agencies. Water captured within the harvestable rights dams may be used for any purpose, including mining-related purposes.

The total area held by the Proponent is 396ha. The harvestable right multiplier for this site was determined using maps obtained from NSW Office of Water at http://www.farmdamscalculator.dnr.nsw.gov.au/cgi-bin/ws_postcode.epl. These maps show that the Project Site has a dam multiplier value of 0.09ML/ha, which was confirmed in a letter from Wayne Ryan (NSW Office of Water) dated 22 March 2010. As such the total harvestable right for the property is 35.64ML total dam/basin capacity.

The Project would, however, include construction of a Tailings Storage Facility in the location shown in **Figure 2**. The Tailings Storage Facility has been sized to wholly contain tailings from the site operations and the rainfall depth in the 100-year ARI storm event and would be effectively impermeable. Upstream flow that would otherwise enter this structure would be diverted around it using a series of diversion structures. As a result, the Tailings Storage Facility would effectively isolate 12ha of the Majors Creek catchment within the Project Site and, as such, when calculating the harvestable right for the Project, we have reduced the site area by 12ha to 384ha. As such, the Proponent's revised harvestable right is 34.56ML.

Dams or basins constructed for the purposes of maintaining water quality (e.g. sediment basins, effluent management structures or water quality control ponds) are exempt from the harvestable right calculation for a site, although this assumes that water detained in these structures is not re-used onsite and is eventually released to downstream waters. If water within such structures is used for mining-related purposes, then the capacity of the structures is included within the Proponent's harvestable right volume.

The Proponent proposes to construct eight harvestable right dams within the Project Site. The location of these dams is presented on **Figures 2 and 3** and **Table 2** presents the indicative size of each dam. It is noted that the sizes of the dams may be adjusted depending on which existing farm dams are decommissioned to ensure that the Proponent's harvestable right of 34.56ML is not exceeded.

Table 2
Proposed Harvestable Rights Dams

Dam Identifier	Anticipated Volume (ML)
A	7.5
B	1.9
C	4.1
D	4.8
E	2.3
F	3.1
G	2.2
H	8.6
Total	34.5
Source: Big Island Mining Pty Ltd	

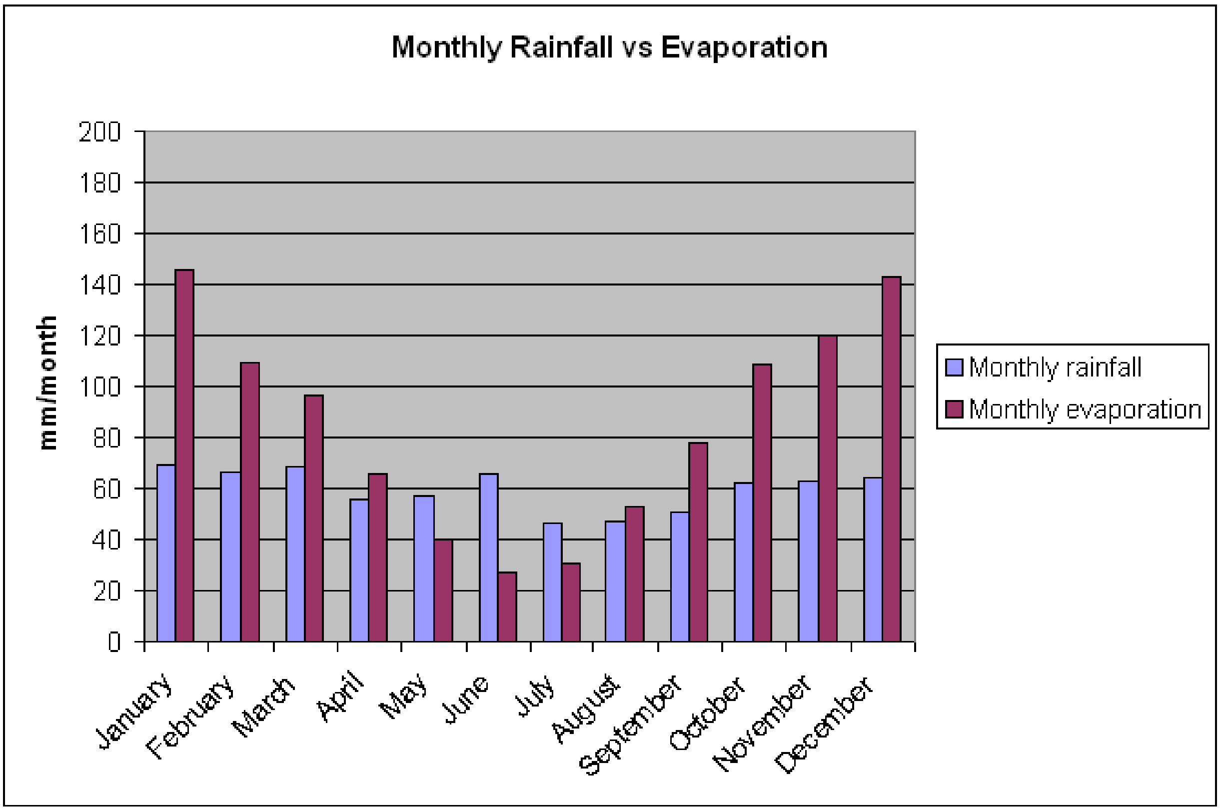
4.4 CLIMATE

Nearby Braidwood (Wallace Street Bureau of Meteorology Rainfall Station – Number 69010, located approximately 13km to the north-northeast of the Project Site) has a warm temperate climate and experiences mean rainfall of 717mm/yr. Evaporation data from the same station is 1,017mm/yr. Rainfall is relatively consistent throughout the year and evaporation is significantly higher in summer, as shown in **Figure 5.** **Table 3** shows the mean number of rain days per year for the Wallace Street, Braidwood monitoring station.

Table 3
Mean Number of Rain Days per Month (Wallace Street, Braidwood).

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean no. of rain days per month	8.6	8.0	8.3	7.4	7.7	8.5	7.6	8.1	8.8	8.9	8.6	8.2	98.7

Figure 4 **Rainfall and Evaporation Comparison Using Braidwood Data (Station 69010)**



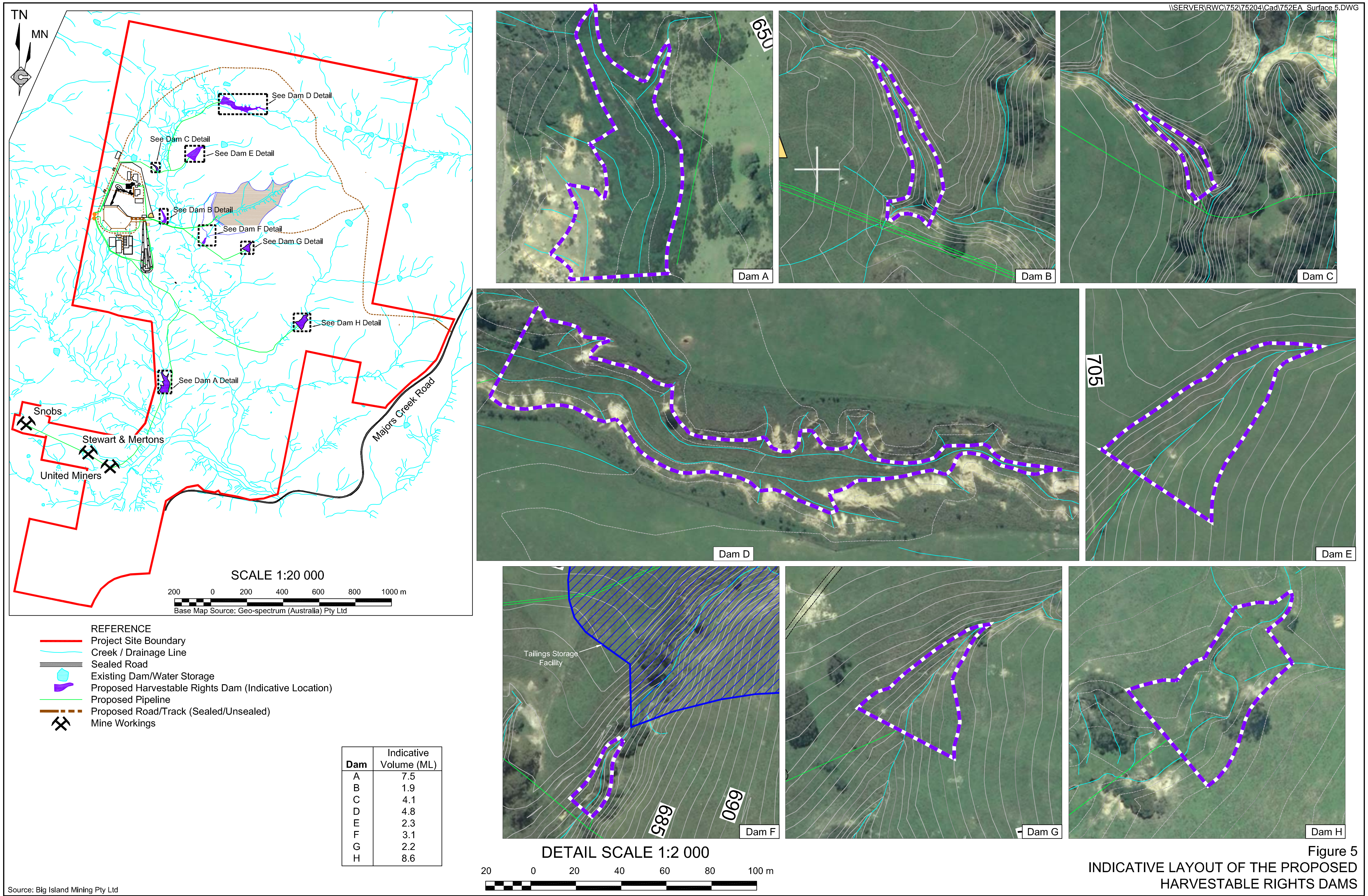
4.5 VEGETATION

Most of the northern section of the Project Site has been cleared of native trees and is under an excellent cover of pasture grasses. Scattered stands of native timber remain along some of the larger drainage lines, particularly south of the main mine infrastructure. The southern section of the Project Site has been extensively disturbed by prior mining activities and is dominated by woody weeds, regenerating wattles and areas of no vegetation. Vegetation and ecological issues are detailed in the Ecology Assessment (Gaia Research, 2010) and the *Environmental Assessment* (RW Corkery & Co. Pty. Limited, 2010).

4.6 LAND USE

The Study Area has been used most recently for grazing. Gold prospecting and mining has occurred in the past and there is extensive evidence of this the form of old workings, disused shafts and spoil heaps.

Downstream lands are mainly used for grazing and also show evidence of previous gold prospecting and mining.



REFERENCE
- Project Site Boundary
- Creek / Drainage Line
- Sealed Road
- Existing Dam/Water Storage
- Proposed Harvestable Rights Dam (Indicative Location)
- Proposed Pipeline
- Proposed Road/Track (Sealed/Unsealed)
- Mine Workings

Dam	Indicative Volume (ML)
A	7.5
B	1.9
C	4.1
D	4.8
E	2.3
F	3.1
G	2.2
H	8.6

Source: Big Island Mining Pty Ltd

Figure 5
INDICATIVE LAYOUT OF THE PROPOSED HARVESTABLE RIGHTS DAMS

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4.7 SOILS

Details of soils across the Project Site are contained in SEEC (2010). In summary, soils within the Project Site have the following characteristics:

- Coarse to medium-grained, weakly-structured topsoils with sandy-clay subsoils.
- Initial drainage into topsoils is rapid, although subsoils have imperfect drainage. As such, infiltration rates would decrease rapidly as soils approach maximum waterholding capacity.
- Soils are moderately erodible (Maximum RUSLE K-Factor of 0.039) and are significantly dispersible (i.e. Type D according to the classifications in Landcom, 2004).
- Soils are USCS Class CH (inorganic, highly plastic clays) and are prone to significant shrinking and swelling as they wet and dry.
- Soils are prone to tunnelling and slumping and might not be inherently suitable for use in earth structures (e.g. dam walls or embankments).
- Soils are non-saline, highly acidic and relatively infertile.

5. WATER BALANCE

5.1 WATER DEMAND

5.1.1 Water for Processing Operations

Principally, water would be recovered from tailings for recycling in the processing of ore. However, inherent losses in that system mean that this recycled water is insufficient to meet ongoing demand.

The Proponent estimates that demand for 'new' water for processing operations would be approximately 130ML/yr at maximum production. This equates to an average of 356,164L/day. Note this figure includes a small allowance for washdown of plant and machinery. Note also that the proposed rate of production is anticipated to increase from approximately 161 000t per year in Year 1 to approximately 354 000t per year in Year 4 when the maximum production rate would be achieved. Production is then expected to decrease to approximately 108 000t per year in Year 5. As a result, the maximum production rate, and therefore the highest water demand, is expected to occur for only a limited time during the life of the Project. However, to ensure that this assessment appropriately considers the maximum anticipated surface water-related impacts, this site water balance has assumed the maximum water requirements during the life of the Project. It is likely that actual water demand will be less that the assumed water demand during the majority of the Project life.

5.1.2 Dust Suppression

Exposed soils are at risk of wind erosion. To mitigate this risk, water would be used for dust suppression. The anticipated annual average amount of water required for dust suppression is presented in **Table 4**, assuming a total of 3ha of exposed soils on the haul road, ROM pad and around the processing plant. We assume that alternative dust suppression measures such as chemical dust retardants would be employed on the access road.

Maximum daily demand for water for dust suppression is expected to be approximately 4mm/day in the peak summer months, which equates to 0.12ML/day over the assumed 3ha area of exposed soils. In calculating the water demand for dust suppression in **Table 4**, it is assumed that dust rise would only be a potential problem on non-rainy days. As such, the estimations in **Table 4** are based on the average number of non-rainy days as reported by the Bureau of Meteorology (Wallace Street station 69010).

5.1.3 Drinking and Ablutions

Potable water and water for staff ablutions would be sourced either from rainwater tanks fed from office roofs or from water trucked to the site. As a result, water for drinking and ablutions has not been included in this water balance.

Table 4
Estimated Water Demand for Dust Suppression

Month	Dust suppression application rate (mm/day)	Amount of water required over 3ha per day	Average number of dry days per month (from BoM, Wallace Street, Braidwood)	Monthly water demand
January	4mm/day	0.12ML/day	22.4	2.7ML
February	4mm/day	0.12ML/day	20.0	2.4ML
March	3mm/day	0.09ML/day	22.7	2.0ML
April	2mm/day	0.06ML/day	22.6	1.4ML
May	1mm/day	0.03ML/day	23.3	0.7ML
June	1mm/day	0.03ML/day	21.5	0.6ML
July	1mm/day	0.03ML/day	23.4	0.7ML
August	1mm/day	0.03ML/day	22.9	0.7ML
September	2mm/day	0.06ML/day	21.2	1.3ML
October	2mm/day	0.06ML/day	22.1	1.3ML
November	3mm/day	0.09ML/day	21.4	1.9ML
December	4mm/day	0.12ML/day	22.8	2.7ML
			TOTAL ANNUAL DEMAND	**18.4ML**

5.1.4 Return of Baseflow to Majors Creek

Groundwater modelling by AGE Consultants Pty Ltd (AGE, 2010) estimates that up to 2.1L/s of baseflow would be lost from Majors Creek as a result of inflow losses into the mine void. Stormflows would be largely unaffected, as they are sourced mainly from surface runoff, not from the sub-surface aquifer.

Of the 2.1L/s lost from Majors Creek, 0.3L/s would be lost from Spring Creek (which ultimately feeds into Majors Creek), 1.7L/s would be lost as outflow from the geological aquifer, and 0.1L/s as outflows from the alluvial aquifer associated with Majors Creek.

To compensate for this loss, Big Island Mining Pty Ltd propose to 'return' water to the Majors Creek system at a rate commensurate with the modelled losses (i.e. up to 2.1L/s). This would be discharged into Majors Creek at a point downstream of the modelled limit of groundwater impacts. This minimises the risk that any water 'returned' to the creek system simply cycles back into groundwater. To meet this commitment, up to 66.2ML/yr would need to be 'returned' to the creek.

5.2 WATER SUPPLY

Apart from water used for drinking and ablutions (refer to Section 5.1.3), three separate water supply sources have been identified for this Project. .

1. Groundwater inflow into the proposed Dargues Reef Mine itself. Dewatering of these workings is conservatively estimated in the Groundwater Assessment (AGE, 2010) at 4L/s, which equates to approximately 126ML/yr. This would be the primary source for Project water.
2. Surface runoff collected in harvestable right dams. As discussed in Section 4.3, the maximum harvestable right for the property has been calculated at 34.56ML of total dam capacity. This water would be the preferential supply source for any return of flow to Majors Creek as detailed in Section 5.1.4 and would not be used for any other purpose.
3. Extraction of groundwater from historic mine workings, namely the Snobs, Stewart and Mertons and United Miners workings. Modelling contained in the Groundwater Assessment (AGE, 2010) suggests that up to 78ML/yr is available from this source. It would be the secondary source for Project water and the backup supply for returning flow to Majors Creek should the harvestable right dams not be sufficient (refer to Modelling Results in Section 5.3 for details).

5.3 MODELLING

5.3.1 Project Water

A simple water balance assessment of Project water requirements shows that ample water is available for processing, washdown and dust suppression. At maximum production, these demands total 148ML/yr.

Supply from groundwater inflows and historic mine workings totals 204ML/yr which exceeds the maximum demand of 148ML/yr by 56ML. As such, Project water is well catered for from groundwater sources.

5.3.2 Majors Creek Return Supply

5.3.2.1 Background, Setup and Calibration

A water balance was prepared using an in-house daily model called RATES to determine the capacity for the harvestable right dams to reliably deliver water back into Majors Creek, thereby offsetting the modelled losses due to groundwater inflows into the new mine. RATES uses 100 years of daily rainfall data from the Bureau of Meteorology and allows for modifications to runoff/infiltration characteristics and daily water demand. Although the model allows water demands to be scaled seasonally and/or set to only apply on non-rainy days (e.g. as is the case for dust suppression), we have conservatively assumed a commitment to constantly return 2.1L/s to Majors Creek over the life of the mine. In reality, the rate of release would be adjusted to reflect the anticipated rate of reduced groundwater inflow on an annual basis. As a result, 2.1L/s reflects the maximum rate of release during the life of the Project.

Other key modelling calibrations include:

- Initial rainfall loss of 5mm per day to account for surface wetting and initial soaking.
- Ongoing rainfall loss of 85% to account for infiltration and groundwater recharge. This is conservatively calibrated based on the characteristics of the soils as detailed in the Soils Assessment, also by SEEC.
- 100 years of daily rainfall records from the Bureau of Meteorology's Braidwood Wallace Street station (station 69010) from 1 January 1903 to 31 December 2002. During this period the average rainfall was 728mm/year.
- Average daily pan evaporation data from the same Bureau of Meteorology station. Evaporation is drawn as a daily loss from the proposed harvestable right dams assuming eight dams with a total volume of 34.56ML, average depth of 3m, and total dam surface area of 1.152ha. No shading or covering of dams is assumed.
- Constant demand of 2.1L/s.
- An assumption that water from the harvestable right dams is preferentially used to supply water to Majors Creek before any water is drawn from an alternative source (e.g. the historic workings) for this purpose.
- An assumption that the harvestable right dams would not be used to supply any operational water; they would only be used to supply the return of flows to Majors Creek.

5.3.2.2 Results of Modelling

Key results from RATES modelling are contained in **Table 5**. These results show that, over the 100-year modelling period, the harvestable right dams would be able to supply a constant demand for 2.1L/s to Majors Creek 97% of the time. The shortfall would need to be supplied from an alternative source such as the historic workings.

These results also show that the harvestable right dams would have run dry for a total of 182 days in the worst year on record (1981). In that year, approximately 33ML would have been needed from an alternative source. As noted in Section 5.3.1, there is sufficient capacity in the alternative sources to meet that demand even at maximum production.

The actual probability that water would need to be drawn from the historic workings to supply the return of water to Majors Creek is low because:

- The modelling is inherently conservative, assuming a constant rate of flow to Majors Creek of 2.1L/s. The actual rate of flow returned to Majors Creek would be commensurate with the anticipated loss from the system as modelled by AGE (2010). This loss peaks at 2.1L/s.
- The risk that an extremely dry year coincides with the maximum demand from the harvestable right dams is very low.

Figure 6 shows the available harvestable-right dam capacity throughout the modelling period as a continuous plot. **Figure 7** shows the number of days in each year when the harvestable-right dams would have run dry. During those periods, supply would revert to an alternative source (i.e. the historic workings).

Table 5
Results of Water Balance Modelling

Percent of time during the modelling period that demand for water return to Majors Creek was met by the harvestable right dams.	97%
Average amount of water required from the historic workings per year to make up the average 3% shortfall.	2ML/yr (approx.)
Worst year in the model record - number of days the harvestable right dams were dry.	182 days
Worst year in the model record - amount of water that would be required from the historic workings in that year.	33ML/yr (approx.)
Number of years in the model record when the harvestable right dams ran dry for at least one day	29 years
Median number of days the harvestable right dams ran dry within those 29 years	18 days (equates to approximately 3.3ML of water demand)

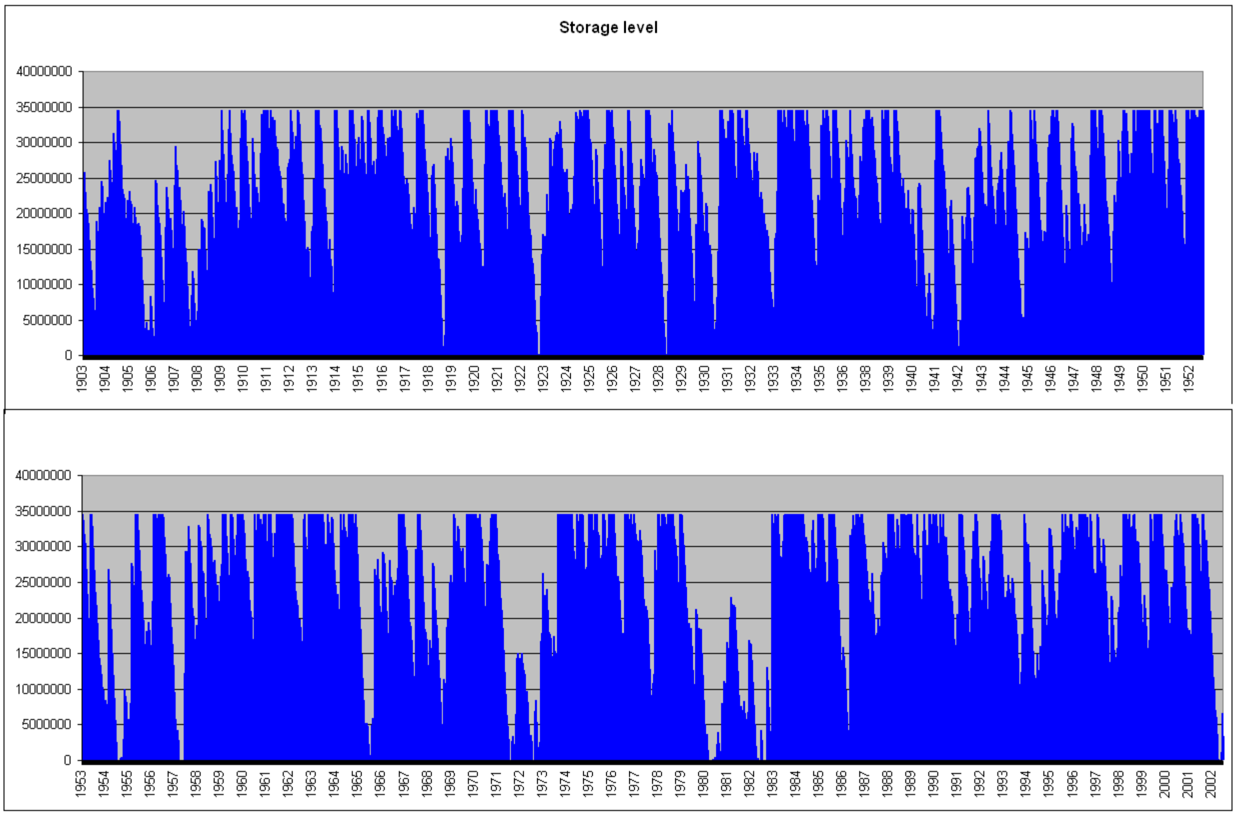
5.3.3 Summary and Conclusion

In summary, the modelling suggests that sufficient water would be available for mining-related purposes during the life of the Project. In addition, it is noted that the modelling incorporated the following conservative assumptions.

- The assumed groundwater available from dewatering of the proposed Dargues Reef Mine of 4L/s is expected to be a minimum. During initial mining operations, available water may be as high as twice this amount (AGE, 2010).
- The modelled water requirement represents a water requirement during the maximum rate of production. Maximum production is likely to be achieved in Year 4 of the five year Project life.

- The modelling assessed 100 years of rainfall data. The probability of the worst year of rainfall during that period occurring during the period of maximum production is approximately 1%. However, even if this does occur, the Project would still have sufficient water available for mining related purposes.
- The groundwater assessment assumed approximately 78ML of water would be extracted from the historic workings. Modelling suggests that, even in the worst year on record, only 55ML would need to be extracted from this source to meet shortfalls for Project water and the return of water to Majors Creek. 22ML of this would make up the shortfall for processing, washdown and dust suppression, with the remaining 33ML going to surface flows in Majors Creek.

Figure 6 Modelling Plot Showing Water Levels in the Harvestable-Right Dams

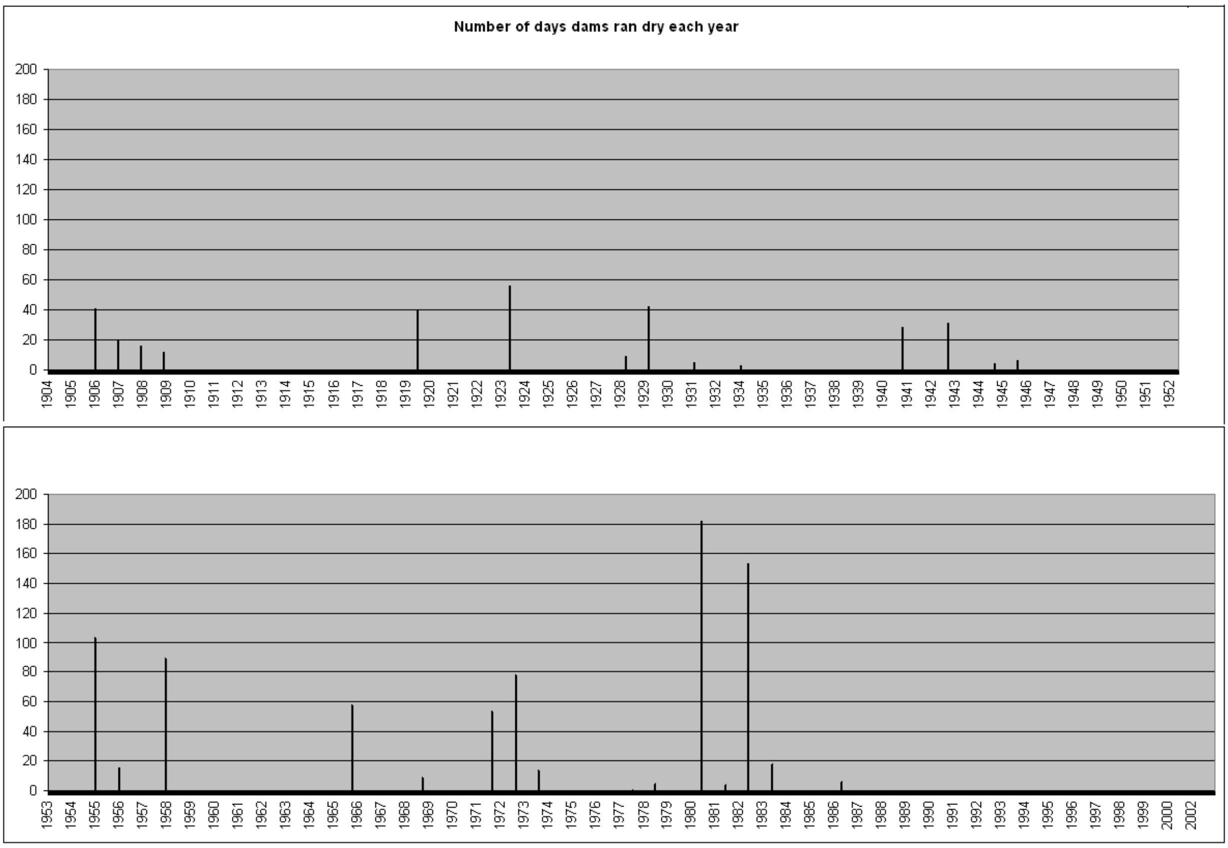


5.4 LICENCES

A series of harvestable-right dams would be constructed across the Project Site, with a total capacity of all dams not exceeding 34.56ML. These dams would be sited on first or second-order streams with no permanent flow only and, as such, would not require a licence from NSW Office of Water for extraction of water from the dams. Eight locations have been identified for these dams as shown in **Figure 7**. These locations have been confirmed as acceptable in correspondence from Wayne Ryan (NSW Office of Water) on 22 March 2010 (their ref: ERM 2010/0278). A copy of this correspondence is attached in **Appendix 2**.

We anticipate that a licence would be required for the Tailings Storage Facility and for any extraction of water from underground workings. A Controlled Activity Approval under Section 91 of the *Water Management Act 2000* would not be required in accordance with the requirements of Section 75U(1)(h) of the *Environmental Planning and Assessment Act 1979* . However, Project Approval will be required under Section 75D of the *Environmental Planning and Assessment Act 1979* for the Project, including for any works within 40m of a drainage line.

Figure 7 Number of Days in Each Modelled Year when Harvestable-Right Dams Ran Dry.



6. SURFACE WATER ASSESSMENT

6.1 CONSTRUCTION PHASE

6.1.1 Area of Disturbance During Construction

Establishment of the Project would involve significant ground disturbance and soil exposure. Exposed soils are prone to erosion and could be transported from the site and into downstream drainage lines.

Soil disturbance in the form of stripping, earthworks and construction is estimated as follows.

- access road – approximately 12ha (approximately 4km long x 30m wide).
- mine processing, offices and other infrastructure – approximately 12ha.

- box cut, decline and haul road – approximately 1.5ha.
- Tailings Storage Facility – approximately 13ha (although the final area of this facility is 12ha, we have assumed 13ha would be disturbed for its construction).

Note that the area of exposed soil during the operational phase of the Project is likely to be significantly less than that required during construction.

6.1.2 Impact Assessment

Under the guidelines and recommendations contained in The Blue Book Volume 1 (Landcom, 2004) and Volume 2E (DECC, 2008a), the erosion hazard for the site is determined using the Revised Universal Soil Loss Equation (RUSLE). Using data gathered as part of the Soils Assessment (SEEC, 2010), the RUSLE predicts the following.

- An annual soil loss of 260t/ha/yr (Soil Loss Class 3 – moderate erosion hazard) over the area proposed for the access road, box cut and processing infrastructure. This equates to a potential impact of 6,630t/yr of soil erosion unless adequate control measures are implemented.
- An annual soil loss of 576t/ha/yr (Soil Loss Class 5 – high erosion hazard) over the proposed Tailings Storage Facility, which lies on steeper lands. This equates to 7,488t/yr of soil erosion unless adequate control measures are implemented.

To mitigate the risks of sediment pollution during the construction phase of the project, best-practice erosion and sediment controls would be required. Further details concerning the RUSLE and erosion hazard are contained in the Soils Assessment (SEEC, 2010).

6.1.3 Construction-Phase Erosion and Sediment Control

Temporary, construction-phase sediment basins are required wherever the erosion hazard assessment predicts 200t/yr or more of soil loss over the area of disturbance (Landcom, 2004). This is the case for all construction works associated with the establishment of the Project. Note that internally-draining structures such as the box cut and Tailings Storage Facility would not require dedicated construction-stage basins once construction has progressed to the point where the structures are internally draining. However, any water accumulating within the excavations for these structures would need to be managed as per normal sediment basin requirements.

We assume that construction-phase sediment basins downslope of the offices, processing, ROM pad and waste rock areas would remain for the operational phase of the project. As such these basins would be sized in accordance with DECC (2008) for a 20-day rainfall depth rather than the standard five days as recommended in Landcom (2004). Recommendations for sediment basin sizing are contained in **Section 7.1**.

Other erosion and sediment controls would need to be installed in accordance with the best-practice guidelines and recommendations contains in Landcom (2004) and DECC (2008) before construction could commence. These controls would need to be maintained in an operational state until they become redundant. Recommendations to this effect are included in **Section 7.1**.

6.2 WATER FLOWS AND WATER QUALITY

6.2.1 Modifications to Drainage Paths

There are no modifications to drainage paths outside of the Project Site.

Within the Project Site, the Tailings Storage Facility would be sited in a small valley occupied by an unnamed first- and second-order stream network (**Figure 2**). This facility would be designed for zero-discharge to downstream watercourses and would have a network of upslope diversion structures to isolate it from upstream flows.

The upslope diversion structures would divert clean runoff around the Tailings Storage Facility and into their original flowpath below the wall of the facility. As a result, the modification to the natural drainage path would only be very localised around the facility and, ultimately, would not divert any water from one catchment to another.

6.2.2 Modifications to Groundwater Recharge

Changes to groundwater recharge and discharge are primarily addressed in the Groundwater Assessment by AGE (2010). From the perspective of surface water, the Project would increase the amount of surface impervious surfaces which could impact the amount and nature of existing groundwater recharge. However, these structures would be largely removed at the end of the Project life. As a result, any reduced recharge would be re-established at the end of the life of the Project. In addition, any temporary impacts would be ultimately addressed by the return of approximately 2.1L/s of baseflow into Majors Creek, mitigating the potential loss of baseflow from that system as a result of groundwater harvesting. This is discussed further in **Section 5**.

6.2.3 Watercourse Flows, Morphology and Ecology

The Groundwater Assessment (AGE, 2010) predicts that baseflows in Spring Creek would be significantly impacted by the Project. Baseflows in Spring Creek are primarily sourced from groundwater, where a spring surfaces in the location shown in **Figure 3.** Measured baseflow is approximately 0.3L/s. Downstream of the present spring location, the ecology and morphology of Spring Creek would most likely be affected by the significant reduction in baseflow. Flows during storm events, when most water is derived from surface runoff rather than groundwater surfacing, are unlikely to be affected.

With the reduction in baseflow, existing pools could potentially stagnate in dry periods. Additionally, the creek corridor would experience a reduction in overall soil moisture, potentially affecting riparian vegetation.

The Proponent proposes to restore lost baseflow by discharging approximately 2.1L/s into Majors Creek immediately downstream of the anticipated limit of groundwater impacts. This means that the potential impacts on Spring Creek are limited to that stretch between the existing spring and where it meets Majors Creek. Impacts on Majors Creek itself are likely to be negligible as it would ultimately experience little change in flow regime.

After the conclusion of mining, we expect the flow regime in Spring Creek to return to a similar level as presently exists as groundwater levels stabilise and the existing spring is restored. The Groundwater Assessment (AGE, 2010) estimate that groundwater levels would largely recover within 12 months of the completion of mining operations, with full recovery within 3 years of the completion of mining operations. As such, the long-term impact on Spring Creek is unlikely to be significant although vegetation and riparian management might be required during and at the conclusion of mining activities to ensure the long-term stability of the system. Recommendations to this effect are included in **Section 7.3**.

6.2.4 Potential Pollutants

Potential pollutants that might be used or generated within the Project Site include the following.

- Reagents used in processing of ore material.
- Fuels and oils for plant and machinery.
- Tailings and associated leachate from the processing of ore.
- Sediment eroded from exposed areas.

Potential water quality impacts could occur in the event of a chemical spill or leakage. To mitigate this risk, appropriate best-management techniques would need to be employed for the handling and storage of potentially-polluting chemicals.

A Tailings Storage Facility would be required for wastewater from the processing of ore, sized and designed to minimise the risk of any discharge to downstream receiving waters.

Best-practice erosion and sediment controls would be required to minimise the risk of sediment pollution to downstream receiving waters. This is discussed further in **Section 6.1**.

Recommendations regarding the management of potential pollutants are contained in **Section 7.3**.

6.2.5 MUSIC Modelling

6.2.5.1 Background and Introduction

Surface water quality was assessed for both the existing conditions (i.e. pre-development) and proposed conditions during operation using MUSIC (Model for Urban Stormwater Improvement Conceptualisation). MUSIC contains algorithms based on the known performance characteristics of common stormwater quality improvement structures used in Australia. These data are derived from research undertaken by the CRC for Catchment Hydrology (now part of eWater) and others. The models are appropriately calibrated and all amendments to MUSIC defaults are noted below. The modelling quantifies:

- the levels of the principal pollutants before and after the development; and
- changes in export levels because of the changed land use.

Statistics are produced by the model for flows (ML/yr) plus the load (kg/yr) and concentration (mg/L) of a range of common pollutants in stormwater including:

- total suspended solids (TSS);
- total phosphorus (TP);

- total nitrogen (TN); and
- gross pollutants (GP).

6.2.5.2 Modelling Area

For the purposes of MUSIC modelling, only those areas likely to experience surface land use changes as a result of the Project are included. To calculate this, the total extent of Project infrastructure as shown in **Figure 2** was evaluated and an equivalent area used for the pre-development model. This ensures that the pre-development and operational-stage models compare equivalent land areas.

We estimate that the total area of land use change would be approximately 24ha. This includes approximately 2ha of access road, approximately 11ha for offices, processing, workshops, yards and storage and approximately 1ha for the haul road. Note that these figures differ from those in **Section 6.1.1**; those figures relate to the construction phase, when ground disturbance is normally slightly higher.

The Tailings Storage Facility (and its associated settling pond) and box cut are excluded from MUSIC modelling because neither structure would drain to the receiving waters; both are closed drainage systems.

6.2.5.3 Climate Data for MUSIC Modelling

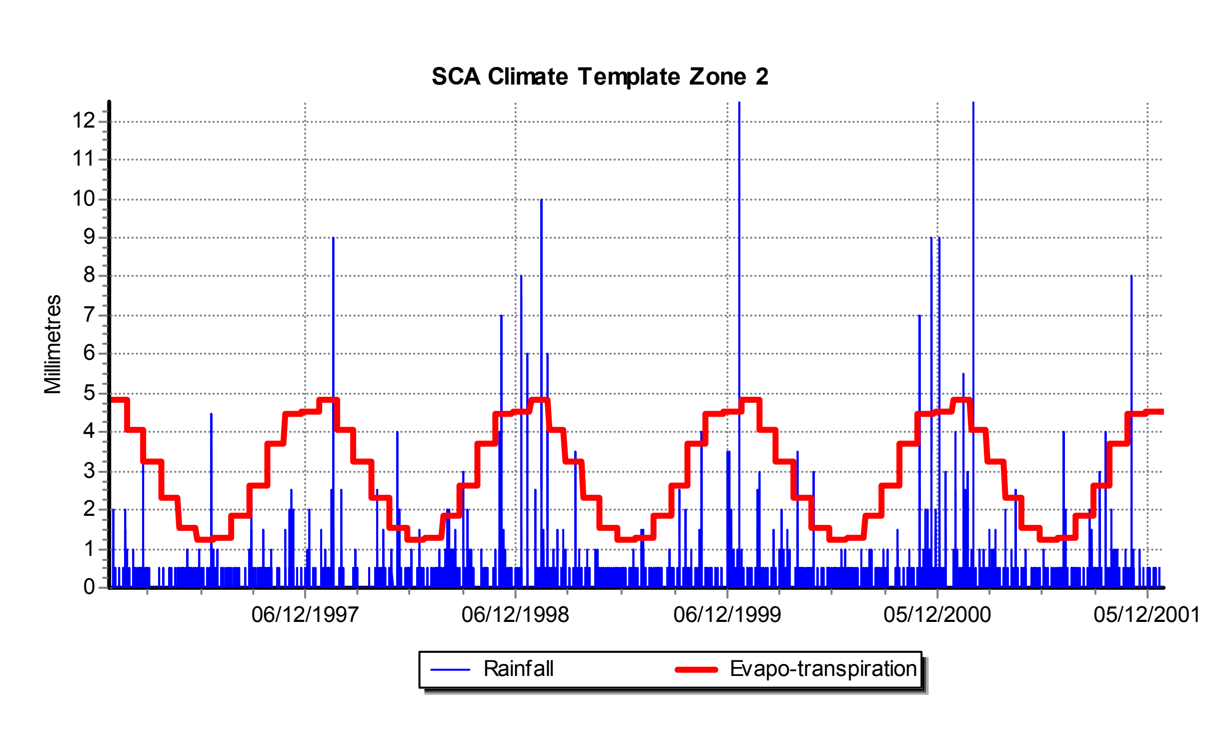
Creation of a MUSIC catchment model requires an associated meteorological data file. This meteorological file needs to use Bureau of Meteorology tipping-bucket pluviograph rainfall data, which is available from only a limited number of stations throughout Australia. Pluviograph data is not available for the Wallace Street, Braidwood station. For the purposes of MUSIC modelling we have used rainfall and evapo-transpiration templates prepared by the Sydney Catchment Authority (SCA) for use in their catchments (SCA, 2009). The Shoalhaven catchment, which lies immediately north of the Project Site, is within the SCA-administered area.

The SCA rainfall template includes five years of average, representative rainfall and evapo-transpiration data at 6-minute timesteps. Statistics for rainfall and potential evapotranspiration (PET) are included in **Table 6** and **Figure 8**.

Table 6
Climate Statistics for the Meteorological Template Used in MUSIC Modelling

Measure	Statistics						
	Mean	Median	Maximum	Minimum	10%ile	90%ile	Mean annual (mm/yr)
Rainfall (mm/6mins)	0.01	0.000	12.5	0.000	0.000	0.000	883
PET (mm/day)	2.966	2.600	4.810	1.230	1.290	4.520	1,083

Figure 8 Climate Time-Series Chart for the Meteorological Template Used in MUSIC Modelling



6.2.5.4 Pre-Development Modelling Setup and Calibration

Under existing conditions, extensive impervious surfaces such as roofs, sealed roads, and other hardstand surfaces do not occur within the 24ha modelled area. There are several unsealed tracks that have been significantly compacted and which are effectively impervious, although these represent only approximately 1% of the modelled area. The remainder of the modelled area is used for agricultural purposes. As such, the existing conditions are modelled using a default “agricultural” node in MUSIC, set to 99% pervious area.

Pervious area runoff and infiltration properties were determined from Macleod (2008) assuming 0.5m of sandy clay loam (note that soil depth in MUSIC only takes into account those layers directly affected by PET, although actual soils might be significantly deeper). **Table 7** provides details of source node pervious area calibration. Although the Soils Assessment (SEEC, 2010) identifies several different soil types, upper soil layers were relatively consistent and can be reliably represented in a MUSIC model using a single suite of parameters for each source node across the Project Site.

6.2.5.5 Operational-Stage Modelling Setup and Calibration

As discussed in Section 6.2.5.2, the areas occupied by the box cut and the Tailings Storage Facility are excluded from both the pre-development and operational-stage models. **Table 8** details the baseflow and stormflow properties used to calibrate the operational-stage land uses expected at the Project Site, based on the layout in **Figure 2**. These are based on details for various land use and surface types described in SCA (2009).

Pervious area properties for all nodes are set in accordance with **Table 7**. The overall area and impervious surface percentages for each source node are determined based on the proposed extent of various structures as illustrated on **Figure 2** and described in the *Environmental Assessment*. In all cases, conservative (over) estimates were assumed.

Table 7
Source Node Pervious Area Calibration Used in the MUSIC Models (from Macleod, 2008)

MUSIC Parameter	Calibration for source nodes at the Project Site
Soil storage capacity	108mm
Initial storage	30%
Field capacity	83mm
Infiltration capacity coefficient	200
Infiltration capacity exponent	2.5
Groundwater initial depth	30mm
Daily recharge rate	35%
Daily baseflow rate	25%
Daily deep seepage rate	5%

Table 8
MUSIC Calibration Details for Operational-Stage Land Use Types

<table>
<tr><th rowspan="2">Surface type</th><th rowspan="2">Land use type*</th><th rowspan="2">Flow type</th><th colspan="2">TSS (mg/L –log_{10})</th><th colspan="2">TP (mg/L –log_{10})</th><th colspan="2">TN (mg/L –log_{10})</th></tr>
<tr><th>mean</th><th>Std. dev</th><th>mean</th><th>Std. dev</th><th>mean</th><th>Std. dev</th></tr>
<tr><td rowspan="2">Operational facilities</td><td rowspan="2">Industrial land use</td><td>Baseflow</td><td>1.20</td><td>0.17</td><td>-0.85</td><td>0.19</td><td>0.11</td><td>0.12</td></tr>
<tr><td>Stormflow</td><td>2.15</td><td>0.32</td><td>-0.60</td><td>0.25</td><td>0.30</td><td>0.19</td></tr>
<tr><td rowspan="2">Access road</td><td rowspan="2">Unsealed roads</td><td>Baseflow</td><td>1.20</td><td>0.17</td><td>-0.85</td><td>0.19</td><td>0.11</td><td>0.12</td></tr>
<tr><td>Stormflow</td><td>3.00</td><td>0.32</td><td>-0.30</td><td>0.25</td><td>0.34</td><td>0.19</td></tr>
<tr><td rowspan="2">Office roofs</td><td rowspan="2">Roof</td><td>Baseflow</td><td>-10.00</td><td>0.00</td><td>-10.00</td><td>0.00</td><td>-10.00</td><td>0.00</td></tr>
<tr><td>Stormflow</td><td>1.30</td><td>0.32</td><td>-0.89</td><td>0.25</td><td>0.30</td><td>0.19</td></tr>
<tr><td colspan="9">Note: based on SCA (2009).</td></tr>
</table>

The operational-stage modelling assumes the following.

- Operational-stage sediment basins would be installed in accordance with Blue Book (Landcom, 2004 and DECC, 2008a) requirements, as detailed in Section 7.2. These are estimated at 6,000m^3 capacity, with a surface area of 4,000m^2.
- Operational-stage sediment basins would be managed as per the requirements of Landcom (2004) and DECC (2008a) to limit discharge waters to 50mg/L up to and including the 20-day, 90th percentile storm event (73.7mm over 20 days).
- The unsealed access road would be constructed following the best-practice details in DECC (2008b). This would include roadside table drains with at-grade turn-out drains every 50m on both sides of the road.
- The offices, processing areas, workshops, yards, storage areas and haul road have an effective impervious area that is 50% of their total area (note that the effective impervious area is generally significantly less than the actual impervious area and accounts for runoff from hard surfaces onto adjacent pervious areas).
- The unsealed access road is approximately 4km long and is within a 30m-wide corridor, which is assumed to be 75% effective impervious.
- Office roofs drain to a rainwater tank(s) of estimated capacity 40,000L. Usage is estimated at 2,835L/day (60 staff x 45L/day + 5 deliveries x 27L/day) (NSW Department of Health, 2001).

6.2.5.6 Results of MUSIC Modelling

A comparison of the pre-development and operational-stage MUSIC results is contained in **Table 9**. These results show that mean annual loads of all pollutants would decrease in the operational stage when compared with the present (pre-development) scenario. This is due to the effectiveness of recommended surface water management measures such as sediment basins.

MUSIC modelling suggests a minor increase in annual surface water flows from the Project Site of 1.7ML/yr (an increase of 3.5%). This is due to the increase in impervious surfaces over the Project Site. Given the 24ha of modelled catchment represents such a small proportion of the overall catchment of Majors Creek (estimated at approximately 530ha upstream of where Spring Creek meets Majors Creek), this is not considered to be significant.

Table 9
Results of MUSIC Modelling (Mean Annual Loads)

MUSIC Model Number	Description	Flow (ML/yr)	TSS[1] (kg/yr)	TP[1] (kg/yr)	TN[1] (kg/yr)	GP[1] (kg/yr)
1	Pre-development	48.1	8,050	23.9	161	23.3
2	Operational stage without surface water management	64.4	24,300	21.9	137	1,810
3	Operational stage including surface water management	49.8	1,190	6.78	76.9	0
2 vs 3	Treatment Train Effectiveness	-23%	-95%	-69%	-44%	-100%
1 vs 3	Pre-development vs Operational stage comparison	+3.5%	-85%	-72%	-52%	-100%

Note 1: TSS = total suspended solids
TP = total phosphorus
TN = total nitrogen
GP = gross pollutants

6.2.5.7 Conclusion

In summary, MUSIC modelling shows that mean annual loads of all pollutants would decrease in the operational stage when compared with the present (pre-development) scenario. However, this assumes that the recommended surface water management measures (**Section 7**) are installed.

6.2.6 Moruya River Water Quality and River Flow Objectives

According to DECCW's website, the NSW Water Quality Objectives are the agreed environmental values and long-term goals for NSW's surface waters. They set out:

- the community's values and uses for our rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- a range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses.

The majority of the Project Site lies in an area classified by the Moruya River Water Quality and River Flow Objectives (http://www.environment.nsw.gov.au/ieo/Moruya/report-02.htm#P163_18347) as an "uncontrolled stream," and also as an "upland river" meaning that a range of water quality and river flow objectives need to be assessed to determine what, if any, impacts a major developments such as this might have and whether those impacts are acceptable. **Table 10** contains an assessment of the potential impacts of the Project, measured against the various Moruya River Water Quality Objectives for upland rivers. **Table 11** contains an assessment of the potential impacts of the Project, measured against the various Moruya River Flow Objectives, also for upland rivers.

Table 10
Impact Assessment Against the Moruya River Water Quality Objectives

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OBJECTIVE	IMPACT ASSESSMENT
Aquatic ecosystems	Total phosphorus (TP) - Water quality modelling predicts a beneficial effect (72% - refer to **Table 9** in **Section 6.2.5.6**) on TP levels because of the reduction in pollutants presently generated by agriculture.
	Total nitrogen (TN) - Water quality modelling predicts a beneficial effect (52% - refer to **Table 9** in **Section 6.2.5.6**) on TN levels because of the reduction in pollutants presently generated by agriculture.
	Chlorophyll-a - Impact would be negligible. The Project is unlikely to change the level of Chlorophyll-a in the receiving waters.
	Turbidity (Total suspended solids, or TSS) - Water quality modelling predicts a beneficial effect on TSS levels because of the reduction in pollutants presently generated by agriculture. - Sediment load would be controlled in any discharge of waters up to the design event, as dictated by Landcom (2004) and DECC (2008).
	Salinity (electrical conductivity) - Impact would be negligible. The Project is unlikely to change the level of salinity in the receiving waters because soils are non-saline.
Aquatic ecosystems	Dissolved oxygen (DO) - Impact would be negligible. The Project is unlikely to change the level of dissolved oxygen in the receiving waters. Flow volumes and patterns are unlikely to be significantly altered.
	pH - Impact would be negligible. The Project is unlikely to change the pH level in the receiving waters. pH would be controlled in any discharge of waters up to the design event, as dictated by Landcom (2004) and DECC (2008).
	Temperature - Impact would be negligible. The Project is unlikely to change the temperature in the receiving waters.
	Chemical contaminants - No impact is likely as all potential chemical contaminants or toxicants would be isolated onsite and/or be directed to the Tailings Storage Facility.
	Biological assessment indicators - Impacts would be negligible. The Project is unlikely to change the level of biological activity in the receiving waters and is unlikely to discharge waters which might affect riparian ecology. In addition, natural base- and storm-flow regimes would be maintained to limit potential ecological impacts.
Visual amenity	Visual clarity and colour - Water quality modelling predicts a beneficial effect (85% - refer to **Table 9** in **Section 6.2.5.6**) on TSS levels because of the reduction in pollutants presently generated by agriculture. - Sediment load and pH would be controlled in any discharge of waters up to the design event, as dictated by Landcom (2004) and DECC (2008).

Table 10 (Cont'd)
Impact Assessment Against the Moruya River Water Quality Objectives

Page 2 of 2

OBJECTIVE	IMPACT ASSESSMENT
Visual amenity	Surface films and debris - Water quality modelling predicts a beneficial effect (85% for TSS and 100% for GP - refer to **Table 9** in **Section 6.2.5.6**) because of the reduction in pollutants presently generated by agriculture.
	Nuisance organisms - Impact would be negligible. The Project is unlikely to change the level of biological activity in the receiving waters or create conditions that might increase the numbers of nuisance organisms. Flow and nutrient levels would be relatively unchanged from the present conditions.
Secondary contact recreation	All indicators (ie.; Faecal coliforms, Enterococci, Algae & blue-green algae, Nuisance organisms, Chemical contaminants, Visual clarity and colour and Surface films) - Water quality modelling predicts a beneficial effect on water quality because of the reduction in pollutants presently generated by agriculture. - The project would be unlikely to change the level of biological activity in the receiving waters or create conditions that might increase the numbers of nuisance organisms. Flow and nutrient levels would be relatively unchanged from the present conditions.
Primary contact recreation	Not Applicable – Watercourse does not contain, or is not immediately upstream of a recognised recreation site.
Livestock water supply	Algae & blue-green algae - The Project is unlikely to modify water quality or flow conditions that might encourage algal growth. - Water quality modelling predicts a beneficial effect on water quality because of the reduction in pollutants presently generated by agriculture.
	Salinity (electrical conductivity) - The Project would be unlikely to modify water quality or flow conditions that might increase salinity levels.
Livestock water supply	Thermotolerant coliforms - The Project would be unlikely to modify water quality or flow conditions that might increase the levels of thermotolerant coliforms.
	Chemical contaminants - No impact is likely as all potential chemical contaminants or toxicants would be isolated onsite and/or be directed to the Tailings Storage Facility.
Irrigation water supply	Majors Creek flows to Araluen, where water is drawn from a mixture of surface and subsurface sources for irrigation. The Project proposal includes the return of 2.1L/s of baseflow into Majors Creek to compensate for modelled losses to groundwater (also of 2.1L/s). Additionally, no harvesting of surface water beyond the harvestable right is proposed. As such, the Project is unlikely to have any impact on downstream irrigators.
Homestead water supply	Not Applicable – Majors Creek is not used for domestic supply. Water for drinking, cooking and bathing on homesteads is drawn from rainwater tanks. Irrespective of this, modelling suggests that the Project is unlikely to decrease the amount or quality of water to downstream users. Reductions in baseflow would be offset by a return of water to Majors Creek.
Drinking water	Not Applicable – Majors Creek is not a current or future offtake point for town water supply. It is not immediately upstream of an offtake point. It is not a groundwater contributing system for a town supply. Irrespective of this, modelling suggests that the Project is unlikely to decrease the amount or quality of water to downstream users. Reductions in baseflow would be offset by a return of water to Majors Creek.
Aquatic foods	Not Applicable – Majors Creek is not used for the collection of aquatic foods and it is a long way upstream of the Deua or Moruya Rivers where aquatic foods might be harvested.

Table 11
Impact Assessment Against the Moruya River Flow Objectives

Page 1 of 2

OBJECTIVE	DETAILS	IMPACT ASSESSMENT
Protect pools in dry times	Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows.	Majors Creek is identified as a perennial stream so is unlikely to experience times of no flow. Groundwater modelling (AGE, 2010) suggests that the project could reduce the baseflow in Majors Creek by up to 2.1L/s due to a reduction in shallow groundwater throughflow. To mitigate this, the Proponent would deliver a constant flow of 2.1L/s to Majors Creek. Details of this are contained in the Water Balance in Section 5.
Protect natural low flows	Protect natural low flows	Groundwater modelling (AGE, 2010) suggests that the project could reduce the baseflow in Majors Creek by up to 2.1L/s due to a reduction in shallow groundwater throughflow. To mitigate this, the Proponent would to deliver a constant flow of 2.1L/s to Majors Creek at all times. Details of this are contained in the Water Balance in Section 5.
Protect important rises in water levels	Protect or restore a proportion of moderate flows (‘freshes’) and high flows.	The proposed water management scheme does not include any harvesting of surface water beyond the Proponent’s harvestable right. Additionally, groundwater harvested by the project that might have impacted water flows in Majors Creek will be returned at a constant rate of 2.1L/s (see above).
Maintain wetland and floodplain inundation	Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems.	The proposed water management scheme does not include any harvesting of surface water beyond the Proponent’s harvestable right. As such, it is unlikely to decrease the natural pattern of flooding or inundation downstream. Although the proposed project would increase the amount of impervious surfaces at the site (and, hence, potentially increase the amount of stormflow runoff), operational-phase sediment basins would act to temporarily detain that water, thereby reducing the potential impacts of increased runoff.
Mimic natural drying in temporary waterways	Mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways.	The Project would be unlikely to impact the existing frequency, duration or seasonality of drying periods in Majors Creek.
Maintain natural flow variability	Maintain or mimic natural flow variability in all streams.	Groundwater modelling (AGE, 2010) suggests that the project could reduce the baseflow in Majors Creek by up to 2.1L/s due to a reduction in shallow groundwater throughflow. To mitigate this, the Proponent would deliver a constant flow of 2.1L/s to Majors Creek at all times. Details of this are contained in the Water Balance in **Section 5**. Stormflow volumes are unlikely to be significantly altered because surface water harvesting would not exceed the maximum harvestable right and any excess runoff from impervious areas would be temporarily detained in sediment basins. Releases from sediment basins would be at a controlled rate designed not to cause erosion or prolonged high flow levels.

Table 11 (Cont'd)
Impact Assessment Against the Moruya River Flow Objectives

Page 2 of 2

OBJECTIVE	DETAILS	IMPACT ASSESSMENT
Maintain natural rates of change in water levels	Maintain rates of rise and fall of river heights within natural bounds.	Although the proposed project would increase the amount of impervious surfaces at the site (and, hence, potentially increase the amount of stormflow runoff) and the relative rate of rise in downstream waters, operational-phase sediment basins would act to temporarily detain excess runoff, thereby reducing the potential impact. Releases from sediment basins would be at a controlled rate designed not to cause erosion or prolonged high flow levels.
Manage groundwater for ecosystems	Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems.	The localised flows in Spring Creek within the Project Site would be affected by groundwater ingress into the mine. However, the modelled decrease in flows to the receiving waters of 2.1L/s (AGE, 2010) would be returned to Majors Creek. The Proponent would deliver a constant flow of 2.1L/s to Majors Creek at all times. Details of this are contained in the Water Balance in **Section 5**.
Minimise effects of weirs and other structures	Minimise the impact of instream structures.	No structures would be constructed in Majors Creek. Harvestable-right dams and the Tailings Storage Facility would be constructed on small, first and second order tributaries of Spring Creek.
Minimise effects of dams on water quality	Minimise downstream water quality impacts of storage releases.	Not applicable. Any releases of water from small, harvestable-right dams on the Project Site would be via the surface-level overflow.
Make water available for unforeseen events	Ensure river flow management provides for contingencies.	Surface water harvesting would only be up to the Proponent's harvestable right. Any losses due to groundwater interception in the mine would be returned to Majors Creek as a constant baseflow of 2.1L/s (see **Section 5**). As such, this Project is unlikely to require contingency measures to allow for unforseen circumstances.
Maintain or rehabilitate estuarine processes and habitats	Maintain or rehabilitate estuarine processes and habitats.	Groundwater modelling (AGE, 2010) suggests that the project could reduce the baseflow in Majors Creek by up to 2.1L/s due to a reduction in shallow groundwater throughflow. To mitigate this, to the Proponent would deliver a constant flow of 2.1L/s to Majors Creek at all times. Details of this are contained in the Water Balance in **Section 5**. Stormflow volumes are unlikely to be significantly altered because surface water harvesting would not exceed the Proponent's harvestable right and any excess runoff from impervious areas would be temporarily detained in sediment basins. Releases from sediment basins would be at a controlled rate designed not to cause erosion or prolonged high flow levels.

6.3 EXISTING SOIL CONSERVATION MEASURES

Gully erosion along Spring Creek has been partially stabilised in recent years by soil conservation works, mainly in the form of fencing of the gully walls to exclude stock and enhance vegetation establishment. We do not anticipate that works associated with the Project would require the removal of this fencing and, as such, we recommend that it remain.

If Project infrastructure crosses the existing gully-edge fencing (e.g. for installing power transmission lines), gates and strainer posts should be installed in the existing fences to maintain their continuity and also allow for maintenance of infrastructure. Recommendations to this effect are included in **Section 7.5**.

Areas of existing native vegetation including recent native tubestock planting should remain. We do not anticipate extensive disturbance to native vegetation.

Any disturbance to riparian vegetation or on creek banks would need to be rapidly stabilised to minimise the risk of erosion. Recommendations to this effect are included in **Section 7.1**.

6.4 EFFLUENT MANAGEMENT

The Project Site is not serviced by reticulated sewer. As a result, all effluent generated by staff and visitors associated with the proposed mining activities would either be treated and disposed of onsite or be stored in a collection tank and pumped out on a regular basis.

If effluent is to be treated and disposed of onsite, a system such as an Aerated Wastewater Treatment System (AWTS) which provides secondary treatment of sewage, would be suitable. Treated wastewater can then be used for surface irrigation to a dedicated effluent management field.

The Soils Assessment (SEEC, 2010) identified that soils within the Project Site are well suited to surface or near-surface irrigation of treated wastewater in accordance with DLG (1998) and AS/NZ 1547:2000. Additionally, evaporation exceeds rainfall for most of the year, thereby facilitating effluent disposal methods that rely on evapotranspiration (e.g. irrigation).

The Proponent advises that the proposed ablution facilities are unlikely to be subject to intermittent or “shock” loads which might otherwise preclude the use of an AWTS. However, the installation, sizing and maintenance of the AWTS would be critical to its ongoing acceptable performance to treat sewage. Additionally, restrictions would be required governing the use of treated wastewater from the AWTS to ensure compliance with the requirements of NWQMS (2006).

A range of recommendations are detailed in **Section 7.6**. We conclude that, providing best-practice measures for the treatment and disposal of wastewater are adopted in accordance with DLG (1998) and AS/NZ 1547:2000, there is a low risk of pollution from the effluent management system.

7. RECOMMENDATIONS

7.1 CONSTRUCTION PHASE EROSION AND SEDIMENT CONTROL

To mitigate the risk of soil erosion causing pollution to downstream waters, we recommend that best-practice erosion and sediment control measures be put in place during the construction phase of the Project. A construction phase Soil and Water Management Plan (SWMP) should be prepared by a qualified professional in accordance with the guidelines and recommendations in Landcom (2004) and DECC (2008). This should take into account the following recommendations.

- A series of sediment basins should be established downslope of any construction areas, including the access road. Sediment basins for the construction phase need to be sized and designed using the following criteria (all from Landcom, 2004):
  - Five-day, 75th percentile rain depth of 18mm (Queanbeyan).
  - Hydrologic group C and Volumetric Runoff Coefficient of 0.25.
  - Type D (dispersible) sediments.
  - Using the prevailing slope gradient and an assumed slope length of at least 80m.
  - A spillway with minimum 0.6m freeboard and sized and lined for stability in the 100-year ARI time-of-concentration rain event.
  - Adequate earth wall compaction.
- Sediment basins that will remain for the operational phase of the project (see Section 7.2) can be constructed to their operational size rather than enlarging them after construction.
- Water from sediment basins cannot be used onsite unless those sediment basins are included in the harvestable right calculation. If not used in that calculation, those waters must be released to downstream waters once they have been tested and achieve the required water quality (see below).
- Sediment basins do not require a sealed floor but can be designed to leak water into the ground. This would help replicate the natural groundwater recharge regime and offset the increase in impervious surfaces.
- Run-on from upslope should be diverted around construction areas using catch drains. These should be sized and lined for stability in the 10-year ARI time-of-concentration rain event.
- Sediment-laden runoff from construction areas should be diverted to sediment basins using catch drains. These should be sized and lined for stability in the 10-year ARI time-of-concentration rain event.
- A maintenance schedule for sediment basins should be prepared to ensure that the following.

  - Waters would be discharged within five days after the conclusion of a rain event, at or below the required water quality limit of 50mg/L and within the pH range 6.5 to 8.5. Note that soil investigations indicate that sediments are dispersible and will most likely require flocculation to assist settling.
  - After discharging treated water from any sedimentation basin, the level of retained sediment should be inspected. If retained sediment exceeds the marked level of the sediment basin's Soil Storage Zone, sediment should be removed and added to an active stockpile.
- Exposed earth bunds, batters and other areas disturbed by construction activities should be stabilised using vegetation, paving or other long-term armouring to achieve the equivalent of 70% grass cover (i.e. a long-term C-factor of 0.05).
- Disturbance to creek banks, riparian areas or any other areas prone to channelized flows of water should be stabilised to achieve at least 70% ground cover within 10 days of completion of formation and before they convey any flows. Ground protection measures should be chosen that can withstand channelized flow conditions (Landcom, 2004).

7.2 OPERATIONAL PHASE EROSION AND SEDIMENT CONTROL

Most areas disturbed during the construction phase would be rehabilitated to provide a protective ground cover using vegetation, paving or other long-term armouring. However, certain high-traffic areas would remain unprotected during the operational phase and, as such, effective erosion and sediment controls are required in accordance with Landcom (2004) and DECC (2008). As part of an operational Soil and Water Management Plan, this should take into account the following recommendations.

- A series of sediment basins should be maintained downslope of the ROM pad, haul road and any other areas not protected from erosion by some form of effective ground cover. These basins need to be sized and designed using the following criteria (all from DECC, 2008 and Landcom, 2004):
  - 20-day, 90th percentile rain depth of 73.7mm (Queanbeyan).
  - Hydrologic group C and Volumetric Runoff Coefficient of 0.7.
  - Type D (dispersible) sediments.
  - Using the prevailing slope gradient and an assumed slope length of at least 80m.
  - A spillway with minimum 0.6m freeboard and sized and lined for stability in the 100-year ARI time-of-concentration rain event.
  - Adequate earth wall compaction.
- Water from sediment basins cannot be used onsite unless those sediment basins are included in the harvestable right calculation. If not used in that calculation, those waters must be released to downstream waters once it has been tested and achieves the required water quality (see below).

- Sediment basins do not require a sealed floor but can be designed to leak water into the ground. This would help replicate the natural groundwater recharge regime and offset the increase in impervious surfaces.
- Run-on from upslope should be diverted around the ROM pad and processing areas to limit erosion using catch drains. These should be sized and lined for stability in the 20-year ARI time-of-concentration rain event.
- Sediment-laden runoff from exposed areas such as the ROM pad, haul road and processing area should be diverted to sediment basins using catch drains. These should be sized and lined for stability in the 20-year ARI time-of-concentration rain event.
- A maintenance schedule for sediment basins should be prepared to ensure that:
  - Waters would be discharged within twenty days after the conclusion of a rain event, at or below the required water quality limit of 50mg/L and within the pH range 6.5 to 8.5. Note that soil investigations indicate that sediments are dispersible and will most likely require flocculation to assist settling.
  - After discharging treated water from any sedimentation basin, the level of retained sediment should be inspected. If retained sediment exceeds the marked level of the sediment basin's Soil Storage Zone, sediment should be removed and added to an active stockpile.
- Earth bunds, batters, stockpiles and other areas previously subject to earthworks should be stabilised using vegetation, paving or other long-term armouring to achieve the equivalent of 70% grass cover (i.e. a long-term C-factor of 0.05).
- Dust control should be undertaken over all areas of exposed soils (i.e. the ROM pad, haul road and around the crushing plant). Water for dust control should be sourced from either mine dewatering, harvestable-right dams or by pumping water from the historic workings and should be applied as required to minimise the risk of dust rise.

7.3 WATER QUALITY MANAGEMENT AND WATER TESTING

7.3.1 Water Quality Management Structures and Methods

As identified in **Section 6.2.4**, there is a risk of pollution to downstream receiving waters as a result of the Project. To mitigate this risk, we recommend that specific water quality management measures be employed onsite. These should include the following.

- The Tailings Storage Facility should be effectively sealed to prevent leakage into the underlying substrate. This includes sealing the earth wall.
- The Tailings Storage Facility should have a diversion bund constructed around it to completely divert any upslope run-on around it. This bund should be stabilised to effectively convey the 100-year ARI, time-of-concentration flow from the upstream catchment.
- All fuel and chemical storage, delivery and handling areas should be bunded to 110% of the size of the largest receptacle.

- Any header tanks for the storage of fuels or chemicals are to have a return-line and/or an alarm fitted to minimise the risk of overflows causing a pollution event.
- Pumps and fluid lines for the delivery of chemicals or fuels are to be bunded and/or protected. Transfer volumes are to be monitored to quickly identify any leaks.

7.3.2 Water Testing

As identified in **Section 6.2.4**, there is a risk of pollution to downstream receiving waters as a result of the Project. Although significant management and mitigation measures would be employed onsite to minimise this risk, we recommend regular water testing in the receiving waters to identify potential issues.

We recommend that water sampling be undertaken in the following locations (see **Figure 3**):

- Majors Creek both upstream and downstream of where Spring Creek joins it (Points 1 and 2 on **Figure 3**);
- Downstream of the Tailings Storage Facility (Point 3 on **Figure 3**); and
- Downstream of the main project infrastructure and sediment basin outlets (Point 4 on **Figure 3**).

Comparisons should be made between the two Majors Creek sampling locations (Sampling Points 1 and 2) to determine what, if any impacts have occurred. Monitoring of water downstream of the Tailings Storage Facility (Sampling Point 3) and main project infrastructure (Sampling Point 4) would quickly identify potential leakage issues with the water management measures in these areas. If water quality was found to be a problem, appropriate action should be taken in consultation with an accredited water quality expert.

Monitoring of discharges into Majors Creek would ensure that water 'returned' to that system was of a suitable quality. These discharges could then be isolated if they were found to be impacting water quality in Majors Creek.

We recommend that water sampling occur every three months during the first two years of mine operation, then reduced to every six months after that time providing no water quality issues have arisen. All samples should be laboratory tested for the following:

- pH
- Electrical Conductivity (EC)
- Total Suspended Solids (TSS)
- Major cations i.e. sodium (Na^+), potassium (K^+), calcium (Ca^{2+})
- Major anions i.e. chloride (Cl-) and sulfate (SO_4^{2-})
- Total Kjeldahl Nitrogen (TKN = organic nitrogen plus ammonia nitrogen)
- Total Oxidized Nitrogen (TON, also referred to as NOx-N = nitrate + nitrite nitrogen forms)

- Ammonia Nitrogen (NH_3-N)
- Total Phosphorus (Total-P) and Reactive Phosphorus (PO_4^{3-})
- Metals (aluminium, arsenic, total iron and filterable iron, zinc)

Field water quality tests should also be conducted on the day of sampling to monitor:

- Field pH
- Field Electrical Conductivity (EC)
- Dissolved Oxygen (DO)
- Oxidation Reduction Potential (ORP)
- Temperature

7.3.3 Stream Morphology and Riparian Health

As identified in **Section 6.2.3**, there is a risk that decreased baseflows in a section of Spring Creek through the Project Site might temporarily impact riparian health during the life of the Project. We recommend that riparian health be monitored annually in this area and, if required appropriate action taken to address any riparian stresses that occur as a result of the decreased baseflows.

We recommend that the commitment to 'return' 2.1L/s of baseflow into Majors Creek be included in the Project scope to minimise impacts to the downstream receiving waters. As identified in water balance modelling in **Section 5**, there is sufficient water available to enable this to occur.

7.4 ACCESS ROAD

To address the risk of erosion from the access road causing sediment pollution in receiving waters, and to minimise the amount of runoff from the road into local waterways, we recommend the following.

- The road be designed and constructed in accordance with the best-practice methods detailed in DECC (2008b).
- The road include armoured (vegetated or similar) table drains along both sides, with regular turn-out drains constructed at-grade every 50m or so.
- Long-term dust suppression be employed on the road in the form of chemical dust retardants or similar.

7.5 SOIL CONSERVATION MEASURES

To address the risk of exacerbating the existing gully erosion in Spring Creek, we recommend that existing soil conservation fencing along the edges of gullies be retained during and after Project operation. Any crossing points (e.g. for power transmission lines) should include gates to allow for the continuity of fencing.

7.6 EFFLUENT MANAGEMENT

To address the risk of surface water pollution from onsite effluent management, we recommend that:

- Effluent be collected onsite and pumped-out regularly (by a licensed contractor and to a licensed receiving facility); or
- Effluent be treated and disposed of onsite. The treatment and disposal system should be designed and operated in accordance with DLG (1998) and AS/NZ 1547:2000.

7.7 HARVESTABLE RIGHT DAMS

As detailed in **Section 4.3**, the Proponent's harvestable right is 34.56ML of total dam capacity. We recommend that existing dams that are not required as part of the proposed water management strategy be decommissioned progressively as new dams are constructed to ensure that the total amount of dam capacity on the site never exceeds the harvestable right.

7.8 WATER MANAGEMENT STRATEGY MONITORING AND AMENDMENT

The results of water quality monitoring and water re-use and/or treatment and discharge from sediment basins should be maintained in the Project Office and incorporated in the Annual Environmental Management Reports for the Project. Copies of the report should be provided to DECCW and I&I NSW

The surface water management strategy should be reviewed at least annually to determine what, if any, changes are required to meet the requirements of the Environment Protection Licence that would be obtained by the Proponent following the granting of Project Approval and to minimise the risk of environmental harm.

8. REFERENCES

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) (2010). *Groundwater Assessment for the Dargues Reef Gold Project*. *Specialist Consultant Studies Compendium, Volume 1 Part 3.*

Department of Environment and Climate Change (DECC). (2008a). *Managing Urban Stormwater: Soils and Construction.* Volume 2E Mines and Quarries. NSW Department of Environment and Climate Change, Sydney.

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Department of Local Government (DLG) (1998). *Environment and Health Protection Guidelines: On-Site Sewage Management for Single Households*.

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Landcom (2004). *Managing Urban Stormwater: Soils and Construction. 4th Edition.* Volume 1. NSW Government, Sydney.

Macleod, A.P. (2008). "MUSIC Calibration Based on Soil Conditions." In Proceedings of Stormwater08; NSW and Qld Stormwater Industry Association Conference, Gold Coast, 2008.

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R.W. Corkery & Co. Pty Limited (2010). *Environmental Assessment for the Dargues Reef Gold Project*.

SEEC (2010). *Soils Assessment for the Dargues Reef Gold Project*. *Specialist Consultant Studies Compendium, Volume 2 Part 8.*

Sydney Catchment Authority (SCA) (2009). *A Guide to the use of MUSIC in Sydney's Drinking Water Catchments* - Draft, 2009. SCA, Penrith.

Appendices

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Appendix 1

Director Generals Requirements

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Table A1.1
Director-General's Requirements
(Department of Planning – 23 April 2010)

Paraphrased Requirement	Relevant EA Section(s)
SOIL AND WATER	
Including: • a detailed site water balance: • a detailed groundwater model; • potential water quality impacts on the environment and other land users; and • a description of the final landform water management;	Sections 5 and 6, plus the Groundwater Assessment (AGE, 2010)

Table A1.2
Coverage of Environmental Issues

Page 1 of 6

Government Agency	Paraphrased Requirement	Relevant EA Section(s)
	WATER	
Department of Environment, Climate Change & Water (01/04/10)	The EA must outline site layout, demonstrating efforts to avoid pollution to water resources (especially for activities with significant potential impacts eg tailings dam) and show potential areas of modification of contours, drainage etc.	Sections 6 and 7
	The EA must provide details of the project that are essential for predicting and assessing impacts to waters:	
	• including the quantity and physio-chemical properties of all potential water pollutants and the risks they pose to the environment and human health, including the risks they pose to Water Quality Objectives in the ambient waters (as defined on www.environment.nsw.gov.au/ieo, using technical criteria derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC 2000);	Section 6
	• the management of discharges with potential for water impacts; and	Section 7
	• drainage works and associated infrastructure; land-forming and excavations; working capacity of structures; and water resource requirements of the proposal.	Sections 5, 6 and 7
	The EA must outline how total water cycle considerations are to be addressed showing total water balances for the development (with the objective of minimising demands and impacts on water resources). Include water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.	Sections 5 and 7
	The EA should fully assess impacts including but not limited to the following:	
	• Groundwater quality issues including the alteration of the groundwater recharge rates and possible contamination of groundwater from the recycled water scheme;	Section 6.2.2 and the Groundwater Assessment

Table A1.2
Coverage of Environmental Issues (cont'd)

Page 2 of 6

Government Agency	Paraphrased Requirement	Relevant EA Section(s)
WATER (cont'd)		
Department of Environment, Climate Change & Water (01/04/10)	• Altered flow and drainage regimes and subsequent effects on the dynamics and recharge ability of groundwater aquifers; and long-term effects on stability and integrity of aquifers;	Refer to the Groundwater Assessment
	• Impacts of altered flow and drainage regimes impacting on receiving waters including impact on creek morphology and ecosystem implications including aquatic ecology, riparian vegetation and weed distribution;	Section 6.2
	• Cumulative impacts of proposed recycled water discharges on the receiving waters – downstream impact of altered flows; effects to river health, ecology and biodiversity; and	Section 6.2
	• Construction impacts on waterways due to runoff and increased sediment and nutrient movement.	Sections 6.1 and 7.1
	The EA should provide details of the project that are essential for predicting and assessing impacts to waters including the quantity and physio-chemical properties of all potential water pollutants and the risks posed to the environment and human health, including the risks they pose to Water Quality Objectives in the ambient waters using technical criteria derived from the ANZECC Guidelines.	Section 6.2
Council (06/04/10)	Council is concerned about use of surface water and ground water that may potentially affect water resources in the area for the local community and environmental flows. It is Council's opinion that N0W approvals are required for use of dam and ground water associated with any use that is not for stock and domestic. The impact of water harvesting needs to be addressed in the EIS.	Section 4.3
	Adequate details with regard to monitoring of water quality and water quantity upstream and downstream of the proposed development need to be addressed in the EIS. Council is particularly concerned about the location of the tailings.	Section 7.3.2
NSW Government Office of Water (01/04/10)	NOW requires the Environmental Assessment (EA) for the proposal to demonstrate that the proposed mining operation will achieve the following: • no impact on adjacent licensed water users, basic landholder rights, minimum base flows, or groundwater-dependent ecosystems; • adequate water licensing under the Water Act 1912 for proposed groundwater extraction and/or groundwater interception and compliance with the S.1 113A Water Act 1912 embargo on groundwater licences in the Coastal Floodplain Alluvial Groundwater Sources and Highly Connected Alluvial Groundwater Sources of Coastal Catchments – Regional NSW, which is provided as a supplement to this letter.	Refer to the Groundwater Assessment Refer to the Groundwater Assessment

Table A1.2
Coverage of Environmental Issues (cont'd)

Government Agency	Paraphrased Requirement	Relevant EA Section(s)
	WATER (cont'd)	
NSW Government Office of Water (01/04/10)	NOW requires the Environmental Assessment (EA) for the proposal to demonstrate the following;	
	1. Adequate and secure water supply.	Section 5
	2. Identification of site water demands, water sources (surface and groundwater), water disposal methods and water storage structures in the form of a water balance. This is to also include details of any water reticulation infrastructure that supplies water to and within the site.	Section 5
	3. Proposed water management on the site based on the site water balance. This is to also include an outline of a proposed surface water and groundwater management plan.	Section 5
	4. A groundwater and surface water impact assessment on adjacent licensed water users, basic landholder rights, groundwater-dependent ecosystems and the surface water environment. This will require a detailed understanding of the existing and predicted surface and groundwater system.	Section 6
	5. Requirement to intercept groundwater and predicted dewatering volumes, seepage volumes, water quality and disposal/retention methods. Intercepted and dewatered volumes need to be predicted throughout mine life and for any post mine life recovery period to reach equilibrium.	Section 5
	6. An impact assessment of the construction, operation and final landform of the proposed onsite waste rock emplacements, Tailings Storage Facility and other potentially contaminating facilities to meet the requirements of the NSW State Groundwater Policy framework document.	Section 6
	7. Identification of works or activities requiring licensing under the Water Act 1912 or Water Management Act 2000, eg. Monitoring bores, aquifer interception, groundwater and/or surface water extraction.	Section 5.4
	8. Proposal to construct watercourse crossings and carry out works within 40m of a watercourse in accordance with former DWE Controlled Activity Approval Guidelines.	Section 5.4
	9. Adequate mitigating and monitoring requirements to address surface and groundwater impacts.	Section 7
	The Environmental Assessment report must include the following for all water-related aspects of the proposal:	
	• an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation);	Section 6
	• proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures; and	Section 7
	• where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of these additional key environmental impacts must be included in the Environmental Assessment report.	Section 6

Table A1.2
Coverage of Environmental Issues (cont'd)

Page 4 of 6

Government Agency	Paraphrased Requirement	Relevant EA Section(s)
	WATER (cont'd)	
NSW Government Office of Water (01/04/10)	The Environmental Assessment must include assessment of water supply and/or water interception and extraction against any Water Sharing Plan, or any embargo in force affecting the site or potential water supply to the proposal. A full description of water supply to all stages of the proposal must be included, which includes: • water source(s) which may be used to supply water to the proposal, existing licences, additional water requirements, and a checklist against any regulatory water sharing or other ministerial plans or other instruments applying to that water source; • explanation of any embargoes or full commitment declarations for the proposal, and any identified means to source water supply for the proposal; • examination of reliability of water supply to the proposal, including alternatives to site rainfall runoff harvesting in the event of drought; • demonstration of prioritisation and effective reuse of saline or other contaminated water within the proposal; • explanation of water circuitry and means to segregate contaminated, sediment-laden and clean water volumes within the proposal and proposal site.	All in Section 5
	The Environmental Assessment report must include demonstration that the project is consistent with the spirit and principles of the NSW State Groundwater Policy Framework Document, the NSW State Groundwater Quality Protection Policy, the NSW State Groundwater Dependent Ecosystems Policy and the Draft NSW State Groundwater Quantity Management Policy, This must include, for the pre-, during, and post- development phases of the project the following:	
	• identification of surrounding water users and any groundwater dependent ecosystems;	Refer to the Groundwater Assessment
	• detailed explanation of potential groundwater volume, piezometric level, water table heights and the direction of flow and quality, through mine life and projections into the post-mine period, any identified connected water sources impacted by mining;	Refer to the Groundwater Assessment
	• detailed explanation of groundwater drawdown or other impacts upon connected groundwaters;	Refer to the Groundwater Assessment
	• explanation of the site water balance, including any changes to water balance inputs from rainfall runoff, additional supplies, dewatering requirements and/or groundwater seepage;	Section 5
	• detailed description of any proposed water supply system utilising groundwater as a source, and assessment of current licensing arrangements against this;	Refer to the Groundwater Assessment

Table A1.2
Coverage of Environmental Issues (cont'd)

Page 5 of 6

<table>
<tr><th>Government Agency</th><th>Paraphrased Requirement</th><th>Relevant EA Section(s)</th></tr>
<tr><th colspan="3">WATER (cont'd)</th></tr>
<tr><td rowspan="2">NSW Government Office of Water (01/04/10)</td><td>• detailed analysis of the impacts of dewatering if required for the project, identifying the magnitude and duration of pumping, the areal extent of water level drawdown, the likely quality of extracted groundwater, alterations to site water balance, and the monitoring and reporting protocols to be adopted to meet licensing requirements;
• measures to prevent contamination of the groundwater;
• identification of potential and likely groundwater-dependent ecosystems, and any impact upon these ecosystems which may result from the proposal; this must include
Terrestrial vegetation with seasonal or episodic reliance on groundwater, and
Aquatic and riparian ecosystems in, or adjacent to, streams or rivers dependent upon the input of groundwater to minimum base flows.</td><td>Refer to the Groundwater Assessment

Refer to the Groundwater Assessment. Limited comments in Section 6.2</td></tr>
<tr><td>The Environmental Assessment report must include demonstration that the project is consistent with the spirit and principles of the NSW State Rivers and Estuaries Policy, Wetlands Management Policy, and relevant groundwater policies defined below. This must include, for the pre-, during, and post- development phases of the project the following:
• general description of channel form, river style or other descriptive category of any affected channel, including identification of key geomorphologic indicators and conditions within the zone of influence for the proposal (ie either between most distant riverine controls surrounding the area of disturbance to the proposal area, and/or within the area of groundwater depressurisation);
• hydrologic character of the riverine system, stream energy and power relationships, energy relationships at bankfull height and at peak flow and assessment of stream power and critical tractive stress for existing and any modified conditions for any rivers affected by the proposal, which provides details of:
o long profile and cross sectional survey along the channel, and identification of at least the closest upstream and downstream controls on the channel;
o assessment of bed and bank material, identification of critical entrainment and destabilisation thresholds;
o assessment of the constriction and resultant change in afflux through, past or over the structure, and resultant changes in energy profiles involving the structure;
o nature of bedload transport, and mechanism(s) to permit bedload transport through the structure.
• procedures to develop stream relocation and reconstruction criteria which utilise best practice management, which must include the principles which underpin any embargoes currently in force under the Water Act, 1912, or operational rules of any Water Sharing Plan in force over the site;</td><td>Section 6.2

N/A

N/A

N/A

N/A

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N/A

N/A</td></tr>
</table>

Table A1.2
Coverage of Environmental Issues (cont'd)

Page 6 of 6

Government Agency	Paraphrased Requirement	Relevant EA Section(s)
	WATER (cont'd)	
NSW Government Office of Water (01/04/10)	• methodologies by which proposed relocation or reinstatement of watercourses will be undertaken, and whether any proposed ecological offset provisions will provide adequate protection to any instream or groundwater dependent ecosystems which exist on the site;	N/A
	• Mechanism to maintain long profile grade through the structure, or to provide energy dissipation through the structure at the re-entry point design volumes/velocity downstream;	N/A
	• Nature of existing controls along all watercourses on the site, and proposed use of engineered structures and vegetation to provide long term control to the channel;	Section 6.3 and 7.5
	• final configuration of any relocation, modification or other impact upon rivers and watercourses on or surrounding the site, including geomorphic character mimicking conditions of undisturbed rivers or watercourses adjacent to the proposal area.	Section 7.3
	The Environmental Assessment report must include:	
	• justification of the proposed final landform with regard to its impact on local and regional groundwater systems;	Refer to the Groundwater Assessment and/or the EA.
	• a detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;	Refer to the EA
	• detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;	Refer to the Groundwater Assessment.
	• a detailed description of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation; and	Refer to the EA
	• the measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.	Refer to the Groundwater Assessment.

Appendix 2

Correspondence from Wayne Ryan (NoW) 22 March 2010.

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NSW GOVERNMENT | Office of Water

22nd March 2010

Contact: Wayne Ryan
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Mr. Andrew Macleod
SEEC
PO Box 1098
Bowral NSW 2576

Our ref: ERM 2010/0278
File No:
Your Ref: 09000285-L2

Dear Andrew,

Re: Harvestable Rights and Water Licensing – Dargues Reef, Majors Creek.

I refer to your letter of 12th March 2010 requesting clarification of surface water harvesting and licensing issues for a proposed gold mine at Dargues Reef, Majors Creek.

Following our teleconference and having reviewed the information contained in your email, the NSW Office of Water advises the following.

1. The proposed dam locations as identified by Darryl Goldrick are deemed to be on 1st and/or 2nd order watercourses as indicated on the Bendoura and Monga 1:25 000 topographic maps. Provided these watercourses have no permanent flow, the proposed dam locations comply with the Farm Dams Harvestable Rights Policy.
2. The maximum harvestable right dam capacity for the property has been calculated as 35.64 megalitres. This is based on Cortona Resources holding of 396 hectares and being located in a rainfall runoff area with a multiplier of 0.09ML/ha.
3. The present groundwater embargo extends to alluvial aquifers only. The NSW Office of Water therefore, would be able to accept and consider an application for groundwater extraction from a geological aquifer/water source. Sufficient information would be required to enable the NSW Office of Water to undertake a comprehensive environmental assessment. The NSW Office of Water cannot offer any guarantees to the successful issuing of a groundwater license.
4. All piezometers proposed at the site will be required to be licensed prior to installation. An application form for the piezometers must be lodged. There is no fee for piezometer licenses.

Should you have any queries regarding the above or require any further clarification, please do not hesitate to contact me.

Yours sincerely

W Ryan

Wayne Ryan
Licensing Officer **NSW Office of Water**
Licensing South

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