UNITY Mining Limited

Big Island Mining Pty Ltd ABN 12 112 787 470

Environmental Assessment

for the

Dargues Gold Mine

Modification 3

MP10_0054

July 2015

Prepared by

R.W. CORKERY & CO. PTY. LIMITED

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Introduction

This *Environmental Assessment* has been prepared by R.W. Corkery & Co. Pty. Limited (RWC) on behalf of Big Island Mining Pty Ltd (the Proponent) to support an application to modify Project Approval MP10_0054 (the Proposed Modification or Modification 3).

The Dargues Gold Mine (the Project) was initially proposed in December 2009. Project Approval PA10_0054 was granted by the Land and Environment Court on 7 February 2012, with subsequent modifications granted on:

- 12 July 2012 (MOD1) to permit the use of paste fill; and
- 24 October 2013 (MOD2) to regularise the approved layout following minor changes during the detailed design phase of the Project.

The application area for the purposes of the Proposed Modification, comprises the original Project Site together with the Proponent's recently purchased "Slings" property. The modified Project Site encompasses approximately 452ha and is located on land that is, with the exception of two parcels of land, owned by the Proponent. The Project Site is located on the western slopes of the Great Dividing Range, approximately 60km southeast of Canberra, 13km south of Braidwood and immediately north of the village of Majors Creek (see **Figure A**).

The Project is an 'approved project' under the (now repealed) Part 3A of the *Environmental Planning & Assessment Act 1979*. As a result, the Project is a 'transitional Part 3A Project' in accordance with Clause 2(1)(a) of Schedule 6A of the Act and Part 3A of the Act, as in force immediately before the repeal of that Part, continues to apply to the Project. This modification application is accordingly made under Section 75W of the EP&A Act.

This summary introduces the Proponent, provides relevant background to the Proposed Modification and presents an overview of the Proposed Modification's design, operational safeguards and predicted Project-related impacts on the surrounding environment.

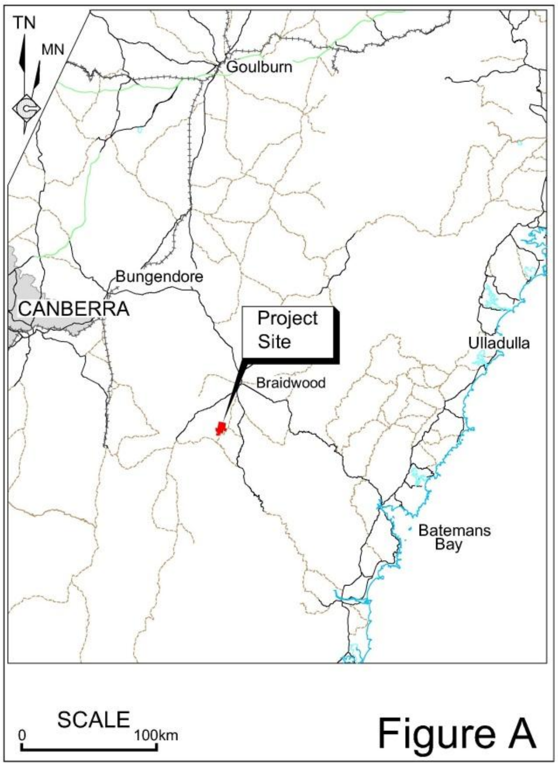

Figure A

The Proponent

The Proponent, Big Island Mining Pty Ltd, is a wholly owned subsidiary of Dargues Gold Mine Limited (DGM). DGM is itself a wholly owned subsidiary of Unity Mining Limited (Unity). Unity is an Australian publicly listed gold mining and exploration company which also owns and operates the Henty Gold Mine in Tasmania and the Kangaroo Flat Gold Mine in Victoria.

Environmental Performance

Construction activities within the Project Site commenced on 11 February 2013. The Project was placed into care and maintenance in December of that year pending completion of optimisation studies and finalisation of funding arrangements.

The following presents an overview of the environmental performance of the Project during the 12 months to 30 June 2014 (Reporting Period). This information has been drawn from the *Annual Environmental Management Report* for the Project for that period.

- Air Quality – Deposited dust was monitored at five locations, with a maximum annual average deposited dust level of 1.87g/m^2/month, significantly less than the annual average performance criteria of 4g/m^2/month.
- Noise – Attended noise monitoring surveys have been undertaken since February 2013. No exceedance of the trigger value of 35dB(A) was attributable to activities at the Project during any of the monitoring events during the Reporting Period.
- Erosion and sediment control during the bulk earthworks phase of the Project was not initially carried out to an appropriate standard. The Proponent has worked diligently to improve sediment and erosion control at the Project Site since the initial reported incident in February 2013 and now has in place permanent sediment and erosion controls and robust procedures and guidelines for their operation. Since the establishment of permanent sediment and erosion controls at the Project Site and in spite of several significant rainfall events, the Proponent has not had any sediment and erosion control incidents or near misses.
- Ecology – A fauna monitoring program was implemented in December 2013, identifying the presence of Common Brushtail Possums, high diversity levels of microbats and amphibians and numerous common reptiles.

  A further monitoring program in February 2015 identified Gang-gang, Varied Sittella and Eastern False Pipistrelle, all of which have previously been identified within the Project Site.

  Two aquatic ecology surveys were completed during 2013-2014, namely, in October 2013 and April 2014. The October 2013 survey sampled 11 locations upstream and downstream of the Project Site identifying:

  – upstream catchments were more degraded than downstream catchments due to historical land use;

  – there has been no degradation in water quality, an overall improvement in aquatic macroinvertebrate assemblages and no change in aquatic habitat health over the period from the commencement of Project-related construction work to the completion of the survey,

  – there were not any obvious adverse impacts on local aquatic ecosystems attributable to the Project.

Proposal Objectives and Description

The Proponent's objectives in modifying MP10_0054 are as follows.

- To maximise the efficiency of the mining and material handling operations.
- To ensure that waste rock remains available in a convenient location for mining purposes and during rehabilitation activities.

- To ensure that processing operations are undertaken in the most cost effective manner, in particular, to remove the requirement for two separate processing facilities, with duplicate Tailings Storage Facilities and other infrastructure to be established.
- To ensure that the Project Site includes all areas of land controlled by the Proponent.
- To minimise, to the maximum extent practicable, the overall environmental impact of the Project.
- To develop the Project in the most robust manner possible to ensure the maximum benefits possible for the community, local businesses, the Proponent's employees and contractors and the Proponent's shareholders.

Overview of the Proposed Modification

This Proposed Modification would include the following components or activities, as shown in **Figure B**.

- An amendment to the Project Site to accommodate the recently purchased "Slings" property.
- A minor increase to the total resource to be extracted and associated extension of the life of the mine.
- Construction and use of the Eastern Waste Rock Emplacement.
- Construction and use of a vehicle crossing over Spring Creek to permit direct access between the box cut and the Tailings Storage Facility and proposed Western Waste Rock Emplacement.
- Final processing of gold concentrate on site to produce gold doré or unrefined gold bars using a conventional carbon-in-leach (CIL) processing plant.
- Construction of an enlarged Tailings Storage Facility to permit storage of additional tailings that would be produced as a result of the additional ore to be processed and the on-site final processing of gold concentrate.
- A range of minor adjustments to the conditions of MP10_0054 to further clarify the intent of the conditions.

It is noted that to produce gold doré within the proposed carbon-in-leach processing plant, the use of cyanide (as sodium cyanide) is required as a leaching agent to remove the gold from the ore. The Proponent is a signatory to the Cyanide Code. In line with its commitments under the Code and to ensure the safe storage, use and disposal of cyanide, the Proponent would implement the following management measures.

- Produce an updated *Hydrocarbon, Chemical and Reagent Management Plan* that would be prepared in consultation with industry experts, the DRE, EPA and DPE.
- Purchase sodium cyanide only from producers who are signatories to the Cyanide Code and who are able to demonstrate appropriate practices and procedures
- Ensure that cyanide is appropriately stored and transferred with appropriate bunding and safety mechanisms in place.
- Ensure that surface water drainage within the processing plant area is contained within a "potentially contaminated water circuit".
- Continually monitor pH levels, HCN gas and critical components of the processing plant.

- Ensure that standard operating procedures consider the risk of unplanned discharge of cyanide-containing solutions.
- Ensure that all cyanide-containing solutions are treated using the proposed cyanide destruction circuit prior to discharge to the Tailings Storage Facility.
- Design and construct the Tailings Storage Facility to contain extreme rainfall events without discharge. In the event of a rainfall event in excess of the design criteria, construct an emergency spillway to safely convey water from the Tailings Storage Facility.
- Manage cyanide concentrations in the supernatant pond such that in the highly unlikely event of an overtopping of the Tailings Storage Facility, the concentration of cyanide in Spring Creek would be less than the ANZECC (2000) trigger value.
- Ensure that the tailings and return water pipes are appropriately designed, constructed, inspected (multiple times per shift) and tested in accordance with the manufacturers' instructions.
- Inspect the Tailings Storage Facility regularly (multiple times per day) for leakage, discharge of supernatant water and fauna deaths.
- Implement a procedure to monitor fauna, rescue (if needed), record and investigate any fauna deaths on or immediately surrounding the Project Site and determine the cause of death where the cause of death is not obvious
- Update the *Water Management Plan* to include monitoring of groundwater and surface water within and surrounding the Project Site for WAD cyanide concentrations.

Consultation

Consultation with the local community involved:

- face to face meetings with the Dargues Reef Community Consultative Committee;
- ongoing public and community meetings, including a site visit to the Proponent's Henty Gold Mine in Tasmania; and
- individual discussions with surrounding landowners.

The Proponent and its consultants also regularly consulted with various government agencies and authorities throughout the planning phase of the Proposed Modification.

Environmental Safeguards and Impacts

The following presents an overview of the range of additional residual impacts on the biophysical environment should the Proposed Modification proceed.

Noise

Revised noise modelling by Spectrum (2015) identified that noise levels as a result of the Proposed Modification would remain below the relevant noise criterion at all times. However, minor increases in noise levels of between 1dB(A) or 2dB(A) at four residences are anticipated during day-time construction operations only.

Ecology

The Proposed Modification would not have a significant impact on any NSW *Threatened Species Conservation Act 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* listed species, population or community.

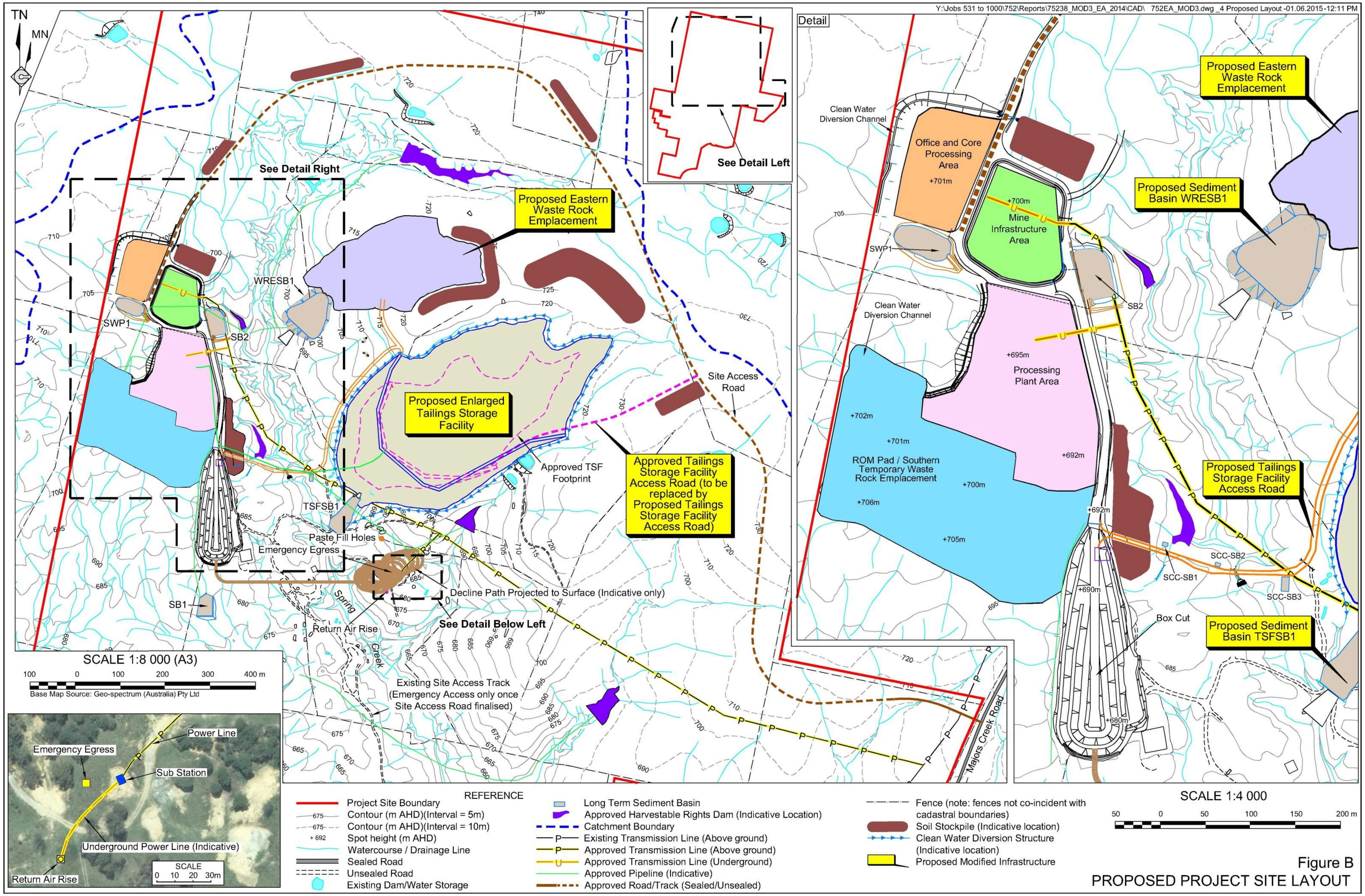

Figure B
PROPOSED PROJECT SITE LAYOUT

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In addition, proposed cyanide-related management measures would ensure that the risk of significant impacts on such species as a result of the use of the cyanide within the Project Site would be negligible.

The Proponent proposes to increase the size of the approved Biodiversity Area to compensate for disturbance of approximately 19.5ha of native-dominated pasture and 0.2ha of regenerating wattles.

Groundwater

The Proponent prepared a revised groundwater model to reflect additional groundwater-related information obtained since the original model was prepared, as well as changes to the proposed mining schedule. The revised model indicated that

- peak groundwater inflows to the mine would be higher than originally modelled (10L/s to 12L/s c.f. 8L/s), with steady-state inflows slightly higher (8L/s c.f. 7L/s to 8L/s);
- the zone of draw down would be slightly smaller and the rate of recovery would be similar to that originally modelled; and
- the loss of baseflow to Majors Creek would steadily increase from nil to 2.5L/s at the end of life, compared with 2.1L/s for the original model.

Surface water

The Proposed Modification would not result in adverse impacts on the surface water environment within and surrounding the Project Site for the following reasons.

- The proponent has prepared *Sediment and Erosion Control Plans* for the Eastern Waste Rock Emplacement, Spring Creek Crossing and Stage 1 of the Tailings Storage Facility construction (until it becomes internally draining). As a result, no unacceptable sediment and erosion control-related impacts are anticipated.
- The Proponent has prepared detailed storage, handling, use and disposal management measures for cyanide that would ensure that the risk of surface water contamination would be minimised to the greatest extent practicable.

Air Quality

Revised air quality modelling by Pacific Environment Limited (2015) identified that air quality levels as a result of the Proposed Modification would remain below the relevant deposited dust and particulate matter criteria at all times during construction and operational phases.

Aboriginal Heritage

The Proposed Modification would result in the collection and reburial of artefacts from two Aboriginal heritage sites (Sites GT OS1 and GT OS2). Given the consultation undertaken with the Aboriginal community and the community's concurrence with the proposed mitigation collection and reburial of these artefacts as well as the ongoing management of identified and potential heritage items located within the Project Site, it is considered that impacts to Aboriginal cultural heritage would be acceptable.

Traffic and Transportation

The Proposed Modification would result in a substantial reduction in the number heavy vehicles that would travel through Braidwood and the communities along the transportation route.

Others

Further to the above, the residual impacts associated with non-Aboriginal heritage, bushfire, visual amenity, and soils and land capability would be negligible.

PROJECT EVALUATION AND JUSTIFICATION

The Proposed Modification has been evaluated and justified principally through consideration of its potential impacts on the environment and potential benefits to the local and wider community.

Through a detailed and thorough risk screening, Preliminary Hazard Analysis assessment, as well as the consideration of the principles of ecologically sustainable development, the evaluation has found that, with the implementation of the proposed operational controls, safeguards and/or mitigation measures, the residual risk posed by each possible environmental incident or impact has either been reduced from its original level or deemed an acceptable risk.

Further, the design of the Proposed Modification has addressed each of the sustainable development principles, and on balance, it is concluded that the Proposed Modification achieves a sustainable outcome for the local and wider environment.

Conclusion

The Proposed Modification has been, to the extent feasible, designed to address all issues raised by the local community and all levels of government, as well as the principles of ecologically sustainable development. The Proposed Modification provides for the ongoing development of the mine, resulting in the production, sale and despatch of gold ore and concentrate which would be significant in generating further employment opportunities and maintaining stimulus to the local economies of Majors Creek, Braidwood and the Palerang LGA. The post-mining landform would also provide for the re-establishment of agricultural land.

In light of the conclusions included throughout this *Environmental Assessment*, it is assessed that the Proposed Modification could be constructed and operated in a manner that would satisfy all relevant statutory goals and criteria, environmental objectives and reasonable community expectations.

Key Statistics

	Approved Project (MOD2)	**Modified Project (MOD3)**
Project Details		
Identified Reserve	1.4Mt at 5.2g/t gold for 233 000 ounces of gold	1.541Mt at 5.3g/t gold for 250 633 ounces of gold
Project Completion Date	31 August 2018	31 August 2022
Maximum Ore Production Rate	Total – 1.2Mt total Annual – 355 000t	Total – 1.6Mt total Annual – 355 000t
Project Site	Total – 403ha Proponent-owned – 396ha	Total – 459ha Proponent-owned / leased – 452ha
Approximate number of employees	Site establishment – 100 Operation – 80	Site establishment – 120 Operation – 100
Economic contribution (per year)		
Local/ regional	$3 million to $7 million	$6 million to $10 million
State and national	$10 million to $31 million	$10 million to $31 million
Taxes, royalties and rates	$1 million to $8 million	$1 million to $8 million
Disturbance Areas		
Site Access Road	2.3ha	2.3ha
Office and Core Processing Area	4.7ha	4.7ha
Mine Infrastructure Area	3.7ha	3.7ha
Processing Plant Area	2.7ha	2.7ha
ROM Pad/Western Waste Rock Emplacement	4.5ha	4.5ha
Box Cut	1.6ha	1.6ha
Tailings Storage Facility (TSF)	9.0ha	16.0ha
Eastern Waste Rock Emplacement	-	5.5ha
TSF Access Road (via Site Access Road)	0.4ha	-
TSF Access Road (via Spring Creek Crossing)	-	0.6ha
Soil Stockpiles	2.7ha	3.7ha
Harvestable Rights Dams	1.5ha	1.5ha
Vegetation Communities		
1 – Ribbon Gum – Snow Gum Grassy Open Forest	0.1ha	0.1ha
2 – Fragmented Ribbon Gum – Snow Gum Grassy Open Forest	0.1ha	0.1ha
3 – Woody Weeds Shrubland	0.1ha	0.1ha
4 – Regenerating Wattles	-	0.2ha
5 – Exotic Vegetation	0.2ha	0.1ha
6 – Native Grassland	0.2ha	0.2ha
7 – Native-dominated Pasture	25.3ha	44.8ha
8 – Exotic-dominated Pasture	0.3ha	0.5ha
9 – Largely Disturbed Land	2.2ha	0.5ha
10 – River Peppermint Open Forest	-	-
Total	**28.5ha**	**46.6ha**

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1. INTRODUCTION

1.1 BACKGROUND

This *Environmental Assessment* has been prepared by R.W. Corkery & Co. Pty. Limited (RWC) on behalf of Big Island Mining Pty Ltd (the Proponent) to support an application to modify Project Approval MP10_0054 (the Proposed Modification, Modification 3 or MOD3).

The Dargues Gold Mine (the Project) was initially proposed in December 2009. Project Approval PA10_0054 was granted by the Land and Environment Court on 7 February 2012, with subsequent modifications granted on:

- 12 July 2012 (MOD1) to permit the use of paste fill; and
- 24 October 2013 (MOD2) to regularise the approved layout following minor changes during the detailed design phase of the Project.

Figure 1 presents the location of the Dargues Gold Mine on the western slopes of the Great Dividing Range, approximately 60km southeast of Canberra, approximately 13km south of Braidwood and immediately to the north of the village of Majors Creek. The Project is located on land that is, with the exception of two parcels of land, owned by the Proponent, and is referred to hereafter as "the Project Site".

Construction of the Project commenced on 11 February 2013 and the Project was placed into care and maintenance in December of that year pending completion of optimisation studies and finalisation of funding arrangements. Section 1.4.6 provides further information in relation to the status of Project construction.

As a result of the optimisation studies that have been undertaken, a range of adjustments to the Project are proposed to be made. In order to facilitate these adjustments, the Proponent is seeking approval to modify MP10_0054 to permit the following.

- A minor increase to the total resource to be extracted and associated extension of the life of the mine.
- Construction and use of the Eastern Waste Rock Emplacement.
- Construction and use of a vehicle crossing over Spring Creek to permit direct access between the box cut and the Tailings Storage Facility and proposed Eastern Waste Rock Emplacement.
- Construction of an enlarged Tailings Storage Facility to permit storage of additional tailings that would be produced as a result of the additional ore to be processed and the on-site final processing of gold concentrate.
- Final processing of gold concentrate on site to produce gold doré or unrefined gold bars using a conventional carbon-in-leach (CIL) processing plant.
- A range of minor adjustments to the conditions of MP10_0054 to further clarify the intent of those conditions.

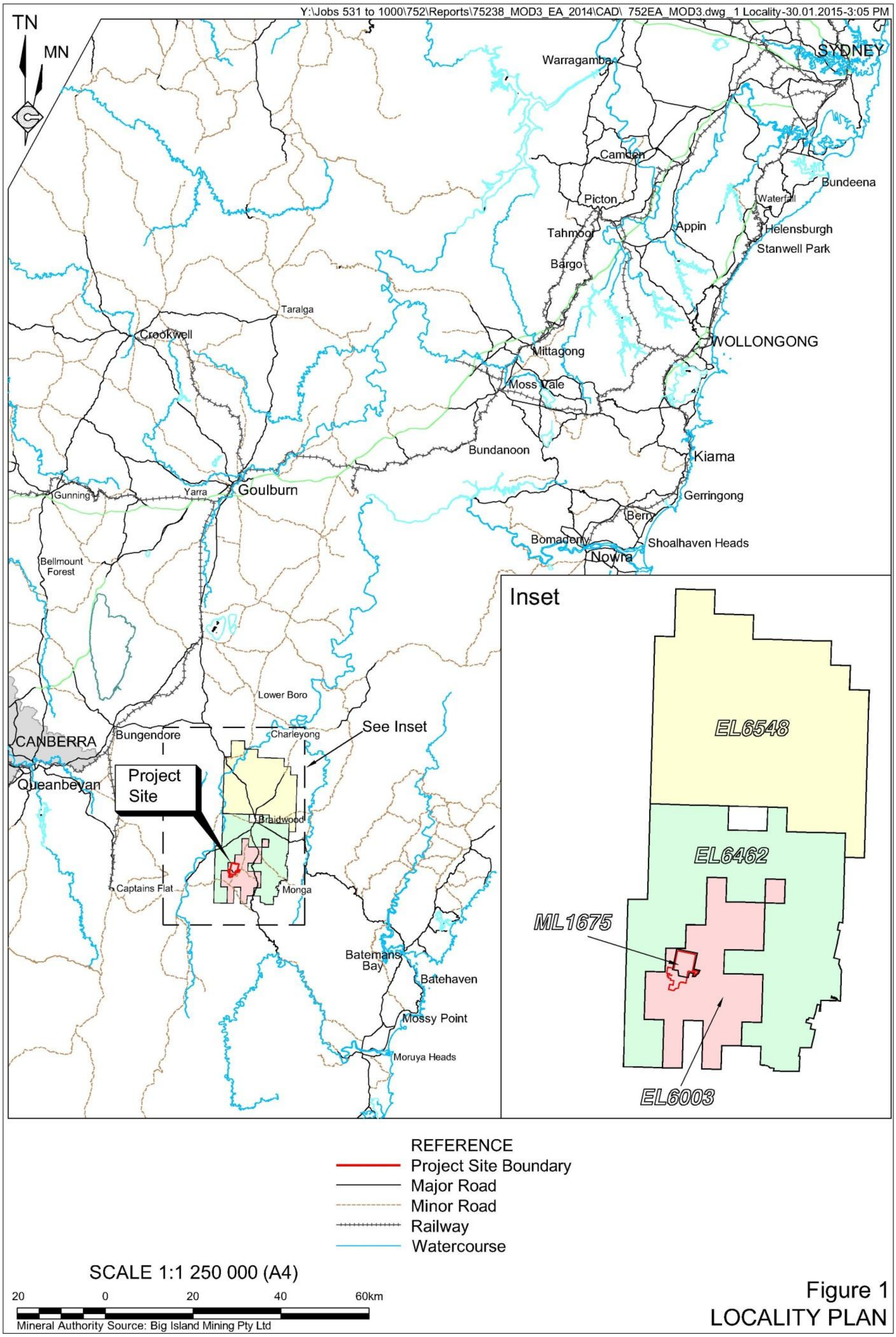

Figure 1
LOCALITY PLAN

These modifications are sought to:

- permit improved efficiencies during operation of the Project, and therefore a more robust Project;
- remove the need for significant truck haulage of concentrate on public roads;
- minimise potential environmental impacts associated with transportation of waste rock; and
- reflect a better understanding of the ore body and improvement of the mine plan since the Project was originally approved and subsequently modified.

This application for Modification 3 is being made under Section 75W of the *Environmental Planning and Assessment Act 1979* (the EP&A Act). As the Project is considered a "transitional Part 3A Project", as defined in Schedule 6A of the EP&A Act, Section 75W applies to the Project, despite the wider repeal of Part 3A of the EP&A Act.

The information contained in this document relates only to those components of the Project that would be the subject of the Proposed Modification. Aspects of the Project that would not be modified would continue to be undertaken in accordance with the following.

- Project approval MP10_0054 and its associated conditions and appendices.
- The *Environmental Assessment* dated September 2010 (RWC, 2010a).
- The *Response to Submissions* dated December 2010 (RWC, 2010b) and associated documentation and correspondence.
- The *Environmental Assessment – Modification 1* dated April 2012 (RWC, 2012a).
- The *Response to Submissions* dated June 2012 (RWC, 2012b).
- The *Environmental Assessment – Modification 2* dated July 2013 (RWC, 2013a).
- The *Response to Submissions* dated September 2013 (RWC, 2013b).

Section 2.1.2 presents, an overview of those activities which would be amended as a result of the Proposed Modification.

1.2 THE PROPONENT

The Proponent, Big Island Mining Pty Ltd, is a wholly owned subsidiary of Dargues Gold Mine Limited (DGM). DGM is itself a fully owned subsidiary of Unity Mining Limited (Unity). Unity is an Australian publicly listed gold mining and exploration company which also owns and operates the Henty Gold Mine in Tasmania and the Kangaroo Flat Gold Mine in Victoria.

As of 1 June 2015, Unity had 8 661 shareholders, of which Diversified Minerals Pty Ltd was the largest with a 7.16% stake in the Company. Unity is controlled by a board of five directors with a combined experience in mining-related industries of more than 115 years.

The Proponent is committed to continue the development and operation of the Project in a manner that achieves environmentally responsible outcomes and sustainable benefits for the local community and broader region. The Proponent contends that the Proposed Modification would further reduce the potential for adverse Project-related environmental impacts while providing the maximum economic and other benefits for all stakeholders, including its employees and contractors, the surrounding community, State and Commonwealth governments, Palerang Council and the Company's shareholders.

1.3 PROJECT SITE AND LAND ZONING

The Project Site includes nine separate freehold land titles described in Section 1.3.2 of RWC (2010a). In addition, the Proponent purchased the "Slings" property, comprising a further nine separate land titles, including one leased parcel of Crown Land which the proponent proposes to purchase, in March 2013 (**Figure 2**). The Proponent proposes to include that property within the Project Site as part of Modification 3. The Proponent has also had the land titles within the original Project Site resurveyed. As a part of that process, folio numbers for each land title were adjusted and a small parcel of land that did not fall within any of the surrounding lots was identified. That parcel of land was given a new folio number. As a result, the modified Project Site comprises 19 land titles of which 17 are owned by the Proponent. One parcel of land, namely Lot 193, DP755934 is Crown Land and is leased by the Proponent under Special Lease 132905. It is the Proponent's intention to make an application to purchase that land prior to expiry of the lease in 2018. A further parcel of land, namely Lot 210, DP755934 is registered to B and C James. The Proponent has entered into an agreement with the James's to access the land.

Table 1 presents the original and updated folio number for all land within the modified Project Site. **Figure 2** presents the location of each of these parcels of land.

Table 1
Project Site Land Titles

RWC (2010a) Folio Number		Revised/Additional Folio Number		Ownership	Comment
Lot	DP	Lot	DP		
102	755934	102	1170553	Dargues Gold Mine Limited	Resurveyed and renumbered land titles
1021	1127185	103	1170553		
2	986483	105	1170553		
3	986483	106	1170553		
104	1100849	104	1180508		
1	986483	1	986483		Original land titles retained
4	986483	4	986483		
5	986483	5	986483		
Part 210	755934	Part 210	755934	B&C James	
		104	1100849	Dargues Gold Mine Limited	Land identified as not falling within surrounding land titles
		1	136801		Land associated with the "Slings" property
		2	136801		
		3	755934		
		82	755934		
		83	755934		
		113	755934		
		114	755934		
		143	755934		
		193	755934	Crown Land	Leased and associated with the "Slings" property

Source: Big Island Mining Pty Ltd

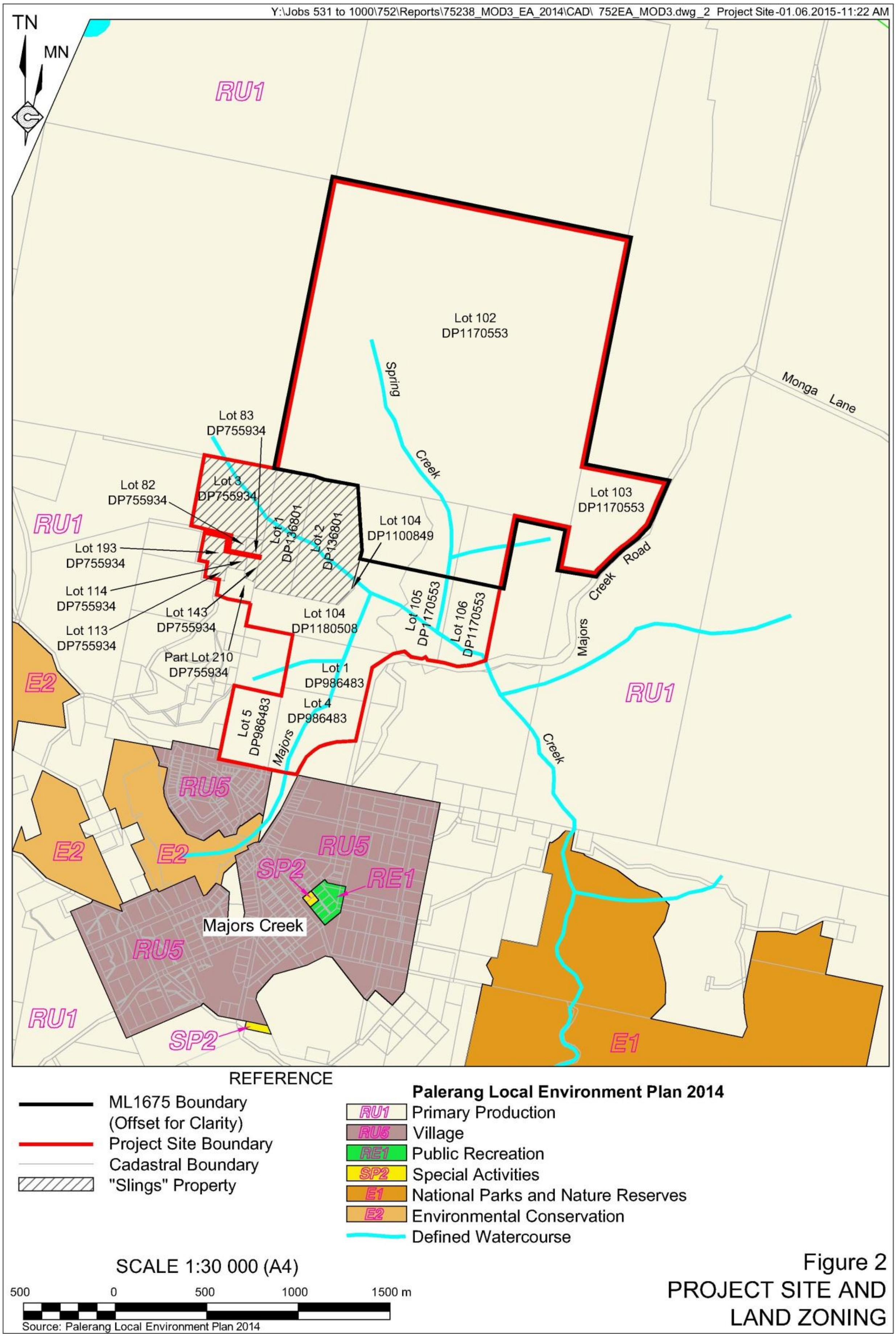

Figure 2
PROJECT SITE AND LAND ZONING

All land within the Project Site is zoned RU1 – Primary Production under the *Palerang Local Environmental Plan 2014* which was gazetted on 19 September 2014 and came into effect on 31 October 2014.

1.4 BACKGROUND TO THE PROPOSED MODIFICATION

1.4.1 Introduction

The Proponent and its predecessors have controlled exploration licences over the Project Site since 2002. At that time, an exploration program was commenced to identify additional hard rock gold resources associated with historic alluvial goldfields. That program significantly increased the size of the previously identified Dargues Gold Deposit.

This subsection provides an overview of the approvals, licences, mineral authorities and permits held by the Proponent, a brief overview of mineral exploration activities undertaken and an overview of the resources and reserves within the Project Site. This subsection also provides a brief overview of the approved activities, status of Project construction and environmental performance to date.

1.4.2 Existing Approvals, Licences, Mineral Authorities and Permits

Table 2 presents the consents, licences and approvals held by the Proponent in relation to the Dargues Gold Mine.

The Proponent understands that further approvals will not be required for the harvesting of surface water within the Project Site as the Proponent will ensure that the total volume of surface water storage is less than or equal to the Proponent's maximum harvestable right dam capacity.

1.4.3 Exploration Operations

Gold was first discovered at Majors Creek on 5 October 1851, with a number of significant alluvial goldfields being established in the following years. The vast majority of gold extracted within the vicinity of the Project Site was won by alluvial mining in the mid to late 1800s. The mineral authorities held by the Proponent encompass the Majors Creek (Elrington) Goldfield, the Jembaicumbene alluvial Goldfield and a small section of the Araluen Goldfield. Past historic production comprises approximately 1.25 million ounces sourced from alluvial (98%) and lode gold (2%) workings. The area surrounding the Project Site represents the richest alluvial goldfield in NSW.

The Dargues Gold Deposit has been evaluated and drill tested by several mining companies. To date, in excess of 40 000m of reverse circulation and diamond drilling has been completed, with the majority targeting along-strike and down-dip extensions of the known mineralised gold lodes.

Table 2
Dargues Gold Mine – Existing Consents, Licences and Approvals

Issuing / Responsible Authority	Approval Number	Date of Issue	Expiry	Comments
Project Approval – NSW EP&A Act				
Land & Environment Court	PA10_0054	8 February 2012	31 August 2018	
Department of Planning and Environment (under delegation)	MP10_0054 MOD1	12 July 2012	31 August 2018	
	MP10_0054 MOD2	24 October 2013	31 August 2018	
Controlled Action Approval – Commonwealth EPBC Act				
C'wlth Minister for the Environment	2010/5770	27 September 2011	30 September 2020	
Environment Protection Licence				
EPA	EPL20095	18 May 2012	-	
Mineral Authorities				
Minister for Resources and Energy	ML1675	13 April 2012	12 April 2024	
	EL6548	5 April 2006	4 April 2017	
	EL6003[1]	3 October 2002	2 October 2015	
	EL6462	1 September 2005	31 August 2013	Renewal sought
Water Licences				
NSW Office of Water	10BL605106	22 June 2012	21 June 2017	Dargues Gold Mine
NSW Office of Water	10BL605107	22 June 2012	21 June 2017	Snobs
NSW Office of Water	10BL605108	22 June 2012	21 June 2017	United Miners
NSW Office of Water	10BL605109	22 June 2012	21 June 2017	Stewart and Mertons
Other Approvals, Licences and Permits				
Dams Safety Committee	Design conforms to the Committee's requirements.	3 February 2013	-	-
Note 1: The Proponent has prepared an application to combine EL 6003 and EL 6462 into a single exploration licence. Application No. ELA 4902				
Source: Big Island Mining Pty Ltd				

The Proponent has identified a range of associated prospects in the vicinity of the Dargues Gold Deposit, including Chinaman's, Ruby Lode, Copper Ridge, Excalibur and the Carmine Prospects. These and other mineralised zones are the focus of current and future mineral exploration activities. However, these prospects do not form a component of the Mine or the Proposed Modification. Should mineralisation with the potential to be economically extracted be identified, a further modification to MP10_0054 or a new development consent would be sought.

1.4.4 Identified Resources and Reserves

Gold mineralisation within the Dargues Gold Deposit occurs as a number of discrete gold lodes positioned within zones of structural weakness and intense alteration within the host Braidwood Granodiorite. The Dargues Gold Deposit JORC-compliant resource inventory is 1.615Mt at 6.3g/t gold for 327 300 ounces of gold and 142 000 ounces of silver. The Project's Proven and Probable Reserve, namely that component of the reserve that can be mined using current mining techniques, is 1.541Mt at 5.3g/t gold for 250 633 ounces of gold.

1.4.5 Approved Activities

The approved Project is fully described in RWC (2010a), RWC (2012a) and RWC (2013a). However, for completeness, the approved activities include the following (**Figure 3**).

- Extraction of waste rock and ore material from the Dargues Gold Deposit using underground sublevel open stope mining methods with a suitable crown pillar, and internal pillars and sills to prevent surface subsidence and ensure geotechnical stability of the approved mine.
- Filling of voids created during underground mining using a combination of paste fill (a mixture of tailings and cement) and waste rock.
- Construction and use of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, fuel store, ventilation rises, paste fill hole(s) 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 flotation circuits, Proponent and mining contractor site offices, workshop, laydown area, ablution 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 harvestable rights dams and an associated water reticulation system, to enable the harvesting and supply of water for environmental flows. It is noted that the proposed water harvesting operations would be consistent with the Proponent’s rights under Section 53 of the *Water Management Act 2000*.
- 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 through Braidwood via public roads surrounding the Project Site using covered semi-trailers.

1.4.6 Status of the Project

Construction activities within the Project Site commenced on 11 February 2013. The Project was placed into care and maintenance in December of that year pending completion of optimisation studies and finalisation of funding arrangements. **Table 3** identifies the status of the various components of the construction activities that had been completed or were in progress at the time of finalisation of this document.

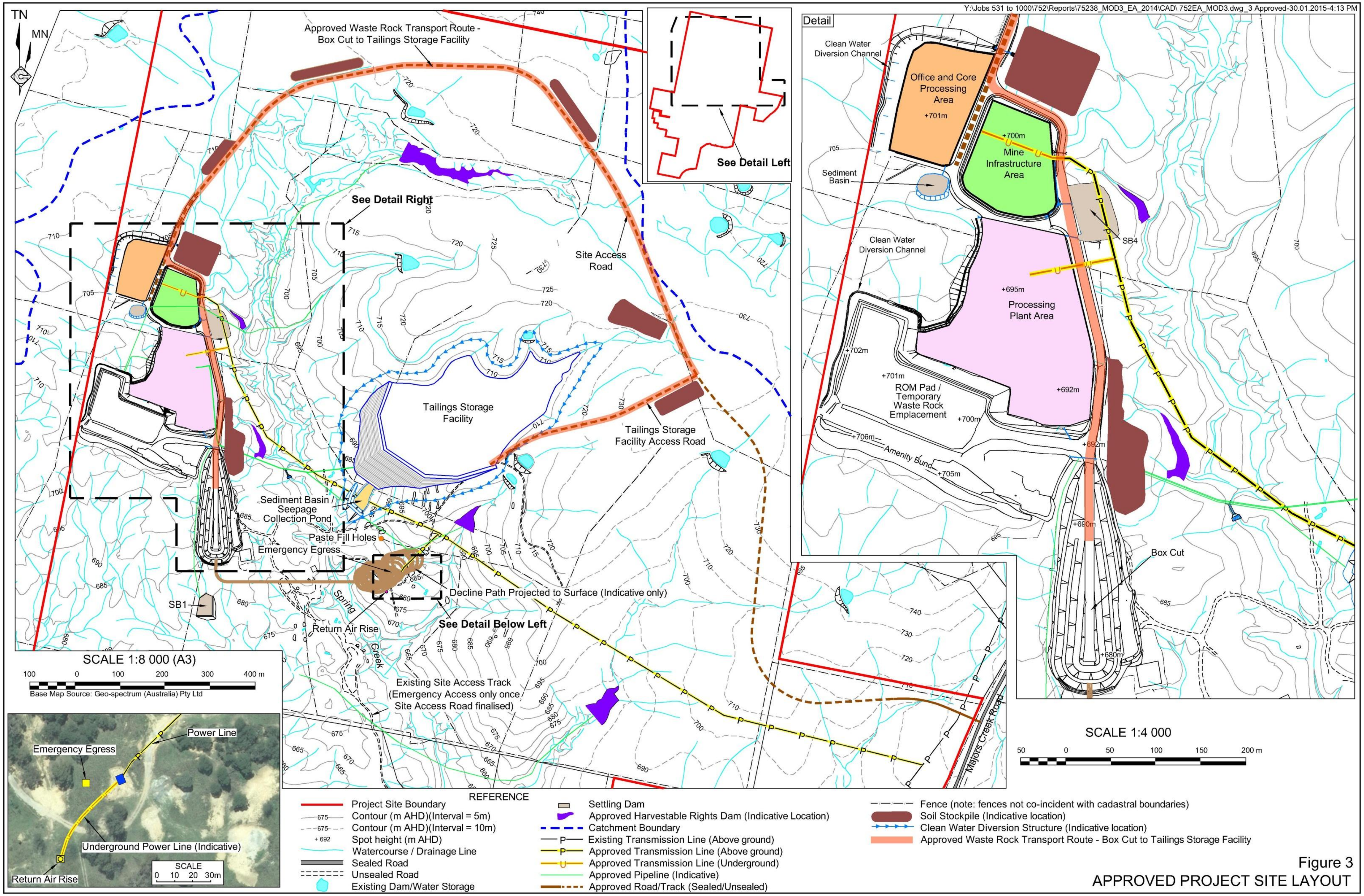

Figure 3
APPROVED PROJECT SITE LAYOUT

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Table 3
Overview of the Status of the Project

Component Area	Commencement Date	Status/Percentage Complete at 31 December 2014	Estimated Completion Date	Comment/Discussion
Intersection of Site Access Road and Majors Creek Road	July 2013	100%	Complete	The intersection of the Site Access Road and Major Creek Road has been constructed consistent with Conditions 3(38), 3(39) and 3(39A) of MP10_0054 and has been inspected and approved by Palerang Council.
Site Access Road	11 February 2013	100%	Complete	The Site Access Road has been constructed consistent with Condition 3(38) of MP10_0054 and has been inspected and approved by Palerang Council.
Mine Infrastructure Area	October 2013	100%	Complete	All bulk earthworks for the Mine Infrastructure Area have been completed, however, construction of permanent built infrastructure has not commenced.
Office and Core Processing Area	11 February 2013	20%	Unknown	A small area for a temporary equipment laydown and a maintenance area for the earthmoving contractor has been established within this area. Further earthworks are yet to commence.
Processing Plant Area	Not commenced	0%	Unknown	Approximately 20% of the footprint of this area has been disturbed, however, earthworks have not yet commenced.
ROM Pad	11 February 2013	100%	Complete	The ROM Pad has been completed consistent with the approved plans included in MP10_0054 MOD2.
Box Cut	11 February 2013	100%	Complete	The box cut was commenced early during the land preparation phase for the Project to provide material for the construction of other components of the Mine, principally the ROM Pad. Approximately 130 000m^3 of material has been removed from the Box Cut, with all of that material transferred to the ROM Pad. During 2013-2014, two blasts were required to fragment non-friable material in the base of the Box Cut. The upper batters of the Box Cut have been shaped, topsoil spread and revegetated with native grasses.
Underground Mine Infrastructure	Not Commenced	0%	Unknown	Underground mine infrastructure is yet to be constructed.
Tailings Storage Facility	Not Commenced	0%	Unknown	The Tailings Storage Facility has yet to be constructed and no disturbance has occurred in this area.

Source: Big Island Mining Pty Ltd

1.4.7 Environmental Performance

1.4.7.1 Introduction

Information presented in this subsection has been drawn from the *Annual Environmental Management Report for the Dargues Gold Mine* (Unity, 2014) which is available for download from the Dargues Gold Mine website (http://www.unitymining.com.au/reporting/). As a result, this subsection provides an overview of the environmental performance of the Dargues Gold Mine for the 12 months to 30 June 2014 (the Reporting Period). Environmental performance for the previous 12 months to 30 June 2013 is presented in the previous Annual Environmental Management Report, also available for download from that website.

1.4.7.2 Air Quality

Deposited dust is monitored at five locations within and surrounding the Project Site. During the Reporting Period, the maximum monthly deposited dust level was 3.2g/m^2/month. The highest average deposited dust level of all five monitoring locations was 1.87g/m^2/month. This is significantly less than the annual average performance criteria of 4g/m^2/month.

PM_{10} monitoring is undertaken every sixth day at one location within the village of Majors Creek. PM_{10} is that component of suspended particulates with an aerodynamic diameter of less than 10µm. The maximum PM_{10} concentration during the Reporting Period was 27.7µg/m^3. The relevant performance criteria is 50µg/m^3.

1.4.7.3 Threatened Flora and Fauna

A fauna monitoring program was implemented in December 2013. The results are summarised as follows.

- Common Brushtail Possums were observed within the Project Site. However, no Common Ringtail Possums or Sugar Gliders were identified despite being previously observed.
- Microbat and bird species diversity was relatively high within the Project Site.
- The Project Site continues to support relatively common species of reptiles.
- The Project Site continues to support a high diversity of frog species.

A further flora and fauna monitoring program was undertaken in February 2015 by EnviroKey. The resulting report is available for download from the Proponent’s website (www.untiymining.com/monitoring). The results may be summarised as follows:

- Two threatened bird species (Gang-gang Cockatoo and Varied Sittella) were recorded.
- One threatened bat species (Eastern False Pipistrelle) was recorded.
- Species diversity and structural composition are largely unchanged from previous surveys.
- While being actively managed by the Proponent, Scotch Broom remains common within and surrounding the Project Site.

Two aquatic ecology surveys were completed during the Reporting Period, namely, in October 2013 and April 2014. The results of the latter survey were not available at the time of finalisation of Unity (2014). The October 2013 survey sampled 11 locations upstream and downstream of the Project Site, as well as within the Project Site itself. The results are summarised as follows.

- Upstream catchments were more degraded than downstream catchments due to historical land use.
- There had been no degradation in water quality over the period from the commencement of project-related construction work to the completion of the survey.
- There has been an overall improvement in aquatic macroinvertebrate assemblages and no change in aquatic habitat health since project-related construction work commenced.
- Two new fish species were observed, that is, Common Galaxias at the monitoring site furthest downstream on Majors Creek and Eastern Gambusia (a noxious species) at the monitoring site furthest upstream on Majors Creek. The latter is not considered to be Project-related as the species was found in Majors Creek, upstream of the confluence with Spring Creek.
- The October 2013 monitoring did not find any obvious adverse impacts on local aquatic ecosystems attributable to the construction of the Project.

1.4.7.4 Noise

Three attended noise monitoring surveys were undertaken at six monitoring locations during 2013-2014. During all surveys and at all locations, noise sources were determined to be typical of rural environments, with noise generally associated with local traffic or from insects and birds. Project-related noise could be heard at various monitoring locations, but was faint to barely audible. No exceedance of the trigger value of 35dB(A) was attributable to activities at the Project during any of the monitoring events during the Reporting Period.

1.4.7.5 Erosion and Sediment Control

Erosion and sediment control during the bulk earthworks phase of the Project was not initially carried out to an appropriate standard. The Proponent has worked diligently to improve sediment and erosion control at the Project Site since the initial reported incident in February 2013 and now has in place permanent sediment and erosion controls and robust procedures and guidelines for their operation. Since the establishment of permanent sediment and erosion controls at the Project Site and in spite of several significant rainfall events, the Proponent has not had any unplanned discharges of water (sediment laden or otherwise).

1.4.7.6 Surface Water

Surface water monitoring was undertaken at a range of locations upstream of, downstream of and within the Project Site. **Table 4** presents an overview of the results for key parameters of that program.

Table 4
Overview of Surface Water Monitoring Results

Parameter	Unit	No. of Analyses	Max	Min	Trigger Value	Exceeded Trigger	Discussion
pH	pH Unit	94	8.25	7.02	6.5-8.5	0	All Samples were within Trigger Value range.
Electrical conductivity	µS/cm	102	939	111.5	>450	18	Samples that exceeded the trigger value were obtained from sampling locations SW2 and SW3. These locations are within Spring Creek and are adjacent to or downstream of old mine workings. It is believed that Spring Creek and the old mine workings are hydraulically connected and that this results in the elevated readings at these locations.
Oil and Grease	mg/L	102	1	1	>10	0	All samples below trigger value.
Source: Unity (2014) – After Table 12							

1.4.7.7 Groundwater

Groundwater monitoring was undertaken at a range of locations within and surrounding the Project Site. **Table 5** presents an overview of key parameters of that program. The detailed results presented in Unity (2014) are summarised as follows.

- One bore (DRWB03) has continuously exceeded the majority of the initial trigger values since construction.
- A range of other bores exceeded the initial trigger values for a range of parameters.
- The initial trigger values were determined based on limited data. Given that Project activities have not intersected groundwater, the results of the groundwater monitoring program effectively form a baseline assessment, the Proponent intends to review the identified trigger values during the next annual review of the Project's *Water Management Plan*.

Table 5
Overview of Groundwater Monitoring Results

Parameter	Unit	No. of Analyses	Max	Min	Trigger Value	Exceeded Trigger	Discussion
pH	pH Unit	87	12.93	6.37	6.5-8.5	14	The majority of trigger value exceedances were from DRWB03. This bore has consistently shown a high pH and this has not changed during the Reporting Period. One exceedance was detected at DRWB01 and DRWB04.
Electrical Conductivity	µS/cm	28	2600	242	1300	4	All exceedances of the trigger value were from DRWB03. This bore has unique chemistry and has consistently showed high electrical conductivity since being installed.
Source: Unity (2014) – After Table 13							

1.4.8 Compliance with Approvals and Licences

1.4.8.1 NSW Project Approval

Condition 8 of Schedule 5 of MP10_0054 requires the Proponent to commission an independent audit by a suitably "qualified experienced and independent team of experts whose appointment has been endorsed by the Director-General."

The first Independent Audit was undertaken in March 2014 by Trevor Brown of Trevor Brown & Associates. In summary, there were.

- no non-compliances with the conditional requirements of MP10_0054;
- no non-compliances with the commitments embodied in the Statement of Commitments in Appendix 5 of MP10_0054; and
- the various management plans prepared for the Project are adequate.

1.4.8.2 Commonwealth Controlled Activity Approval

Condition 22 of Controlled Activity Approval 2010/5770 under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires submission of an annual compliance report for the 12 months July to June of each reporting year. Reports are available for the periods to 30 June 2013 and 30 June 2014 on the Dargues Gold Mine website (http://www.unitymining.com.au/reporting/).

These reports indicated that of the 27 conditional requirements associated with the approval, that 17 had been fully complied with and 10 were not yet applicable in the 2012-2013 reporting period, while in the 2013-2014 reporting period 9 had been fully complied with, 7 were complete and 11 were not yet applicable.

1.4.8.3 Environment Protection Licence

The Proponent holds Environment Protection Licence (EPL) 20095 for the Project. That licence was issued on 12 May 2012 and bulk project related earthworks commenced on 11 February 2013. Shortly after the commencement of the Project, a number of substantial rainfall events occurred, resulting in discharge of sediment-laden water from the Project Site. These events were reported and the Proponent liaised closely with the Environment Protection Authority following those events.

On 26 August 2014 the Proponent pleaded guilty in the land and Environment Court to three pollution-related incidents, with a range of penalties and fines issued for each as follows.

1. 23 to 25 February 2013 – $78 000.
2. 28 February 2013 – $10 000.
3. 1 March 2013 – $15 000.

Following these incidents, the Proponent implemented a range of measures as part of a Pollution Reduction Program to prevent a recurrence of the incidents, including the following.

- Increase the design capacity of sediment basins for both construction and operational phases of the Project.
- Engagement of a professional sediment and erosion control specialist to supervise all significant earthworks within the Project Site.
- Preparation and implementation of updated sediment and erosion control plans for key aspects of the project. Examples include SEEC (2015b, 2015c and 2015d) presented in **Appendix 2**.
- Implement revised and comprehensive training of all operational staff in relation to the importance of sediment and erosion control and associated procedures as well as reporting requirements associated with pollution events.
- Implemented changes to standard contract arrangements to better ensure that any contractors engaged within the Project Site are aware of their obligations under the EPL and the Project Approval Conditions.

1.5 FORMAT OF THE REPORT

This *Environmental Assessment – Modification 3* has been compiled in a single volume with five sections of text as follows.

Section 1: Introduces the Proposed Modification, the Proponent, the Project Site and provides relevant background information.

Section 2: Describes the Proponent's objectives and the Proposed Modification in sufficient detail to enable the application for modification to be fully understood.

Section 3: Provides a description of the process used to identify and prioritise the key issues for assessment, including stakeholder consultation and a review of relevant planning instruments.

Section 4: Describes the anticipated impacts associated with the Proposed Modification.

Section 5: Evaluates the Proposed Modification in terms of Ecologically Sustainable Development and biophysical, economic and social considerations. A conclusion relating to the acceptability of the Project based on the above is also presented.

Section 6: Lists the various source documents referred to for information and data used during the preparation of the *Environmental Assessment*.

Section 7: Lists the commonly used Terms, Acronyms and Symbols.

Appendices: Present the following additional information.

- **Appendix 1** – Revised Statement of Commitments.
- **Appendix 2** – Surface Water Assessment.

- **Appendix 3** – Toxicity Profile and Risk Assessment for Cyanide.
- **Appendix 4** – Cyanide Code Signatory Acceptance.
- **Appendix 5** – Report on Cyanide Destruction for the Dargues Reef Project.
- **Appendix 6** – SEPP 33 Risk Screening and Preliminary Hazard Analysis.
- **Appendix 7** – Tailings Storage Facility – Final Design Update.
- **Appendix 8** – Acoustic Assessment.
- **Appendix 9** – Ecology Assessment.
- **Appendix 10 –** Groundwater Assessment.
- **Appendix 11 –** Aboriginal Heritage Assessment.
- **Appendix 12 –** Air Quality Assessment.

1.6 MANAGEMENT OF INVESTIGATION

This document has been prepared by Mr Mitchell Bland (BSc (Hons), MEcon Geol, LLB (Hons)), Principal Environmental Consultant with R.W. Corkery & Co Pty. Limited with the assistance of Mr Chris Dickson (B.SC Phys Geog) and Mr Nicholas Warren (BSc, MBus(Marketing), MEnvSc), both Environmental Consultants with the same company. Mr Rob Corkery (B.Appl.Sc.(Hons), M.Appl.Sc.) undertook an internal peer review of this document.

Professional representatives of the Proponent assisted with the preparation of this document including, but not limited to:

- Mr James Dornan, (BSc), Manager – Projects – Unity Mining Limited;
- Mr Josh Kennedy (BEng), formerly Senior Mining Engineer – Dargues Gold Mine Limited;
- Ms Angela Lorrigan (BSc (Hons), GradDip Mineral Economics), General Manager Discovery and Growth – Unity Mining Limited; and
- Mr Tony Davis (BEng), formerly Chief Operating Officer – Unity Mining Limited.

In addition, specialist advice in relation to the Proposed Modification has been provided by:

- Dr Neil Pennington, Principal Noise Consultant, with Spectrum Acoustics;
- Mr Mark Passfield and Mr Andrew Macleod, both Directors with Strategic Environmental and Engineering Consultants;
- Dr Sandra Wallace, Director, with Artefact;
- Dr Roger Drew and Ms Tarah Hagen, both Toxicologists and Risk Assessors, with ToxConsult;
- Mr Simon Smith, Senior Engineer, with Knight Piésold; and
- Mr Tony McKay, Senior Process Engineer, with DRA (Australasia) Pty Ltd.

Finally, the drafts of this document was the subject of expert peer reviews by the following specialists.

- Mr Simon Smith, Senior Engineer, with Knight Piésold in relation to the Tailings Storage Facility-related aspects of the Proposed Modification.
- Mr Tony McKay, Senior Process Engineer, with DRA (Australasia) Pty Ltd in relation to the processing-related aspects of the Proposed Modification.
- Ms Jennifer Hughes, Partner with Baker and McKenzie in relation to whether the *Environmental Assessment* reflects the requirements of planning and environmental law in NSW.

2. DESCRIPTION OF THE PROPOSED MODIFICATION

2.1 INTRODUCTION

2.1.1 Objectives of the Modification

The Proponent's objectives in developing the Project were identified in Section 2.1.1 of RWC (2010a). The Proponent's objectives in modifying MP10_0054 are as follows.

- To maximise the efficiency of the mining and material handling operations.
- To ensure that waste rock remains available in a convenient location for mining purposes and during rehabilitation activities.
- To ensure that processing operations are undertaken in the most cost effective manner, in particular, to remove the requirement for two separate processing facilities, with duplicate Tailings Storage Facilities and other infrastructure to be established.
- To ensure that the Project Site includes all areas of Proponent controlled land.
- To minimise, to the maximum extent practicable, the overall environmental impact of the Project.
- To develop the Project in the most robust manner possible to ensure sufficient resources are available to manage the Project in a manner that is consistent with best practice and to maximise the benefits for the community, local businesses, the Proponent's employees and contractors and the Proponent's shareholders.

2.1.2 Overview of the Proposed Modification

This Proposed Modification would include the following components or activities (**Figure 4**).

- An amendment to the Project Site to accommodate the recently purchased "Slings" property.
- A minor increase to the total resource to be extracted and associated extension of the life of the mine.
- Construction and use of the Eastern Waste Rock Emplacement.
- Construction and use of a vehicle crossing over Spring Creek to permit direct access between the box cut and the Tailings Storage Facility and proposed Western Waste Rock Emplacement.
- Final processing of gold concentrate on site to produce gold doré or unrefined gold bars using a conventional carbon-in-leach (CIL) processing plant.
- Construction of an enlarged Tailings Storage Facility to permit storage of additional tailings that would be produced as a result of the additional ore to be processed and the on-site final processing of gold concentrate.
- A range of minor adjustments to the conditions of MP10_0054 to further clarify the intent of the conditions.

The Proposed Modification to the Project Site is described in Section 2.1.3. Sections 2.2 to 2.6 present a detailed description of each of the above.

2.1.3 Modifications Required

2.1.3.1 Conditions of MP10_0054

The Proponent anticipates that the following modifications to the conditions of MP10_0054 will be required. The proposed additions are underlined and the proposed deletions are presented in ~~strikeout~~ text. Text in parenthesis provides a justification of the proposed modification where it is not provided elsewhere in this document.

- Definitions.
  - EA — Environmental Assessment titled Environmental Assessment for the Dargues Reef Gold Project, and Specialist Consultant Studies Compendium Volume 1 and 2, dated September 2010, prepared by R. W. Corkery and Co Pty Limited, including the Response to Submissions, and additional information from Gaia Research Pty Ltd dated 5 May 2011;

    Environmental Assessment titled Environmental Assessment for the Dargues Reef Gold Project, Modification 1, dated April 2012, prepared by R. W. Corkery and Co Pty Limited, including the Response to Submissions;

    Environmental Assessment titled Environmental Assessment for the Dargues Gold Mine, Modification 2, dated July 2013, prepared by R.W. Corkery and Co Pty Limited, including the Response to Submissions; and

    Environmental Assessment titled Environmental Assessment for the Dargues Gold Mine, Modification 3, dated <insert month> 2015, prepared by R.W. Corkery and Co Pty Limited, including the Response to Submissions.

  - Response to Submissions.

    The Proponent's responses to issues raised in submissions, including those titled:

    Response to Government Agency and Public Submissions for the Dargues Reef Gold Project, dated December 2010;

    Response to NSW Office of Water Submission Dated 16 December 2010 for the Dargues Reef Gold Project, dated December 2010;

    Response to DECCW Issues, dated 2 March 2011;

    Response to Submission Received 15 April 2011, dated 20 April 2011;

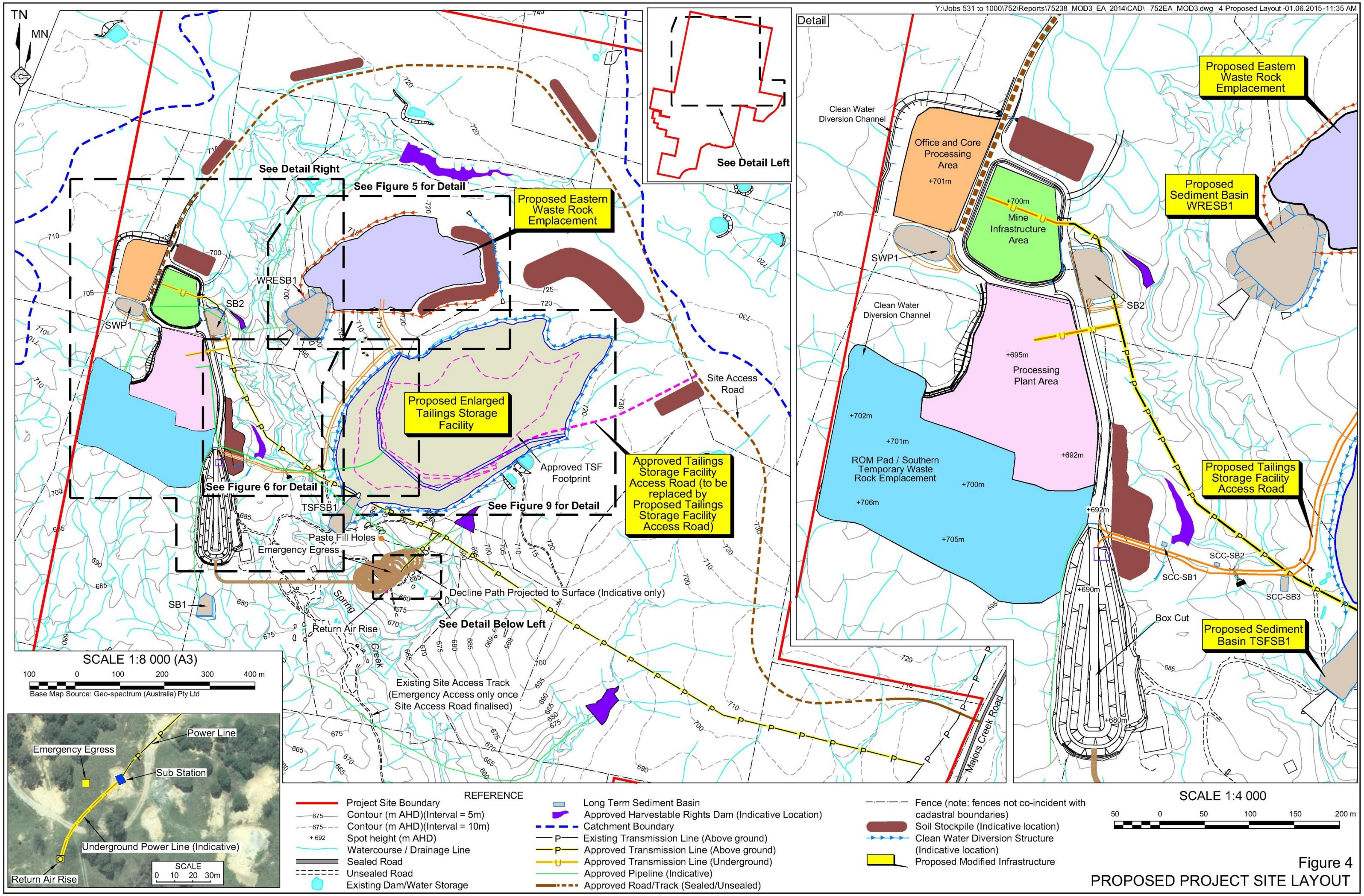

Figure 4
PROPOSED PROJECT SITE LAYOUT

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Letter from Cortona Resources Limited, dated 15 December 2010;

Response to Government Agency and Public Submissions – Modification 1 dated June 2012;

Response to Agency and Public Submissions – Modification 2 dated September 2013; and

Response to Agency and Public Submissions – Modification 3 dated <date to be confirmed>.

~~– RTA Roads and Traffic Authority.~~

– RMS Roads and Maritime Service.

- Schedule 2, Condition 5.
  - The Proponent may carry out mining operations on the site until 31 August ~~2018~~ 2022.
- Schedule 2, Condition 6.
  - The Proponent shall not:
    - process more than 355 000 tonnes of ore at the site in a calendar year;
    - process more than ~~1.2~~ 1.6 million tonnes of ore at the site over the life of the project;
    - use any ~~cyanide or~~ mercury on site to process or extract gold from the project; or
    - process or smelt any ore other than that extracted from the site.
- Schedule 3, Condition 15.
  - The Proponent shall ensure compliance with the emission standards for Group 6 treatment plants under Schedule 3 of *Protection of the Environment Operations (Clean Air) Regulation 2010* (non-ferrous metal production). ~~any pollutant limits in the EPL set after further assessment of the potential air quality impacts associated with the gold smelting process (refer to Condition 17 below).~~
- Schedule 3, Condition 24.
  - The Proponent shall ensure that the basin of the ~~capacity of the~~ tailings storage facility achieves a permeability standard of 1×10^{-9}m/s over 900mm or equivalent. ~~is designed to meet the requirements of the Environmental Guidelines – Management of Tailings Storage Facilities (VIC DPI, 2004) and that the walls, floor and final capping of the tailings storage facility is designed to be equivalent to 600mm clay of permeability 1×10^{-8}~~m~~/s.~~

    ~~Note: An alternative permeability standard may be acceptable following completion of an appropriate risk assessment undertaken in accordance with the Environmental Guidelines – Management of Tailings Storage Facilities (VIC DPI, 2004) to the satisfaction of OEH and the Director-General.~~

- Schedule 3, Condition 37.
  - The Proponent shall prepare and implement an Aboriginal Heritage Management Plan for the project to the satisfaction of the Director-General. The Plan must:

    (a) be prepared in consultation with OEH and the Aboriginal community;

    (b) be submitted to the Director-General for approval prior to construction; and

    (c) include a:

    - program for fencing ~~the 5~~ identified Aboriginal sites;
    - program for the recording, salvage and surface collection of any Aboriginal objects/sites that may be encountered within the project area;
    - description of the measures that would be implemented if any Aboriginal skeletal remains are discovered during the project; and
    - protocol for the ongoing consultation and involvement of the Aboriginal community in the conservation and management of the Aboriginal heritage of the objects/sites.
- ~~Schedule 3, Condition 40.~~
  - ~~The Proponent shall:~~
    - ~~keep accurate records of the:~~
    - ~~amount of concentrate transported from the site (on a monthly basis); and~~
    - ~~the date and time of loaded truck movements from the site; and~~
    - ~~provide the Director-General with a summary of these truck movements on a quarterly basis.~~
- Schedule 3, Condition 41.
  - The Proponent shall ensure that:
    - ~~a maximum of 4 concentrate trucks exit the site per hour;~~
    - ~~the dispatch of concentrate from the site is limited to between the hours of 7am to 10pm Monday to Saturday and 8am-10pm Sundays and Public Holidays;~~
    - all heavy vehicle movements to or from the site are prohibited between the hours of 7am – 8.30am and 3pm-5pm on school days; and
    - ~~a bus is operated from Braidwood to offer mine workers transport to and from the site each day; and~~
    - all reasonable and feasible measures are implemented to minimise the project's contribution to the traffic on Majors Creek Road, Araluen Flat Road, Captains Flat Road, Coghill Street and Wallace Street.

- Appendix 1 – Schedule of Land.
  - Replace the table in Appendix 1 with **Table 1** of this document.
  - Replace the figure on p23 with **Figure 2** of this document.
- Appendices 2, 3, 4 and 7.

  Replace figures on pp24, 25, 27, 29, 30 and 56 with suitable figures showing the proposed modified layout and revised Project Site boundary.

A minor modification would be required to EPL 20095 to permit establishment of licenced discharge points for the additional proposed sediment basins.

2.1.3.2 Statement of Commitments

The Proponent also notes that a range of modifications are required to the Statement of Commitments presented in Appendix 5 of MP10_0054. These modifications are required to remove inconsistencies or duplication between the Statement of Commitments and the Conditions of MP10_0054 or to remove commitments that are no longer relevant or are contrary to the intent of MP10_0054 or the Proposed Modification. **Appendix 1** of this document presents the Revised Statement of Commitments, together with a justification of each modification proposed.

2.2 EXTENSION OF MINE LIFE AND RESOURCE TO BE RECOVERED

In general, as mineral exploration and mining progresses, more detailed information in relation to the geological setting and mineralisation of an ore body is obtained. As a result, progressively more detailed estimates of the resource or geological metal endowment will be calculated. This in turn permits mine plans to be optimised and ore reserves, or the amount and average grade of material that may actually be mined, to be determined.

Table 6 presents an overview of the various resources and reserves estimates prepared for the Dargues Gold Mine. These estimates have been prepared and published in accordance with the requirements of the version of the *Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves* (JORC Code) applicable at the time that the estimate was prepared. Further information in relation to these statements can be obtained from the Proponent's website.

Table 6
Dargues Gold Mine – Resources and Reserves

Resource and Reserve Statement Year	Classification	Tonnes	Grade	Contained Gold
2010	Resource	1.4Mt	6.2g/t	286 000oz
2012	Resource	1.615Mt	6.3g/t	327 000oz
	Proven and Probable Reserve	1.4Mt	5.2g/t	233 000oz
2013	Resource	1.615Mt	6.3g/t	327 000oz
	Proven and Probable Reserve	1.541Mt	5.3g/t	250 633oz
Source: Big Island Mining Pty Ltd				

In summary, the resource for the Dargues Gold Mine has increased from 1.4Mt in 2010 to 1.615Mt in 2013. Similarly, the proven and probable reserves have increased from 1.4Mt in 2012 to 1.54Mt in 2013. This has been achieved through growth in the geological resources and further optimisation of the mine plan to extract material that earlier mine plans proposed to leave in situ. The revised mine plan does not extend lower than the approved maximum depth of approximately 500m below surface.

As a result, the Proponent proposes to seek an increase in the approved maximum amount of ore permitted to be extracted over the life of the Project from the approved 1.2Mt to a proposed 1.6Mt.

The Proponent does not propose to increase the approved annual rate of production of 355 000t of ore per year. As a result, the proposed increase in ore to be mined would require additional time to complete mining operations. In addition, the Proponent notes that mining operations have yet to commence within the Project Site. As a result, the Proponent seeks an extension of the four year period during which mining operations are permitted to be undertaken, from 31 August 2018 to 31 August 2022.

2.3 PROPOSED EASTERN WASTE ROCK EMPLACEMENT

2.3.1 Introduction

As part of the Proponent's previously described review of the efficiencies and costs associated with the Project, the proposed mining schedule and closure plan for the Project have been reviewed and a range of efficiencies have been identified. This section briefly describes the modified mining schedule and resulting material movement balance that has resulted in the requirement for additional waste rock to be placed on the surface.

2.3.2 Modified Mining Schedule and Material Balance

Section 2.4.4 of RWC (2010a) identified that ore would be extracted using a sublevel open stope mining method. Mining would progressively move from the upper levels of the deposit to the lower levels, with some ore material left *in situ* to support the open stopes prior to backfilling with paste fill and waste rock. This mining method would permit waste rock from the central and lower sections of the mine to be directly placed into completed stopes.

As a result of the Proponent's review of the mining operations, a slightly modified mining schedule is proposed. The modified mining schedule would require development to deeper levels of the deposit earlier in the life of the mine than in the original schedule, with sublevel open stope mining progressing from the lower levels of the mine to the upper levels. Completed stopes would then be back filled with paste fill or waste rock prior to the stope above being mined. This mining method, while permitting more efficient and complete extraction of the ore, and greater use of paste fill would result in more waste rock being generated early during the life of the mine, with few opportunities to directly place that waste rock into completed voids underground. As a result, the approved ROM Pad and waste rock emplacement would have insufficient storage capacity.

2.3.3 Layout of the Eastern Waste Rock Emplacement

Figure 4 presents the location of the Eastern Waste Rock Emplacement while **Figure 5** presents the indicative layout of the emplacement. In summary, the emplacement would be constructed as a valley-fill emplacement to the east of Spring Creek. This location would ensure that:

- the emplacement would not be visible to residents surrounding the Project Site;
- the emplacement is shielded from sensitive noise receivers; and
- material is available in close proximity for rehabilitation of the tailings storage facility at the end of mine life, thereby minimising the costs of that rehabilitation.

Figure 5 presents the design on the Eastern Waste Rock Emplacement. In summary, the emplacement would have the following design criteria.

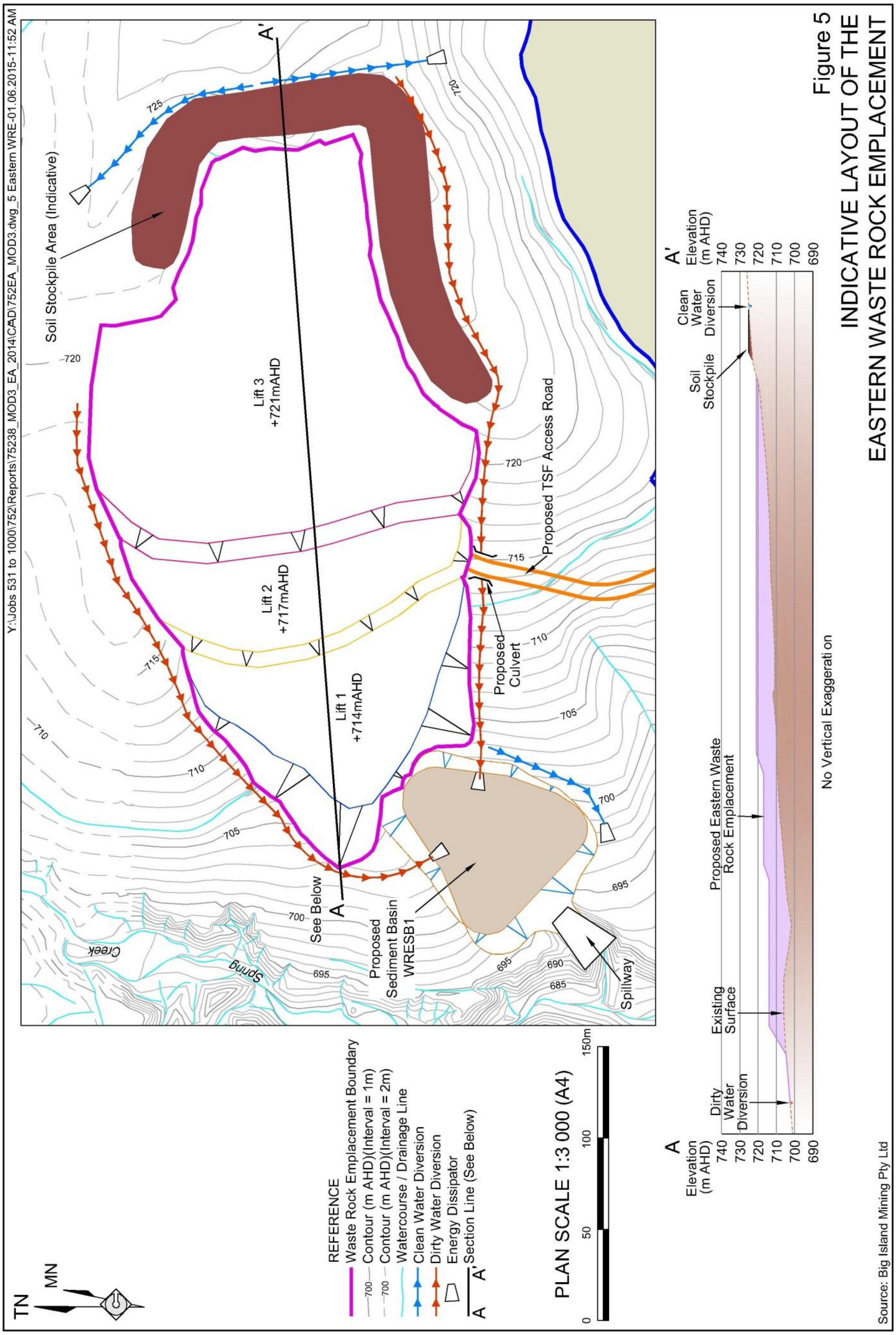
- Maximum elevation .... approximately 721m AHD.
- Footprint .... approximately 6ha.
- Design capacity.................. approximately 350 000t or 150 000m^3.
- Number of lifts................... three.
- Lift height .... between 3m and 4m.

2.3.4 Construction of the Eastern Waste Rock Emplacement

The limit of proposed disturbance would initially be marked on the ground to ensure that the ground disturbing activities are limited to the nominated area. This would be followed by installation of the relevant surface water controls.

SEEC has prepared a detailed *Sediment and Erosion Control Plan* for the Eastern Waste Rock Emplacement, referred to hereafter as SEEC (2015b) and presented as **Appendix 2**. That plan has been prepared in accordance with the requirements of *Managing Urban Stormwater Volumes 1 and 2E* (Landcom, 2004 and DECC, 2008b). **Figure 5** presents an overview of the requirements of SEEC (2015b). In summary, the Proponent would install the following prior to commencement of other ground disturbing works.

- Clean water diversions upslope of the proposed emplacement.
- Dirty water diversions down slope of the proposed emplacement.
- A sediment basin (WRESB01) to collect and temporarily store potentially sediment-laden water to permit settling of the suspended sediment prior to discharge. The sediment basin would include a stabilised spillway/discharge location to permit discharge of surface water in the case of a rainfall event that exceeds the design capacity of the basin. As indicated in SEEC (2015b), accumulated water would be treated and, following testing to confirm consistency with the ambient water quality within Spring Creek, discharged within 10 days to ensure that sufficient storage capacity remains within the basin. In the event, for whatever reason, appropriate water quality is not able to be achieved, water within WRESB01 would be pumped to the Tailings Storage Facility to prevent release of sediment-laden water to Spring Creek.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Soil Stockpile Area (Indicative)
Lift 3
+721mAHD
Lift 2
+717mAHD
Lift 1
+714mAHD
Proposed TSF Access Road
Proposed Culvert
Proposed Sediment Basin WRESB1
Spillway
See Below
A
A'
Spring Creek
REFERENCE
Waste Rock Emplacement Boundary
Contour (m AHD)(Interval = 1m)
Contour (m AHD)(Interval = 2m)
Watercourse / Drainage Line
Clean Water Diversion
Dirty Water Diversion
Energy Dissipator
Section Line (See Below)
PLAN SCALE 1:3 000 (A4)
0
50
100
150m
TN
MN
Elevation (m AHD)
740
730
720
710
700
690
Dirty Water Diversion
Existing Surface
Proposed Eastern Waste Rock Emplacement
Soil Stockpile
Clean Water Diversion
No Vertical Exaggeration
Figure 5
INDICATIVE LAYOUT OF THE EASTERN WASTE ROCK EMPLACEMENT
Source: Big Island Mining Pty Ltd

In addition, the Proponent would construct a culvert under the proposed haul road to permit dirty water on the southern side of the emplacement to flow to the sediment basin.

Following completion and inspection of the sediment and erosion controls structures by a suitably qualified expert, the Proponent would commence soil stripping operation in accordance with the procedures identified in Section 2.3.3 of RWC (2010a). Soil stockpiles would be established upslope of the emplacement in locations where they would not be subject to erosive surface water flows.

2.3.5 Operation of the Eastern Waste Rock Emplacement

Waste rock would be transported from the underground mine by underground haul truck to the eastern side of Spring Creek. During the construction phase of each of the lifts of the Tailings Storage Facility (see Section 2.6.5.1), it would be used to construct the structural core of the embankment. If the material is not required for the Tailings Storage Facility construction, it would be transported to the Eastern Waste Rock Emplacement. The material would then be levelled with a bulldozer and further material placed on the levelled landform until the final design elevation of each lift is reached. The first lift would be constructed in its entirety, after which Stages 2 and then 3 would be constructed.

2.3.6 Rehabilitation of the Eastern Waste Rock Emplacement

At the end of the life of the Project, waste rock within the Eastern Waste Rock Emplacement would be used for rehabilitation operations. Potential uses include the following.

- Capping of the tailings storage facility.
- Back filling of the box cut to achieve the identified final landform with internal slopes of 1:3 (V:H).

The Applicant notes that while a final capping thickness for the Tailings Storage Facility has yet to be determined, capping operations are likely to require between 0.5m and 1.0m of waste rock. Based on the proposed footprint of the tailings surface of the facility of 9.3ha, between 46 500m^3 and 93 000m^3 of capping material would be required. As a result, it is likely that the majority of the waste rock within the Eastern Waste Rock Emplacement would be relocated during rehabilitation of the Tailings Storage Facility. Remaining material would be available to backfill the boxcut in accordance with Condition 3(51)(c) of MP10_0054, namely to achieve a final slope of 1:3 (V:H).

In the event that not all waste rock is required for rehabilitation operations, remaining waste rock would be shaped to achieve slopes of 1:5 (V:H) or less consistent with the surrounding landform and rehabilitated as described in Section 2.14.7 of RWC (2010a).

2.4 PROPOSED SPRING CREEK CROSSING AND ACCESS ROAD

2.4.1 Introduction

As a component of the review of the approved Project, the efficiency of access to the Tailings Storage Facility and Eastern Waste Rock Emplacement was assessed. In summary, the approved access to the eastern side of Spring Creek from the box cut and processing plant area requires vehicles to travel approximately 2.8km via the approved Site Access Road and Tailings Storage Facility Access Road (**Figure 3**). In addition, underground mining vehicles are not suitable for long haulage distances at surface. The approved transportation route would therefore require unloading and temporary storage of waste rock at the Western Waste Rock Emplacement and reloading into surface trucks for transportation.

Potential adverse impacts associated with this procedure would include the following.

- Inefficiencies associated with unloading/reloading and transportation of a large volume of waste rock over a distance of 2.8km.
- Transportation via the Site Access Road which is in line of sight of residences to the south and southwest of the Project Site, resulting in potential adverse noise and visual amenity impacts.
- Additional road maintenance requirements for the Site Access Road.
- Additional interaction between light and heavy vehicles on the Site Access Road.

As a result, the Proponent proposes to construct a heavy vehicle crossing over Spring Creek. The proposed road would permit direct access from the box cut and processing plant area to the Eastern Waste Rock Emplacement and Tailings Storage Facility. The approved Tailings Storage Facility Access Road would not be required and would therefore not be constructed.

2.4.2 Design of the Proposed Crossing

This subsection describes the proposed Spring Creek crossing and presents measures that would be implemented to minimise potential adverse impacts.

The proposed crossing has been conceptually designed by K&C Brown and Associates Pty Ltd, a Canberra-based consulting engineering firm. **Figure 6** presents a plan of the proposed crossing, while **Figure 7** presents a range of cross sections through the proposed crossing and its approaches. Detailed designs for the crossing would be completed following the receipt of approval for the Proposed Modification, assuming that it is granted. The final design would be consistent with:

- *Guidelines for watercourse crossings on waterfront land* published by Office of Water in July 2012.
- *Why do fish need to cross the road? Fish passage requirements for waterway crossings* published by Fisheries NSW in 2003; and
- relevant Australian and other standards.

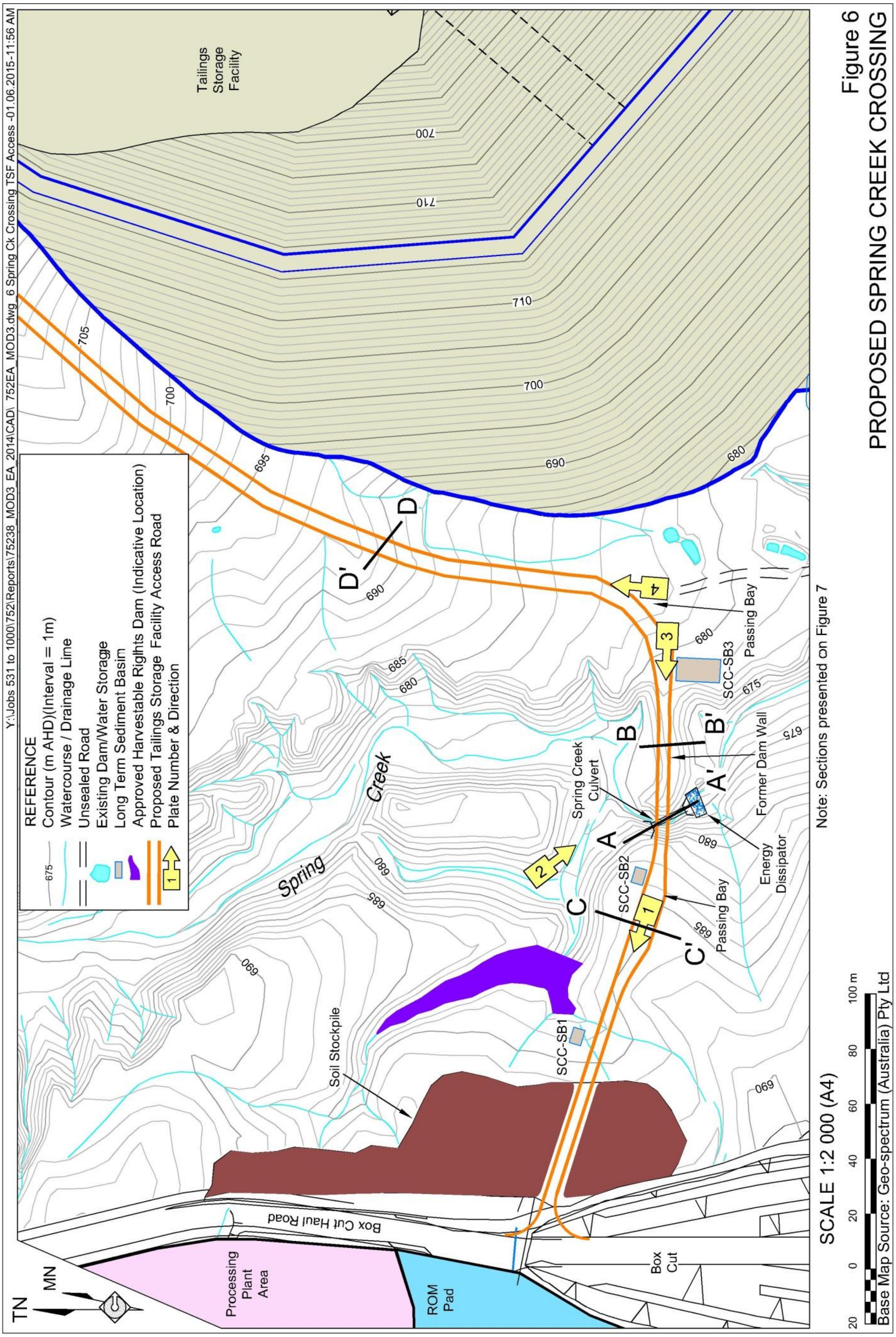

Figure 6
PROPOSED SPRING CREEK CROSSING

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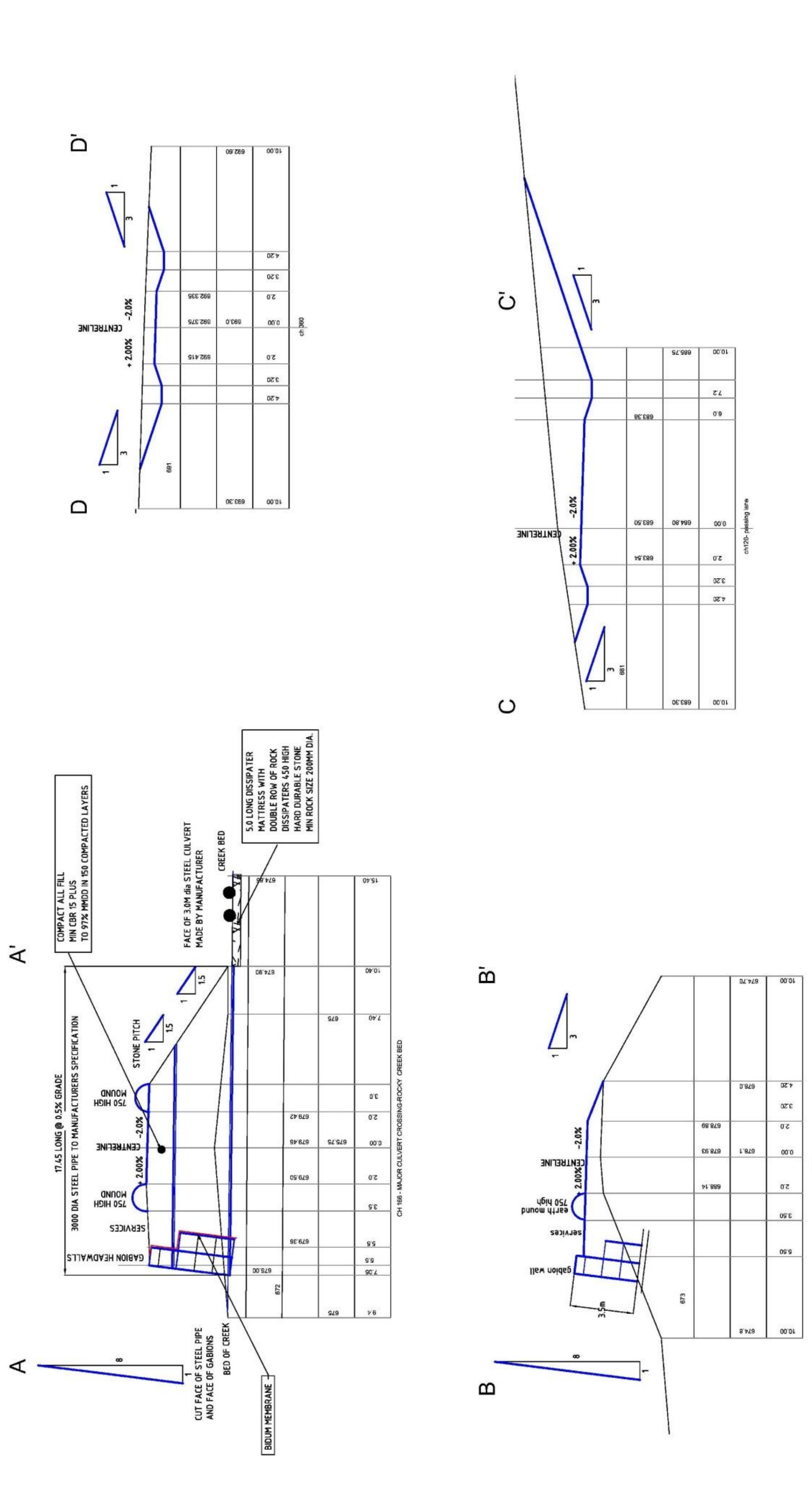

Note: Section locations are shown on Figure 6

Source: K & C Brown & Associates P/L

Figure 7
PROPOSED SPRING CREEK CROSSING SECTIONS

The indicative design criteria for the proposed crossing are as follows.

- Surface – unsealed, all weather compacted roadbase suitable for use by heavy vehicles.
- Length, including approaches – approximately 700m.
- Width – 4m (one way traffic) from the Box Cut to the Tailings Storage Facility, then 8m (two way traffic) from the Tailings Storage Facility to the Eastern Waste Rock Emplacement.
- Passing bays – two.
- Maximum gradient – approximately 1:7 (V:H).
- Surface water controls – to be installed in accordance with a detailed and staged *Sediment and Erosion Control Plan* prepared by SEEC in accordance with *Managing Urban Stormwater Volumes 1 and 2C* (Landcom, 2004 and DECC, 2008a). This plan is referred to hereafter as SEEC (2015c) and is presented in **Appendix 2.**
- Roadside batter slopes – approximately 1:3 (V:H) where cut and fill is required.

The crossing would have the following design parameters. **Figures 6** and **7** presents a range of these design features.

- Width – 4m road surface with a 0.75m high safety barrier both sides and 2m services corridor on the northern side, for a total width of 8.5m. A 4m wide road surface is suitable for one way traffic.
- Culvert – 3m diameter, partially buried pipe or equivalent arch or box culvert.
- Engineered downslope gabion basket retaining wall.
- Surface water controls – to be installed in accordance with SEEC (2015c) (see Section 2.4.3.3).

Importantly, in selecting the location for the crossing, the Proponent has selected the site of a former dam wall, now breached, across Spring Creek. The dam is interpreted to have serviced former historic mining operations. **Plates 1** to **4** present views of the proposed location of the crossing and former dam wall.

Aboriginal heritage site GTOS02 is located on the former dam wall and would be salvaged prior to construction of the crossing (see Section 4.6).

The uppermost 1.5m of the material within the former dam embankment, as well as any fill material required to construct the road, would be conditioned and compacted to achieve 95% Modified Maximum Dry Density. This sub-base would then be sheeted with a minimum of 200mm of crushed roadbase to achieve a suitable surface for operation of heavy vehicles.

The proposed crossing would be protected on the upstream side using a gabion basket wall (**Figure 7** – Cross sections A-A’ and B-B’). The downstream face of the crossing would be protected using stone pitch with an indicative slope of 1:1.5 (V:H).

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Plate 1: View along the western alignment of the access road looking west
(Ref: DSC_3377)

Plate 2: View of the former dam wall looking southeast, showing breach of wall
(Ref: DSC_3409)

Plate 3: View of the former dam wall looking west, showing breach of dam wall
(Ref: DSC_3403)

Plate 4: View along the eastern section of the access road looking north
(Ref: DSC_3404)

The proposed culvert which would be installed within the breach in the former dam wall has been designed by K&C Brown & Associates Pty Ltd. The culvert would be a 3m diameter partially buried pipe or equivalent arch or box culvert approximately 17.5m long. The upstream side of the culvert would be protected by the gabion basket wall, with a geotextile membrane in the inner surface to prevent fine sediment eroding from the crossing sub-base and entering Spring Creek. The downstream side of the culvert would be protected by a rock mattress with two rows of rock dissipators to limit the velocity of surface water re-entering the watercourse and the potential for erosion of the banks.

The services corridor would be used to install the tailings decant return and paste fill pipeline from the processing plant to the Tailings Storage Facility and the decant return pipeline from the Tailings Storage Facility to the processing plant. These pipelines would be protected from inadvertent damage by heavy vehicles through the use of a safety bund between the roadway and service corridor. In addition, the Proponent would implement the following to ensure that neither tailings nor decant return water would be permitted to enter Spring Creek.

- The pipelines would be installed within a bunded trench of sufficient capacity or would be surrounded by secondary pipes to ensure that tailings or decant return water would be retained in the event of a pipeline failure.
- Multiple leakage detection and automatic shutoff systems would be implemented. These may include pump pressure or load detectors or direct leakage detection within the pipes.
- Regular inspection and maintenance regimes would be implemented, including visual inspections multiple times each day and physical and remote sensing inspections at manufacturer-recommended intervals. The Proponent would ensure that any planned or inspection-related maintenance requirements would be promptly implemented by suitably experienced personnel.

2.4.3 Erosion and Sediment Control

2.4.3.1 Introduction

As identified in Section 1.4.8.3, a range of sediment and erosion control-related issues arose during the initial stages of Project construction. As a result, the Proponent engaged SEEC to prepare a detailed *Erosion and Sediment Control Plan* (SEEC, 2015c) for the proposed Spring Creek crossing and approach roads in accordance with the requirements of Landcom (2004) and DECC (2008a). A copy of that plan is presented as **Appendix 2**. It is noted that a range of minor adjustments to the alignment of the assess road to the east of the Spring Creek Crossing have been required since finalisation of SEEC (2015c). That document would be updated to reflect those minor adjustments prior to commencement of construction operations.

SEEC (2015c) includes recommendations regarding the staging, design, construction and management of erosion and sediment controls for the crossing. It is the Proponent’s intention to implement all recommendations provided in that document. The following subsections present a brief summary of proposed sediment and erosion control works to be installed.

2.4.3.2 Erosion and Sediment Controls – General Road Construction

SEEC (2015c) identifies the following range of erosion and sediment controls to the installed on the approaches to the proposed crossing and the procedures for their implementation.

- Schedule works for the months from April to May or July to September, where practicable. If this is not practicable, prepare a revised sediment and erosion control plan taking into account the higher average rainfall during the intervening periods.
- Install barrier fencing to delineate the work area and limit the potential for inadvertent ground disturbance.
- Install sediment fencing as appropriate downslope of all areas to be disturbed prior to construction commencing.
- Construct stabilised dirty water diversion drains, including energy dissipaters, at the discharge locations down slope of proposed areas of disturbance prior to construction commencing.
- Construct and operate two sediment basins to the west of Spring Creek and one to the east prior to construction commencing. **Table 7** presents the proposed volume and spillway design criteria for the basins.

Table 7
Sediment Basin and Spillway Design Criteria

Basin[1]	Sediment Storage Volume (m^3)	Settling Volume (m^3)	Total Basin Volume (m^3)	Basin Spillway			
				Depth (m)	Side Slope (V:H)	Base Width (m)	Top Width (m)
SCC_SB1	9	46	55	0.5	3:1	1	3
SCC_SB2	17	57	74	0.5	3:1	1	3
SCC_SB3	69	229	298	0.75	3:1	2	5

Note 1: see **Figure 6** for locations

Source: Modified after SEEC (2015c) - Table 4

- Construct clean water diversions upslope of all areas of proposed disturbance prior to construction commencing.
- Install temporary waterway crossings at all locations where the proposed road crosses a natural drainage line until the final crossing/culvert can be installed. Section 2.4.3.3 provides a more detailed description of the proposed works within Spring Creek.
- Ensure slope lengths during constructions are no more than 80m when rain is predicted. Slope lengths are to be reduced to no more than 40m in steeper sections of the proposed road.
- Progressively stabilise completed areas.

- Ensure appropriate supplies of geotextile fabric or plastic are maintained on site to cover exposed areas, as required, in the event of forecast rain.
- Implement a procedure to ensure that all erosion and sediment controls are inspected and re-instated, if required, in the event that rain is predicted within the next 24 hours.
- Inspect all sediment controls following rainfall and remove accumulated sediment as required. Treat, test and discharge accumulated water within sediment basins within 5 days. In the event, for whatever reason, appropriate water quality is not able to be achieved, water within the sediment basins would be removed and used for Project-related purposes or irrigated to land, with measures implemented to ensure that that water is not able to enter a watercourse.

2.4.3.3 Erosion and Sediment Control – Spring Creek Crossing

Installation of erosion and sediment controls associated with the construction of the Spring Creek crossing would occur in three stages as follows.

- Stage 1 – Site Establishment and Clean Water Diversion Installation.
  - Ensure Stage 1 activities are undertaken during a period of at least five days with no rain predicted.
  - Install upstream and downstream sandbag bunds within Spring Creek to isolate the proposed crossing from stream flow. Pump or siphon stream flows around road construction works via temporary diversion pipes.
  - Construct a temporary vehicle crossing, including a temporary culvert/pipes, with the discharge located downstream of all proposed works.
  - Install stabilised bunds up and down stream of the proposed ground disturbing works.
  - Remove the sandbag bunds and associated pump/syphon system and direct stream flow through the temporary culvert/pipe.
- Stage 2 – Construction of the Proposed Crossing.
  - Ensure all construction works are completed within two months to limit potential for rainfall events and sediment accumulation within the works area.
  - Prioritise construction of the permanent culvert to allow stream flow to be diverted to this structure as soon as possible.
  - Progressively stabilise all exposed surfaces.
- Stage 3 – Removal of Temporary Access and Lined Earth Bunds.
  - Ensure Stage 3 activities are scheduled during a period of at least three days with no rain predicted.
  - Separate stream flow from on-site water by re-installing temporary upstream and downstream sandbag bunds within Spring Creek. Pump or siphon stream flows around road construction works via temporary diversion pipes.

– Remove the temporary vehicle crossing, including temporary culverts/pipes.
– Complete final rehabilitation and stabilisation of disturbed or exposed soil.
– Remove sandbag bunds and pump system.

2.4.4 Operation of the Proposed Crossing

The proposed road would be used to transport waste rock directly from the approved underground mine to the Tailings Storage Facility or proposed Eastern Waste Rock Emplacement using underground haul trucks.

Loaded haul trucks would exit the box cut and turn right onto the proposed road. In order to minimise disturbance associated with the proposed road, it has been designed to be of a width that is suitable for one-way traffic only. Traffic using the road would be managed using the same procedure that would be used to manage one-way traffic within the underground mine, namely two way radios would be used to advise other traffic of vehicle movements on the proposed road, with laden vehicles having right of way over unladen vehicles and heavy vehicles having right of way over light vehicles. Two passing bays are proposed, one on each side of the proposed crossing.

The proposed road would be inspected as part of the routine inspection program for the Project. In addition, all sediment and erosion controls would be inspected prior to and following rainfall.

2.5 FINAL PROCESSING OF GOLD CONCENTRATE

2.5.1 Introduction

Following placement of the Project into care and maintenance in December 2013, a detailed review of all aspects of the Project was completed. That review identified that off-site leaching of gold concentrate imposed a number of unsustainable costs on the Project for limited environmental benefit. Those costs included the following.

- Transportation of up to 30 000t per year of concentrate to an off-site processing facility located between 75km and 900km from the Project Site. This would impose additional traffic on the community surrounding the Project Site and along the transportation route, generate additional and unnecessary greenhouse gas emissions and impose a financial burden on the Proponent.
- Establishment of a second facility, including a separate management team and associated inefficiencies.

As indicated in Section 3.2.2.1 of RWC (2010a), in proposing off-site leaching, the Proponent was fulfilling a commitment made at a public meeting in November 2008. The Proponent acknowledges that that commitment was given without a full understanding of the financial implications of off-site processing and without an open and frank discussion with the community and other stakeholders in relation to the risks associated with the use of cyanide and the fact that it is a commonly and safely used reagent in gold mines throughout Australia and the world.

The Proponent recognises that the Proposed Modification is not consistent with a commitment previously given to the community not to use cyanide within the Project Site. However, in order to secure the long-term future of the Project and the associated benefits that would flow from it in terms of employment, economic activity, training opportunities and other benefits, the Proponent contends that on-site leaching is necessary. An overview of the financial modelling of the approved and modified Projects is presented and discussed further in Section 2.8.

In light of the above, the Proponent has engaged in a detailed and robust consultation program with residents surrounding the Project Site, with the wider community and with relevant stakeholders, including community groups, Palerang and Eurobodalla Councils and other government agencies. Section 3.2 provides a description of the consultation undertaken for the Project.

This sub-section provides a brief overview of the properties, effects, use and management of cyanide generally, as well as the manner in which it would be used within the Project Site and the measures that would be implemented to ensure that the proposed activities would be undertaken in a safe manner that would not result in environmental harm.

2.5.2 Cyanide Properties, Effects, Sources, Use and Management

2.5.2.1 Introduction

The Proponent engaged ToxConsult to prepare an overview of the toxicity profile for cyanide. That report was prepared by Dr Roger Drew and Ms Tarah Hagen and is referred to hereafter as ToxConsult (2015a). The report is presented in **Appendix 3**. That Appendix also includes a companion report (ToxConsult, 2015b) describing a risk assessment prepared by Dr Drew and Ms Hagen. That report is discussed in detail in Section 4.3.5.2. Dr Drew is a Diplomat of the American Board of Toxicology, the peak professional association of toxicologists globally and Adjunct Associate Professor in the Department of Epidemiology and Preventative Medicine at Monash University.

2.5.2.2 Properties of Cyanide

Cyanide is a simple ion of carbon and nitrogen (CN^-). The ion typically forms complexes with a range of other elements or groups of elements. As a result, cyanide occurs in a range of forms, including the following.

- Cyanide ion (CN^-).
- Hydrogen cyanide (HCN).
- Various metallo-cyanide complexes, including complexes with Ag, Cu, Hg, Ni, Zn, Fe, Co, Au, Pt and Pd.
- Cyanogen $(CN)_2$.
- Cyanates (compounds containing OCN^-).
- Thiocyanates (a collective description for compounds containing SCN).

Typically cyanide is classified based on the ease with which the CN^- ion may be released, as follows.

- Free cyanide – CN^- and HCN.
- Weak acid dissociable (WAD) cyanide – includes those compounds that may release CN^- at a moderately acidic pH of between 4.5 and 6 PLUS free cyanide. Typically WAD cyanide is considered to be the most appropriate indicator of biologically available cyanide for monitoring purposes.
- Total cyanide – includes those compounds that that may release CN^- at a strongly acidic pH PLUS WAD cyanide AND free cyanide.

Cyanide is not an accumulative toxin and organisms that receive a non-lethal dose of cyanide will typically breakdown the cyanide through a range of metabolic processes. Repeated exposure to low levels of cyanide does not appear to result in long-term effects.

Cyanide in the environment typically breaks down with time to form non-biologically available compounds. ToxConsult (2015a) note that cyanide seldom persists in surface waters, with volatilisation and precipitation rapidly reducing the cyanide concentration.

2.5.2.3 Effects of Cyanide

HCN and CN^- are the principal toxic forms of cyanide, with the former being the most toxic because it is readily diffusible across biological membranes, is volatile (may occur as a gas) and is highly reactive. The solubility and form of cyanide in the environment is highly dependent on pH, temperature, dissolved oxygen, salinity, other ions and complexing metal agents and the presence of sunlight. Typically, the formation of HCN or CN^- is reduced at pH greater than 9. As a result, when used in an industrial setting, the prevention of HCN generation is readily achieved through management of pH at greater than 9.5 through the use of lime or caustic.

The biological effect of cyanide is associated with the fact that it rapidly binds with iron-containing enzymes in animals, limiting the ability of oxygen to be transported and used within the organism. In large enough doses, cyanide may result in rapid death. In lower doses, non-lethal symptoms may include difficulty in breathing, giddiness, headaches, weakness and confusion. At sub-lethal doses, these effects may render an individual more susceptible to other adverse impacts, including predation.

Cyanide may enter the bloodstream of an organism via:

- inhalation of HCN gas;
- ingestion of cyanide in a form that reacts to form HCN in the digestive system; and
- absorption through the skin.

Typically, inhalation and ingestion are the most likely to result in adverse biological outcomes. As a result, avifauna (birds and bats) are typically more likely to be affected by cyanide associated with mining operations than terrestrial fauna because they may more easily access tailings storage facilities with supernatant water with elevated concentrations of WAD cyanide. Typically, fauna access to cyanide-containing solutions within processing plants is limited because of the lights and noise associated with those operations make the area highly unattractive to wildlife.

ToxConsult (2015a) identifies that numerous studies indicate that significant avian mortalities may occur when WAD cyanide concentrations are greater than 50mg/L and that relatively few or no mortalities are observed at lower concentrations. ToxConsult (2015a) also identifies that fish may be particularly sensitivity to cyanide, with the ANZECC freshwater WAD cyanide trigger value for protection of 95% of aquatic species of 0.007mg/L. The drinking water guideline for Australia is 0.08mg/L WAD cyanide.

ToxConsult (2015a) identifies that the effect of cyanide in humans is similar to the effect in animals in that high doses of cyanide may rapidly result in respiratory or neurotoxicological symptoms. However, at lower doses, cyanide is readily metabolised into non-toxic thiocyanate which is excreted in urine, with the plasma half-life of cyanide in humans of 20 to 60 minutes. ToxConsult (2015a) state that there is no evidence that repeated exposure to low concentrations of cyanide results in accumulation of HCN in blood. Similarly, there is no evidence that such exposure is carcinogenic or has an adverse effect on mothers or children during pregnancy.

2.5.2.4 Sources of Cyanide

Cyanide complexes occur naturally in food and other plants as cyanogenic glycosides. These compounds may breakdown during digestion to form sugars and HCN. Over 2 600 species of plants produce such compounds. These include almonds, pits from stone fruits, sorghum, cassava, soybeans, spinach, lima beans, sweet potatoes, maize, millet, sugarcane, and bamboo shoots.

Cyanide is typically manufactured and used in an industrial setting such as the Project as Sodium Cyanide (NaCN). Sodium cyanide typically takes two forms, namely:

- solid briquettes mixed with caustic to ensure that the pH of the material remains above 9.5 to limit the generation of HCN; or
- a liquid, typically an approximately 30% solution.

An alternative and less common source of cyanide includes on-site generation through the supply of natural gas or LPG and nitrogen to an on-site electrical-powered plasma reactor. The carbon in the natural gas or LPG separates from the other compounds and reacts with the nitrogen to form sodium cyanide.

2.5.2.5 Cyanide Uses

Cyanide is most commonly used industrially for the production gold, with ToxConsult (2015a) noting that approximately 80% of the world's annual gold production relies on cyanide leaching. Two principal methods are used for gold production as follows.

- Heap leach – Gold ore is crushed to a relatively uniform size (approximately 8-10mm) and is stacked onto prepared pads with an underdrainage system installed. A solution containing cyanide is irrigated over the pads, leaching the gold from the ore. The gold-bearing solution is then collected from the base of the ore pile by the underdrainage system and the gold is extracted from the solution.
- Tank leach – Gold ore is finely crushed and ground, typically to less than 80µm, mixed with water and pumped through a series of tanks containing a cyanide solution. Alternatively, as is proposed for the Dargues Gold Mine, the ore may be

initially processed using a concentrator to reduce the amount of material to be leached and to increase the concentration of gold prior to being passed to the leaching tanks. Cyanide concentrations in the leaching solutions tend to be higher in tank leaching operations than in heap leaching operations. Two variants of tank leaching are commonly used, namely carbon-in-leach (CIL) and carbon-in-pulp (CIP). These techniques use activated carbon granules to adsorb dissolved gold. CIL has carbon present in all tanks with gold leaching and adsorption taking place simultaneously whereas CIP typically has two tanks at the start of the tank train that has no carbon present but all subsequent tanks have carbon added.

According to ToxConsult (2015a), the majority of gold produced using cyanide leaching is produced using the heap leach methodology.

Other non-mining industrial uses of cyanide include electroplating where various metallo-cyanide complexes are used to facilitate the deposition of metallic coatings. Cyanide is also used in fumigants and pesticides. Finally, HCN is also present in cigarette smoke.

2.5.2.6 Cyanide Management – Generally

Section 2.5.4.4 presents a detailed description of the cyanide management measures to be implemented by the Proponent for the Project. This subsection identifies a range of commonly implemented measures used in the mining industry to ensure that adverse safety and environmental impacts are avoided.

Cyanide management measures that are typically implemented include the following.

Transportation

- Solid sodium cyanide is mixed with caustic to limit the potential for generation of HCN.
- Bulk solid sodium cyanide is generally transported in specially designed and constructed containers (referred to as isotainers) designed to contain the material in the event of a traffic accident or similar.
- Alternatively, solid sodium cyanide is transported in large bags stored inside wooden boxes and transported in locked shipping containers. The Proponent does not propose to use this transportation method for the Project.

Storage

- Solid sodium cyanide is mixed with water in specially designed mixing tanks. These tanks are typically bunded to contain any cyanide solution in the event of an unplanned spill.
- The pH of the leaching solution is maintained above 9.5 to limit the potential to generate HCN gas.

Use

- The concentration of cyanide in the leaching solution is typically the minimum required to leach the gold. This is partially to limit the potential for adverse safety or environmental effect and partially because sodium cyanide is an expensive reagent and companies only use the minimum amount required to leach the ore.
- Process plants typically have monitoring equipment that ensures the efficient and safe usage of cyanide. These include the following.
  - Inline cyanide monitors to monitor cyanide concentration in the leach solution at strategic points through the process stream.
  - Inline pH monitors to ensure that pH levels are maintained at levels required to limit the generation of HCN gas.
  - Automated HCN gas monitors located throughout the plant
- Where required, measures are implemented to minimise the interaction of fauna with the leaching solution. Typically, tank leaching operations are not attractive habitat for fauna.
- Measures are implemented to ensure that leaching solution does not leak into the natural environment. These include corrosion protection of facilities and bunding of tank leach operations to contain possible spillage.

Disposal or destruction

- Typically, cyanide solutions are recycled as far as practicable to ensure maximum reuse of the cyanide.
- Where cyanide-containing tailings are to be pumped to a tailings storage facility, the concentration of cyanide in the supernatant or liquid fraction of the tailings may be reduced through the use of cyanide destruction techniques to ensure that the concentration is less than that identified by the relevant site-specific requirements or regulations. In NSW, the EPA commonly imposes the following criteria for discharge to tailings storage facilities. The Proponent anticipates that these criteria will be included in the amended Environment Protection Licence for the Project.
  - 20mg/L WAD cyanide – 90% of the time.
  - 30mg/L WAD cyanide – at all times.

  The Proponent would ensure that the identified concentration of WAD cyanide would be achieved at the outflow from the cyanide destruction circuit. When concentrated tailings are mixed with flotation tailings, the anticipated WAD cyanide concentration on discharge into the Tailings Storage Facility would be substantially reduced as a result of dilution. Where concentrate tailings are discharged in the absence of flotation tailings, the WAD cyanide concentration on discharge to the Tailings Storage Facility would be similar to that measured at the outflow from the cyanide destruction circuit.

2.5.3 Cyanide Code

The *International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide In the Production of Gold* (the Cyanide Code) is a program developed under the guidance of the United Nations Environmental Program and the then International Council on Metals and the Environment. Information presented in this subsection has been drawn from the International Cyanide Management Institute website (http://www.cyanidecode.org).

The Cyanide Code is a voluntary program for gold mining companies, focusing on the safe management of cyanide during production, transportation, use and disposal. The Cyanide Code includes a range of nine principles and 31 standards of practice. The principles identified by the Cyanide Code include the following. Further information in relation to the principles and standards of practice is available from the Institutes website.

1. Production – Encourage responsible cyanide manufacturing by purchasing from manufacturers who operate in a safe and environmentally protective manner.
2. Transportation – Protect communities and the environment during cyanide transport.
3. Handling and Storage – Protect workers and the environment during cyanide handling and storage.
4. Operations – Manage cyanide process solutions and waste streams to protect human health and the environment.
5. Decommissioning – Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.
6. Worker Safety – Protect workers' health and safety from exposure to cyanide.
7. Emergency Response – Protect communities and the environment through the development of emergency response strategies and capabilities.
8. Training – Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.
9. Dialogue – Engage in public consultation and disclosure.

Operations that adopt the Cyanide Code must be independently audited to ensure compliance with each of the principles and standards of practice and those audits are published on the International Cyanide Management Institute's website.

The Proponent became a signatory to the Cyanide Code on 14 January 2015. **Appendix 4** presents correspondence from the International Cyanide Management Institute confirming acceptance of the Proponent's application to become a signatory and outlining the actions required to maintain signatory status. In summary, these are as follows.

- Undertake an initial verification audit of the Dargues Gold Mine by an independent auditor who meets the International Cyanide Management Institute's criteria for auditors by 14 January 2018 or within 12 months of the receipt of the first delivery of cyanide, whichever is the earliest. The Proponent proposes to seek pre-operational conditional approval under the Cyanide Code for the Project.

- Update the information provided to the International Cyanide Management Institute at least annually and whenever there is a change in the status of the Proponent's operations.
- Refrain from using the International Cyanide Management Institute's logo until the initial verification audit indicates compliance with the Cyanide Code.

The Proponent proposes to develop its cyanide management measures in a manner that is consistent with the principles and standards of practice of the Cyanide Code and to fully comply with the requirements of a signatory to the Code as they apply to the Project. The Proponent does not propose to seek certification for its Henty or Kangaroo Flat Gold Mines as those operations are approaching the end of their operational life or are in care and maintenance respectively.

2.5.4 Proposed Modified Processing Operations

2.5.4.1 Introduction

This subsection provides an overview of the proposed modified processing operations. Information is provided on those components of the approved processing plant that would no longer be required and the additional components that would be constructed to facilitate final processing of gold concentrate. The subsection also provides an overview of the proposed process flow chart and the project-specific management measures that would be implemented to complement the generic measures described in Section 2.5.2.6.

2.5.4.2 Modified Plant Layout

The approved processing plant comprises the following components.

1. A ROM pad/temporary waste rock emplacement.
2. A crushing and grinding circuit that would reduce the ore to a size suitable for gravity separation and flotation.
3. A gravity circuit that would recover a proportion of the gold, principally, the coarser grained gold.
4. A flotation circuit that would separate gold-bearing minerals from a sulphide concentrate.
5. A flotation tailings thickening and process water recovery circuit and tailings distribution system.
6. A paste plant that would mix tailings and cement for backfilling of completed stopes within the underground mine.
7. A gold room to produce gold doré from gravity gold.
8. A concentrate cleaning and dewatering circuit that would generate up to 30 000 dry tonnes per year of concentrate.
9. A concentrate storage area and loading area.

In addition, ancillary infrastructure associated with these items, including water supply tanks, workshops, hardstand areas, laboratory and ablutions facilities are approved.

The proposed modified plant would retain components 1 to 6 as well as the relevant ancillary infrastructure. The approved gold room (Item 7) would be modified to permit recovery of leached gold as well as gravity gold. Items 8 and 9 would, however, not be required and would therefore not be constructed.

In place of the components that would not be constructed, and largely within the same footprint, the Proponent would construct the following infrastructure. A detailed description of the operation of each of the following components is provided in Section 2.5.4.3. Section 2.5.4.4 provides a description of the proposed reagent management measures that would be implemented.

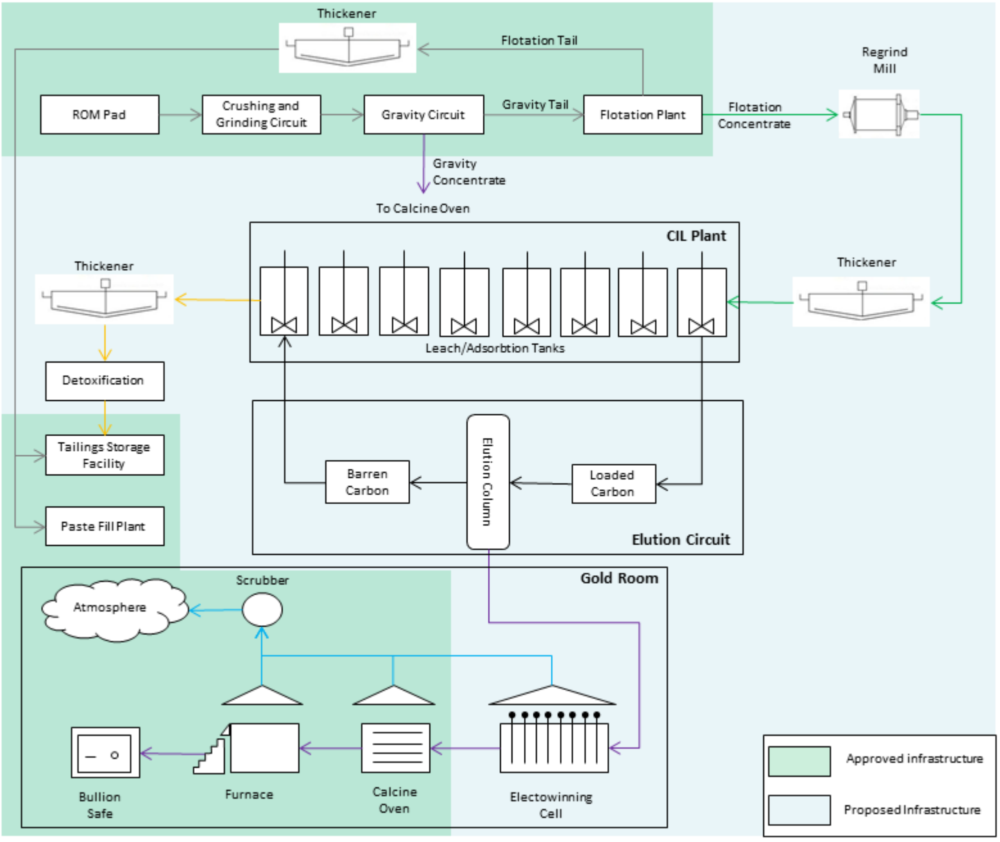
- A carbon-in-leach (CIL) plant, comprising a number of leach tanks and associated infrastructure. The CIL plant would be fully bunded, with the bunding capable of containing 110% of volume the largest leach tank. The bund would be equipped with a blind sump and pumps to facilitate removal of leaching solution and concentrate in the event of a spill.
- An elution circuit and associated infrastructure. The elution circuit would also be fully bunded, with the bunding capable of containing 110% of the volume of the elution tank. Given that the fluids in the elution tank would be hot and highly alkaline, the bunding would be constructed of material capable of withstanding discharge of such material.
- A modified gold room and associated infrastructure. RWC (2010a) identified that a gold room would be constructed to produce gold doré from the gravity concentrate as sufficient material accumulated. The proposed gold room would be largely the same as the approved gold room, with the exception that it would operate more frequently, indicatively weekly, to produce doré.
- A bunded reagent storage and management area. Management of reagents within the reagent store is discussed in Section 2.5.4.4.

2.5.4.3 Modified Processing Flow Chart

Figure 8 presents a simplified process flow chart for the approved and proposed processing operations. The operations are briefly summarised as follows. Where relevant, references are made to photographs of similar equipment at the Proponent's Henty Gold Mine. Those photographs were taken during a site inspection of that Mine by members of the local community and are presented in Section 3.2.3.3.

- The gold ore would be crushed, mixed with water and ground before being pumped to the gravity circuit and then to the flotation plant as described in Sections 2.6.3 and 2.6.4 of RWC (2010a).
  - The gravity concentrate, namely the heavy fraction of the ore containing most of the coarse gold, would be transferred to the gold room for processing with the gold-bearing precipitate from the electrowinning cell within the elution circuit.

- The flotation tail, namely that component of the ore with the gold-bearing minerals removed, would be pumped to either the Tailings Storage Facility or the Paste fill Plant for use underground.
- The gold concentrate would be transferred to a regrind mill where it would be further reduced in size before being transferred to a thickener (**Plate 10**) where excess water would be removed and returned to the flotation plant for reuse.



Source: Big Island Mining Pty Ltd

Figure 8
SIMPLIFIED PROCESS FLOW CHART

- The CIL Plant would comprise a series of eight leach and adsorption tanks (**Plate 8**).
- The thickened concentrate would be pumped to Tank 1 and mixed with lime, sodium cyanide solution and other reagents as required. pH within the slurry would be maintained at approximately 9.5 to prevent the volatilisation of HCN.
- The concentrate slurry would be permitted to flow sequentially from Tank 1 to Tank 8. During this process, the gold would be leached from the concentrate into solution.
- Activated carbon granules (**Plate 9**) would be added to Tank 8 and would flow in the opposite direction to the concentrate slurry, namely from Tank 8 to Tank 1. The dissolved gold would be progressively recovered from the

solution through adsorption onto pores of the activated carbon. The loaded or gold-bearing carbon would be removed from Tank 1 and pumped to the elution circuit.

– Tailings from the CIL Plant would be pumped to a thickener where process water, including reagents, would be removed and recycled back to the CIL Plant. Thickened concentrate tailings would then be pumped to the cyanide destruction plant.

- The cyanide destruction plant would utilise the Inco detoxification process.
  - Thickened concentrate tailings would be pumped to a mixing tank where sodium metabisulphite and copper sulphate would be added and air or oxygen would be sparged or bubbled through the solution. This process results in free and WAD cyanide reacting to form cyanate (OCN^-) which precipitates as insoluble metal-iron-cyanide complexes. Residual metals liberated as part of the detoxification process are precipitated as their hydroxides (ToxConsult, 2015b). The Proponent would ensure that the WAD cyanide concentrations in the liquid fraction of tailings discharged from the cyanide destruction circuit would be less than the criteria identified in the EPA's *Sodium Cyanide Policy*, namely:
    - less than 20mg/L 90% of the time; and
    - less than 30mg/L at all times.
  - The concentration of WAD cyanide would be tested through an inline analyser and cross checked with manual sampling and testing multiple times per day to ensure that the relevant discharge criteria are achieved. Following testing, the concentrate tailings would be pumped to the Tailings Storage Facility. Concentrate tailings would not be used in the paste fill plant and would not be permitted to be placed into underground stopes.
  - CSIRO undertook test work on the efficiency of the proposed cyanide destruction process. The resulting report, referred to as CSIRO (2014) is presented in **Appendix 5**. That assessment determined that WAD cyanide concentrations of substantially less than 20mg/L may be obtained, with the final concentration dependent on the rate of addition of reagents to the cyanide destruction circuit. In addition, that test work confirmed that the cyanide destruction reactions continued following completion of the test work as a result of residual sodium metabisulphite and copper sulphate in the tailings stream. The Proponent would manage the cyanide destruction circuit to achieve the WAD cyanide concentrations identified above on discharge from the cyanide destruction circuit.
- The Elution Circuit would comprise a number of storage tanks, as well as an elution column.
  - Initially, loaded carbon, with its adsorbed gold, would be rinsed and subjected to an acid wash to remove unwanted impurities.

- – Following rinsing and washing, the loaded carbon would be pumped to an elution column where it would be heated to 110ºC and strong, highly alkaline cyanide solution would be added under pressure. The adsorbed gold would be redissolved into solution, and pumped to an electrowinning cell within the gold room.
- – Carbon, with its gold removed, would be reactivated and returned back to the CIL plant for reuse in the process.

- The gold room would comprise one or more electrowinning cells, a calcine oven, a furnace and associated moulds, a secure storage for doré and ancillary infrastructure.
  - – The gold-bearing solution from the elution tank would be pumped to an electrowinning cell where the gold would be electroplated from the solution onto cathode plates or steel wool.
  - – The electroplated gold-bearing material, together with the gravity concentrate from the gravity circuit would then be placed into a calcine oven where volatile components would be removed.
  - – Following calcining, the remaining material would be mixed with fluxes and placed into a furnace where it would be heated to form a liquid (**Plate 11**). The contents of the furnace would be poured into a series of moulds and the doré, or unrefined gold bars would be placed into secure storage pending transportation off site (**Plate 12**). The resulting slag would be returned to the crushing and grinding circuit and reprocessed to recover any remaining gold.
  - – Gasses produced by the electrowinning cells, calcining oven and furnace would be captured and passed through the approved scrubber before being released to the atmosphere (**Plate 11**). All gasses released from gold room would comply with the requirements for emissions for Group 6 non-ferrous metal facilities identified in Schedule 3 of *Protection of the Environment Operations (Clean Air) Regulation 2010.*

The Proposed Modification would not result in changes to the water demand or water budget for the Project.

2.5.4.4 Project-specific Cyanide and Reagent Management

Hazardous Materials Risk Assessment

Table 8 presents a list of reagents that were identified in RWC (2010a) for use in the Flotation Plant. **Table 8** also presents the additional chemicals that would be required for the proposed processing operations.

Table 8
Indicative Processing Reagents and Chemicals

Reagent/Chemical	Purpose	Delivery Method	Reagent Form
Reagents Identified in Table 2.5 of RWC (2010a)			
Copper Sulphate Pentahydrate	Flotation Activator	25 kg Bags	Blue Crystals or Powder
Potassium Amyl Xanthate	Flotation Collector	25kg Bags	Powder
IF6500	Flotation Frother	Integrated Bulk Container (nominally 1 000L capacity)	Liquid
MF351	Flocculant	25kg Bags	powder
Nitric Acid	Concentrate filter cleaning	Integrated Bulk Container (nominally 1 000L capacity)	Liquid
LPG	Gold room furnace	Bulk 2.3t tank	Liquefied gas
Additional Proposed Reagents			
Sodium Cyanide	Leaching of gold	22t Isotainers	Solid Briquettes
Lime	pH management	Bulk 10t silo	Powder
Caustic	pH management	$1m^3$ IBC	Liquid
Sodium Metabisulphite	Cyanide destruction	1t Bulka bags	powder
Oxygen	Leaching of gold	$60m^3$ bulk tank	Liquefied gas
Hydrogen chloride	Elution	$1m^3$ IBC	Liquid
Source: Big Island Mining Pty Ltd			

Appendix 6 presents a risk screening for the previously identified and proposed reagents identified in **Table 8.** That assessment has been undertaken in accordance with the requirements of the following documents.

- *Applying SEPP 33* published by the NSW Department of Planning in January 2011.
- *Hazardous Industry Planning Advisory Paper No 3 – Risk Assessment 33* published by the NSW Department of Planning in January 2011.

Based on the risk screening, sodium cyanide is the only reagent for which a Preliminary Hazard Analysis is required. **Appendix 6** also provides a Risk Classification and Prioritisation Assessment, as well as a qualitative risk analysis for transportation, storage, use and disposal.

The following subsections provide a description of the Project-specific management measures that would be implemented by the Proponent during the transportation, storage, use and disposal of cyanide. These measures have been broadly arranged to reflect the principles of the Cyanide Code (See Section 2.5.3) and have been considered during the Preliminary Hazard Analysis and should be read in conjunction with the generic, industry standard measures identified in Section 2.5.2.6.

Cyanide Production

The Proponent would purchase sodium cyanide only from producers who are signatories to the Cyanide Code and who are able to demonstrate appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

Cyanide Transportation

Consistent with industry practice, the Proponent would rely on the supplier of sodium cyanide to obtain all relevant approvals to transport the material from the manufacturing facility to the Project Site. The supplier would also be responsible for transferring the solid sodium cyanide to the on-site storage tank. The Proponent would assume responsibility for managing the sodium cyanide solution from that point.

The following, however, provides a brief description of how one supplier, namely Orica, transports and transfers sodium cyanide to its customers.

- Sodium cyanide is manufactured as briquettes mixed with caustic to ensure that that the pH of the material remains above 9.5 and the potential for the generation of HCN is limited.
- Sodium cyanide briquettes are loaded into 22t isotainers and placed on a semitrailer driven by an operator who has received specific and detailed training the management of dangerous goods, including cyanide. The isotainers are designed to maintain their integrity in the event of a road accident. Orica advises that that they have not had a single transportation-related discharge of cyanide using this system in the 20 years since it was introduced.
- All trucks would travel from the production facility to the customer’s site via an approved route that has been the subject of a risk assessment and approval process from the relevant road authorities.
- On arrival at the customer’s site, the operator parks the semitrailer in a bunded area adjacent to the cyanide storage tank. The two hoses are then connected and water is transferred into the isotainer from an on-site source. The water is then circulated until the solid sodium cyanide has dissolved and it is transferred to a bunded, on-site storage tank.
- The empty isotainer is then removed from the Project Site and returned to the manufacturer’s production facility for reuse.

The Proponent anticipates that between four and six deliveries per year of sodium cyanide would be required.

Cyanide Storage

The Proponent would implement the following storage-related cyanide management measures. The following Project-specific management measures, as well as the usage and disposal-related management measures, would be embodied in an updated *Hydrocarbon, Chemical and Reagent Management Plan* that would be prepared in consultation with industry experts, the DRE, EPA and DPE.

- Ensure sodium cyanide is stored (and used) in accordance with Australian Standard AS4452 *The Storage and Handling of Toxic Substances.*
- Ensure that the cyanide-containing storage tank is fully bunded, with the capacity of the bund at least 110% of the largest storage tank (**Plate 6**).
- Fit the storage bund with a blind sump and pump which would transfer accumulated rain water or cyanide solution in the event of a spill, to the CIL plant.

- Fence and lock the storage tank and ensure that access is only permitted to authorised, trained and properly equipped personnel.
- Ensure that the storage tank is alarmed, under video surveillance and is continuously monitored to ensure no unauthorised access.
- Install HCN alarms to detect generation of HCN and ensure that a procedure exists to evacuate all personnel in the event that the alarm is triggered.
- Ensure that the storage tank and all pumps, pipes and fittings are inspected regularly and maintained as per the manufacturers' instructions and replaced as required.

Cyanide Usage

The Proponent would implement the following usage-related cyanide management measures.

- Ensure that the cyanide solution is transferred from the storage tank to the leach tanks via suitable pipes and that all such pumps, pipes and fittings are inspected and maintained as per the manufacturer's instructions and replaced as required.
- Ensure that the leach tanks and any other tank, or container holding cyanide solution, is contained within a sealed and bunded area with a storage capacity of at least 110% of the capacity of the largest tank and has splash guarding installed (as required by AS4452 *Storage and Handling of Toxic Substances*). It is noted that Section 5.7.2 of AS4452 requires that the capacity of bunding be sufficient to contain the capacity of all containers within the bunded area, not just the largest container. This, however, only applies where the materials may be classified as Packing Group I or the tanks are interconnected, namely where leakage from one tank could lead to the emptying of others. In the present case, the leach tanks would not be interconnected, with flows between tanks requiring the leach solution to be pumped. In addition, the leach solution is not classified as a Packing Group I substance because the solution is not intended to be transported and because leach solutions have not been so classified for other CIL plants in NSW. Finally, it is noted that the risk of catastrophic or multi-tank failure of the leach circuit is negligible, with the Proponent determining that some external event such as a direct impact by an aircraft required to cause such an event.
- Ensure that all bunded areas include a blind sump and are fitted with suitable pumps or other mechanisms to transfer any spilt material to the processing circuit.
- Ensure, notwithstanding the negligible risk of multi-tank failure of the leach tanks, that surface water drainage within the processing plant is isolated from natural drainage under all circumstances. In the event of a catastrophic or multi-tank failure of the cyanide containment system discharged solutions would report initially to the Process Water Pond, then the ROM Pad Collection Basin and finally the box cut to prevent discharge of cyanide containing solutions to Spring Creek.

- Ensure that automated pH monitors are installed within the leach tanks to detect if the pH drops below 9.5.
- Test the cyanide concentration within the leach solution regularly and adjust the rate of application to ensure that optimum concentration is maintained.
- Install fixed and provide personnel HCN gas detectors and ensure that such detectors are designed to alert personnel if relevant concentrations of HCN gas are detected.
- Ensure that critical components of the processing plant are inspected regularly (multiple times per shift) and monitored automatically, with alarms and automatic shutdowns, as required, and that emergency response plans and procedures are developed and plant operators are trained in their implementation.
- Ensure that standard operating procedures consider the risk of unplanned discharge of cyanide-containing solutions.

Cyanide Disposal

The Proponent would implement the following disposal-related cyanide management measures.

- Ensure that all cyanide-containing solutions are treated using the cyanide destruction circuit and that the WAD cyanide concentration on discharge from the cyanide destruction circuit is reduced to:
  - less than 20mg/L 90% of the time; and
  - less than 30mg/L at all times.
- Undertake in line and routine monitoring of WAD cyanide concentrations to demonstrate compliance.
- Ensure that the tailings pipe from the processing plant to the Tailings Storage Facility, the return decant pipe and the paste fill pipe are appropriately designed, constructed, inspected (multiple times per shift) and tested in accordance with the manufacturers' instructions.
- Ensure that the tailings and decant pipes are fitted with multiple leak detection systems and automated pump shut offs in the event of a pipe failure. These leak detection systems may include load indicators on pumps, linked flow metres or direct leak detection systems.
- Construct the tailings, decant and paste fill pipes within a bunded corridor with sufficient capacity to store 110% of the volume of the largest pipe from the discharge point at the processing plant to the invert at the Tailings Storage Facility.
- Test water within the supernatant pond regularly to ensure that relevant WAD cyanide criteria are achieved within the pond (see Section 2.6.6.4).
- Inspect the Tailings Storage Facility regularly (multiple times per day) for leakage or discharge of supernatant water.

- Implement a procedure to:
  - monitor fauna usage of the Tailings Storage Facility;
  - rescue any fauna that may become stuck or bogged in the Tailings Storage Facility;
  - record and investigate any fauna deaths on or immediately surrounding the Project Site; and
  - remove deceased fauna from the Tailings Storage Facility and surrounds promptly to prevent attraction of other animals.
  - Update the *Water Management Plan* to include monitoring of groundwater and surface water within and surrounding the Project Site for WAD cyanide concentrations.

Decommissioning

The Proponent would implement the following decommissioning-related cyanide management measures.

- Prepare a mine closure concept plan as part to the *Mining Operations Plan* to be prepared for the Project. This would include detailed decommissioning activities for the processing plant, including all cyanide storage and handling infrastructure, the leach circuit and the Tailings Storage Facility.
- Undertake a detailed and ongoing monitoring and reporting program to assure relevant government agencies and the surrounding community that the Project has been safely and fully decommissioned.

Safety, Emergency Response, Training and Dialogue

The Proponent would implement the following management measures.

- Fully comply with the requirements of the *Mine Health and Safety Act 2004* and the *Work Health and Safety Act 2011* to protect workers and other persons against harm to their health, safety and welfare through the elimination or minimisation of risks arising from the transportation, storage, use and disposal of cyanide.
- Update the current *Emergency Response Plan* and *Pollution Incident Response Management Plan* to reflect the transportation, storage, use and disposal of cyanide within the Project Site.
- Ensure that all persons working on the Project Site receive appropriate training in the management of cyanide, including emergency response management.
- Ensure that ongoing community engagement includes information in relation to ongoing management of cyanide within the Project Site, including the results of monitoring programs.
- Provide an opportunity for the community to raise issues of concern and provide feedback in relation to those concerns.

General Reagent Management Measures

In addition to the above cyanide-specific management measures, many of which would also apply to other reagents, the Proponent would continue to implement the following general reagent management measures

- Ensure that reagent suppliers are required to transport all reagents in accordance with *Australian Code for Transportation of Dangerous Goods by Road and Rail.* Implementation of the Code would be the responsibility of the reagent supplier and transportation contractor.
- Store and use all reagents in accordance with the manufacturers' instructions and the relevant Material Safety Data Sheets.
- Store and handle all reagents classified as "toxic chemicals" in accordance Australian Standard AS 4452 *The Storage and Handling of Toxic Substances.*
- Store all liquid reagents within a bunded area with a capacity of at least 110% of the capacity of the largest container.
- Store all solid reagents in a sealed area under cover (**Plate 7**). Storage of cyanide solution is described more fully in Section 2.5.4.4.
- Ensure that reagents are not stored with incompatible chemicals or chemicals that may cause a reaction in the event of a reagent spill.
- Ensure that only the minimum volume of reagents required for the ongoing operation of the Project are stored within the Project Site.
- Ensure that Material Safety Data Sheets and appropriate spill management equipment would be available in the vicinity of all reagent storage areas.
- Ensure that the *Hydrocarbon, Chemical and Reagent Management Plan*, including emergency management procedures, is updated to include the additional reagents to be used within the Project Site and implement the Plan throughout the life of the Project.

2.6 TAILINGS MANAGEMENT

2.6.1 Introduction

Knight Piésold have prepared a detailed design for the enlarged Tailings Storage Facility. The design is described in a report entitled *Tailings Storage Facility – Final Design Update* dated June 2015. That report is referred to hereafter as Knight Piésold (2015) and is presented as **Appendix 7.** This subsection provides an overview of the proposed modified design of the Tailings Storage Facility, including the modified tailings composition and management measures that would be implemented as a result of the Proposed Modification.

2.6.2 Volume of Tailings to be Stored

As identified in Section 2.7.3 of RWC (2010a), the Proponent initially anticipated that the Project would produce approximately 800 000t of tailings. As a result, the approved Tailings Storage Facility capacity of approximately 900 000t was considered to be sufficient.

During the initial modification of the Project Approval (MOD1), approval was sought and obtained for the use of paste fill, reducing the volume of tailings required to be placed at the surface, potentially resulting in a slightly smaller Tailings Storage Facility.

The Proposed Modification would, however, result in the requirement to store the following additional material.

- Approximately 0.4Mt of additional ore associated with the proposed increase in total production from 1.2Mt to 1.6Mt of ore (see Section 2.2).
- Approximately 0.18Mt of gold concentrate tailings that would be processed within the Project Site rather than off site.

Taking into account the approved paste fill operations which would result in a proportion of the flotation tailings being returned to completed voids, the Proponent anticipates that the modified Project would require capacity to store approximately 1.22Mt of tailings.

2.6.3 Characteristics of the Tailings Streams

2.6.3.1 Introduction

The Proposed Modification would result in the generation of two separate tailings streams, namely a flotation tailings and a concentrate tailings. The following sub-sections describe each tailings stream separately, as well as the combined tailings stream.

2.6.3.2 Flotation Tailings

Approximately 90% of the tailings to be placed within the TSF would be flotation tailings. This material would comprise ground ore material with the coarse gold and gold-bearing minerals removed. These tailings are consistent with that described in RWC (2010a) and would remain unchanged as a result of the Proposed Modification.

Table 9 presents the results of a multi-element analysis of the flotation tailings and compares those results with average crustal abundance of each analysed element and the geochemical abundance index. The geochemical abundance index is a measure of the enrichment of particular elements compared to the average crustal abundance, with higher numbers indicating greater enrichment.

In summary, the flotation tailings would be relatively enriched in silver, boron, molybdenum and antimony. However, each of these elements would be bound in the structure of the minerals that form the flotation tailings and would be unlikely to be available to be mobilised into the environment.

Table 9
Flotation Tailings Composition

Element	Unit	Multi-Element Analysis Result	Average Crustal Abundance	Geochemical Abundance Index
Ag	ppm	0.45	<1.0	2
Al	ppm	82 890	82 000	0
As	ppm	<2	2	0
B	ppm	<50	10	2
Ba	ppm	334	500	0
Be	ppm	2.7	3	0
Ca	ppm	34 771	41 000	0
Cd	ppm	0.1	0.1	0
Co	ppm	4.1	20	0
Cr	ppm	159	100	0
Cu	ppm	48	50	0
F	ppm	976	950	0
Fe	ppm	14 800	41 000	0
Hg	ppm	0.1	0.1	0
K	ppm	19 222	21 000	0
Mg	ppm	6 298	23 000	0
Mn	ppm	630	950	0
Mo	ppm	25	2	3
Na	ppm	30 025	23 000	0
Ni	ppm	125	80	0
P	ppm	712	1 000	0
Pb	ppm	6	14	0
Sb	ppm	3.8	0.2	4
Se	ppm	0.06	0.1	0
Sn	ppm	3.3	2	0
U	ppm	3.13	2	0
V	ppm	88	160	0
Zn	ppm	34	190	0
Source: RWC (2012a) – Table 3.				

In addition, analysis of two composite flotation tailings samples undertaken by Independent Metallurgical Operations during the initial planning stages for the Project indicated nett acid production potential, namely the difference between the amount of acid that a sample may produce and the neutralising capacity of carbonate and other minerals in the sample, of negative 108.98kg/t H_2SO_4 and negative 113.41kg/t H_2SO_4. This indicates that the flotation tailings is acid consuming, with the potential to neutralise approximately 110kg of H_2SO_4 per tonne of flotation tailings.

2.6.3.3 Concentrate Tailings

Approximately 10% of the tailings to be placed within the Tailings Storage Facility would be concentrate tailings. This material would be comprised of concentrate following the completion of leaching operations and would be largely composed of pyrite and a mixture of other silicate and sulphide minerals. **Table 10** presents a multi-element analysis of the concentrate tailings. In summary, the concentrate would have highly elevated concentrations of iron and sulphur, reflecting the abundance of pyrite (FeS_2) in the material. A range of other trace elements would also be enriched.

Table 10
Concentrate Tailings Composition

Element	Unit	Multi-Element Analysis Results	Average Crustal Abundance	Geochemical Abundance Index
Ag	ppm	2	0.07	4
Al	ppm	17 982	82 000	0
As	ppm	114	1.5	6
B	ppm	110	10	3
Ba	ppm	91	500	0
Be	ppm	0.45	2.6	0
Bi	ppm	178	0.048	6
Ca	ppm	3 662	41 000	0
Cd	ppm	0.35	0.11	1
Cl	ppm	200	130	0
Co	ppm	338	20	3
Cr	ppm	655	100	2
Cu	ppm	1 611	50	4
F	ppm	237	950	0
Fe	ppm	371 650	41 000	3
Hg	ppm	1.46	0.05	4
K	ppm	5 460	21 000	0
Mg	ppm	3 208	23 000	0
Mn	ppm	178	950	0
Mo	ppm	89	1.5	5
Na	ppm	5 135	23 000	0
Ni	ppm	421	80	2
P	ppm	257	1 000	0
Pb	ppm	76	14	2
S	ppm	435 600	260	6
Sb	ppm	1.4	0.2	2
Se	ppm	33	0.05	6
Sn	ppm	2.3	2.2	0
Sr	ppm	36	370	0
Th	ppm	16	12	0
U	ppm	3.7	2.4	0
V	ppm	39	160	0
Zn	ppm	22	75	0
Source: Knight Piésold (2015)				

Knight Piésold undertook an acid base accounting analysis of the tailings material and determined that the concentrate tailings would be potentially acid forming, with an acid producing potential of 1 315kg/t of H_2SO_4 of concentrate tailings.

2.6.3.4 Combined Tailings Stream

During operation of the processing plant, two distinct tailings streams would be produced as follows.

- Combined tailings stream – when the paste fill plant is not operational, the flotation and concentrate tailings streams would be pumped to the Tailings Storage Facility using the same pipe, effectively combining the two classes of tailings in the ratio of 10:1.
- Concentrate tailings stream – during operation of the paste fill plant, the majority, if not all of the flotation tailings would be diverted to the paste fill plant. As a result, the tailings stream that would be pumped to the Tailings Storage Facility would be largely concentrate tailings.

The Proponent anticipates that the paste fill plant would operate intermittently. As a result, tailings deposited within the Tailings Storage Facility would comprise alternating layers of combined flotation and concentrate tailings, and concentrate tailings. These layers would be evenly distributed through the Tailings Storage Facility.

Based on the acid neutralisation and generation capacity of each tailings stream and the relative proportions of each, the Proponent anticipates that the combined tailings would be potentially acid generating as follows:

- 10t of flotation tailings at -110kg/t H_2S0_4 = -1 100kg H_2S0_4.
- 1t of concentrate tailings at 1 315kg/5 H_2S0_4 – 1 315kg H_2S0_4.
- Nett Acid Generation capacity = 315kg H_2S0_4 or 28.6kg/t H_2S0_4.

2.6.4 Consequence Category for the Enlarged Tailings Storage Facility

Knight Piésold (2015) undertook an assessment of the consequence category for the enlarged Tailings Storage Facility based on the following guidelines.

- *DSC3A – Consequence Categories for Dams* and *DSC3F – Tailings Dams* published by the Dams Safety Committee of New South Wales.
- *Guidelines on the Consequence Categories for Dams* published by the Australian National Committee on Large Dams.

That assessment determined that the enlarged Tailings Storage Facility would have a consequence category in the event of a failure of the embankment of “High C,” an increase on the consequence category for the approved facility of “significant.” This classification has been used to determine the design criteria for the facility.

2.6.5 Design Criteria and Construction

2.6.5.1 Overview

Knight Piésold (2015) presents detailed description of the design of the enlarged Tailings Storage Facility. In summary, however, **Table 11** presents the design criteria for the facility based on the above guidelines and **Figure 9** presents an overview of the final layout. The following subsections provide a more detailed description of critical components of the design of the facility.

Table 11
Modified Tailings Storage Facility Design and Operational Criteria

Design Component	Approved Facility	Modified Facility
Final storage capacity	0.9Mt	1.22Mt
Maximum area (including embankment)	9.0ha	16ha
Anticipated number of lifts	3	5
Maximum embankment elevation	709m AHD 25m above natural surface	716m AHD 32m above natural surface
Construction methodology	Upstream	Downstream
Crest width	6m	6m
Average slope of the embankment	1:3 (V:H)	1:3 (V:H)
Embankment volume	172 000m^3	670 000m^3
Structural zone material	Waste rock	Waste rock
Liner material	Engineered clay liner	Engineered clay liner plus HDPE liner
Liner permeability	1 x 10^{-8}m/s over 600mm	1 x 10^{-9}m/s over 900mm or equivalent
Cut off trench	Yes	Yes
Underdrainage	Yes	Yes
Leachate collection system	Yes	Yes
Tailings discharge location	Embankment crest	Embankment crest
Decant tower location	Upstream	Upstream
Stormwater storage without discharge	-	1 in 1 000 year 72-hour[1]
Emergency spill way	Yes	Yes
– Capacity during operation	-	1 in 100 000 year 72-hour
– Capacity during post closure	-	Maximum probable Flood
Note 1: Exceeds guideline requirements by 10 times		
Source: Knight Piésold		

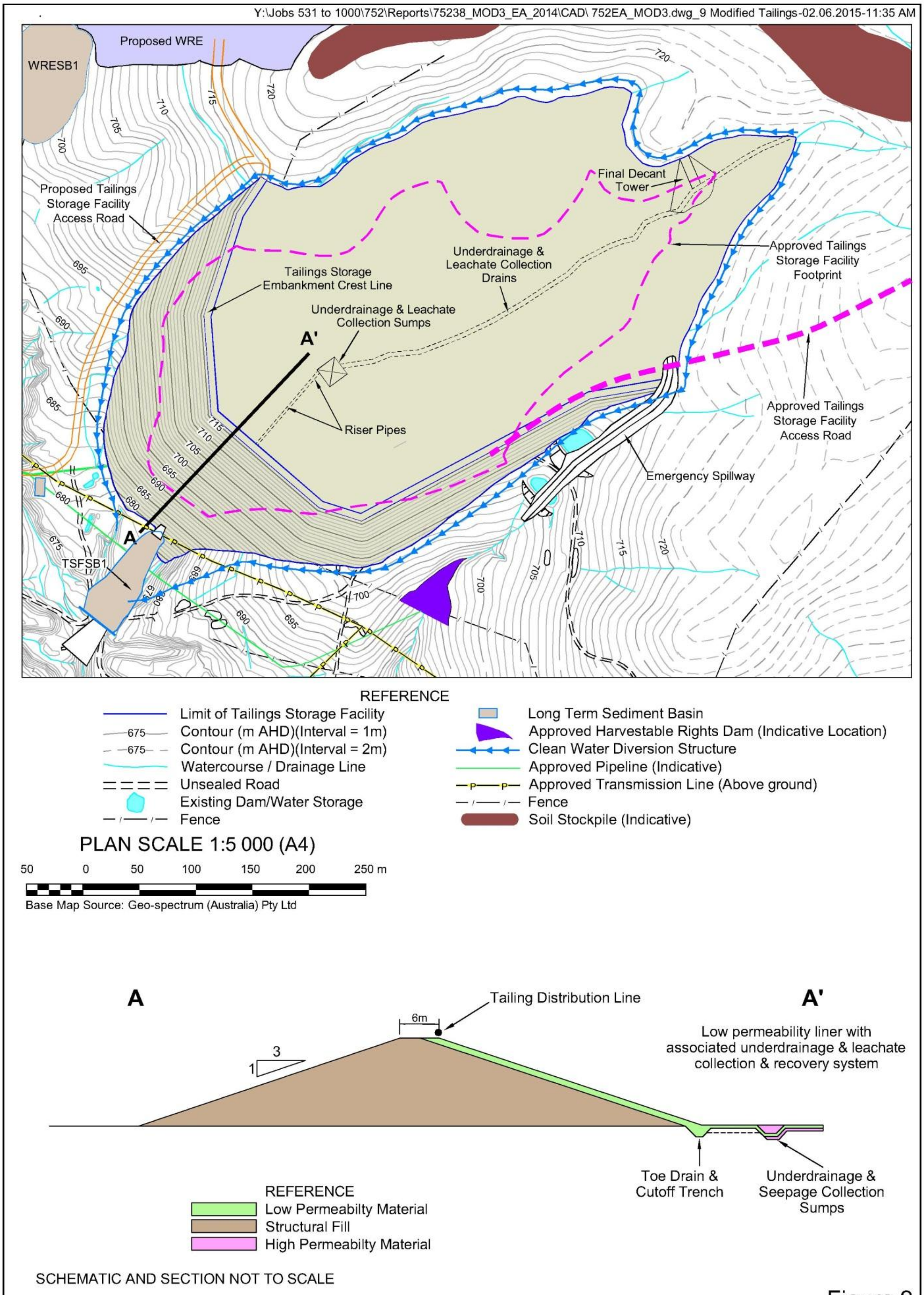


Figure 9
MODIFIED TAILINGS STORAGE FACILITY LAYOUT

2.6.5.2 Tailings Storage Facility Embankment

Design of the Embankment

The design and construction the embankment of the facility would be largely consistent with the design and construction of the approved embankment. Drawings 801-139-A201-021 and 801-139-A201-222 of Knight Piésold (2015) provide a detailed description of the design of the Tailings Storage Facility embankment. In summary, however, the embankment would be constructed with two zones; a structural zone (referred to by Knight Piésold (2015) as Zone C) which would comprise material excavated from within the footprint of the Tailings Storage Facility, as well as waste rock bought to surface from the underground mine. The structural zone material would provide the structural integrity for the embankment. The inner face of the embankment would be lined with a low permeability liner (referred to by Knight Piésold (2015) as Zone A) which is described in more detail in the following subsection.

The embankment would be constructed in five lifts or stages using a downstream construction methodology. **Table 12** presents the anticipated staging of the lifts.

Table 12
Staged Embankment Design

Stage	Cumulative Tailings Capacity (t)	Embankment Design Crest (m AHD)
1	233 106	704.0
2	504 348	709.0
3	827 805	712.5
4	1 016 057	714.5
Final	1 213 601	716.0
Source: Knight Piésold (2015)		

Sediment and Erosion Control during Construction

In recognition of a range of issues that have previously arisen in relation to sediment and erosion control within the Project Site (see Section 1.4.8.3), the Proponent engaged SEEC to prepare a detailed *Erosion and Sediment Control Plan* for the construction of Stage 1 of the Tailings Storage Facility embankment until the facility becomes internally draining. A copy of that plan is presented in **Appendix 2** and is referred to hereafter as SEEC, 2015d**.**

SEEC (2015d) includes detailed recommendations regarding the staging, design, construction and management of erosion and sediment controls for the facility. In summary, the following would be implemented prior to construction of Stage 1 of the facility embankment commencing.

- Install barrier fencing to delineate the work area and limit the potential for inadvertent ground disturbance.
- Install sediment fencing as appropriate downslope of all areas to be disturbed prior to construction commencing.
- Construct clean water diversions upslope of the Stage 1 basin.

- Install Sediment Basin TSFSB01 downslope of the toe of the Stage 1 Tailings Storage Facility embankment (**Figure 9** and Drawing ESCP04 of SEEC (2015d)), including stabilised outlets.
- Install dirty water diversions downslope of all disturbance areas to divert potentially sediment-laden water into TSFSB01.
- Install temporary Sediment Basins TSFSB02 and TSFSB03 within the footprint of the Tailings Storage Facility (see ESCP04 of SEEC (2015d)).

Table 13 presents the indicative capacity of each of the Sediment Basins. Gypsum would be ripped into the inlet, floor and outlet of each of the sediment basins to assist with settlement of suspended sediment

Table 13
Sediment Basin and Spillway Design Criteria

Basin[1]	Sediment Storage Volume (m^3)	Settling Volume (m^3)	Total Basin Volume (m^3)
TSFSB1	865	955	1 860
TSFSB2	813	688	1 501
TSFSB3	813	688	1 501
Source: Modified after SEEC (2015d) - Table 4			

During construction of the initial components of Stage 1 of the Tailings Storage Facility, the Proponent would ensure that the following are implemented.

- Ensure that slope lengths during rainfall events are no more than 100m.
- Ensure that water that accumulates within the sediment basins is used for mining-related purposes or treated, tested and discharged from the basins within 5 days. In the event, for whatever reason, appropriate water quality is not able to be achieved, water within the sediment basins would be removed and used for Project-related purposes such as conditioning of the clay liner or irrigated to land, with measures implemented to ensure that that water is not able to enter a watercourse.
- Ensure that accumulated sediment within each of the sediment basins is removed before the volume exceeds the sediment storage volume identified in **Table 13**.
- Ensure that disturbed areas are stabilised as described in Table 1 of SEEC (2015d) through the use of a soil binding polymer or other covering.

2.6.5.3 Seepage Control

Seepage from the facility has been previously identified as an issue of concern for the community. Knight Piésold (2015) note that the seepage control mechanisms associated with the Project would include the following. The seepage control system is shown on Drawings 801-139-A201-050 to 801-139-A201-054 of Knight Piésold (2015).

- A cut-off trench.

  A cut-off trench would be excavated into the foundation of the Stage 1 embankment. The trench would be excavated to between 2m and 3m in depth and would be approximately 4m wide at the base. The trench would be backfilled with layered and compacted low permeability material. The trench would act to prevent water seeping under the foundation of the embankment.

- A leakage collection drain and sump.

  A leakage collection drain would be constructed at the base of the valley within the facility basin area, under the low permeability liner to intercept seepage through the liner during operation. The drain would comprise a 50 mm perforated draincoil pipe in a 1m deep, sand filled trench.

  The leak collection drain would feed into a gravel-filled leak collection sump which would be fitted with a riser pipe that would run up the inner face of the embankment under the low permeability liner. The riser pipe would be equipped with a submersible pump and would pump water from the sump to the surface where it would be discharge into the Tailings Storage Facility for return to the processing plant via the decant pond.

- A combination low permeability soil and HDPE liner.

  The basin of the facility would be reshaped to achieve a relatively smooth base with slopes of 1:3 (V:H) or less. The remaining *in situ* clay materials would be conditioned and compacted to achieve a target permeability of 3×10^{-8}m/s. This liner would then be overlain with a 1.5mm HDPE liner to form a composite liner system.

- A basin underdrainage collection system and sump.

  The proponent would install a underdrainage collection system to allow interstitial water within the tailings to be removed, reducing the pore pressure on the basin liner and thereby reducing seepage through the liner. Dewatering of the tailings has the added benefit of increasing tailings density and strength.

  The underdrainage system is shown on Drawings 801-139-A201-050 to 801-139-A201-054 of Knight Piésold (2015) and would consist of the following.

  – A collector drain along the main drainage line. The drain would comprise a 7m wide, 300mm thick sand layer covered by waste rock with four 160mm draincoil pipes. The collector drain and pipes would feed would transfer interstitial water from the base of the tailings to the underdrainage collector sump, with the sand and waste rock intended to act as drainage medium even if the draincoil pipes become blocked.

– Branch and finger drains that would be spaced at nominal 25m centres to collect interstitial water from tailings throughout the Tailings Storage Facility basin and permit that water to flow to the collector drain. These drains would comprise a 100mm draincoil pipe, surrounded by sand covered with a geotextile fabric.

– A toe drain would be constructed adjacent to the upstream toe of the embankment. The toe drain would drain interstitial water from tailings adjacent to the embankment, maximising the strength of those material and the stability of the embankment. The drain would comprise a 160mm draincoil pipe within 300mm of sand covered by geotextile.

– An underdrainage collection sump would be constructed against the upstream toe of the embankment to collect interstitial water from the collector drain and the toe drain. This sump would be fitted with a riser pipe that would run up the inner face of the embankment. The riser pipe would be equipped with a submersible pump and would pump water from the sump to the surface.

Additional measures that may be implemented in the event that the proposed seepage management measures do not operate as designed would include a seepage interception trench located downslope of the Tailings Storage Facility embankment and/or seepage recover bores. These measures would be installed only if monitoring identifies unacceptable levels of seepage from the facility.

Finally, Knight Piésold (2015) undertook an assessment of the anticipated seepage from the proposed facility. In summary, two scenarios were modelled as follows.

- Seepage from the facility assuming that the above seepage management measures operate as designed. Knight Piésold (2015) determined that the expected seepage rate would be 0.031L/s, equivalent to a basin permeability of 3.2×10^{-10}m/s.
- Seepage from the facility assuming that the above seepage management measures are non-operational. Knight Piésold (2015) determined that the expected seepage rate would be 0.187L/s, equivalent to a basin permeability of 2.0×10^{-9}m/s.

2.6.5.4 Emergency Spillway

The conditions under which the Tailings Storage Facility would overtop has previously been identified as an issue of concern for the community. The Tailings Storage Facility would contain rainfall events up to and including an annual exceedance probability (AEP) event of 1 in 1 000 years without discharge. Indeed, during much of the life of the facility, the available stormwater capacity would significantly exceed the volume required to contain a 1 in 1 000 year AEP event.

Notwithstanding the above, in the event that a rainfall event that exceeds the design criteria, potential exists for overtopping of the facility. In order to ensure that the facility embankment is not damaged through an uncontrolled discharge, the Proponent would construct engineered spillway to safely convey water from the facility to Spring Creek. **Figure 9** presents the general layout of the final spillway, with Drawings 801-139-A201-060 and 801-139-A201-061 of Knight Piésold (2015) providing further design details.

An emergency spillway would be constructed for each stage of the facility, with the spillway during the operational life of the facility designed to cater for a 1 in 100 000 year AEP rainfall event. Following decommissioning, the spillway would be deepened, widened and extended into the facility to ensure sufficient capacity to cater for a Maximum Probable Flood rainfall event.

2.6.5.5 Structural Integrity of the Embankment

The seismic events that the Tailings Storage Facility embankment has been designed to withstand has previously been identified as an issue of concern for the community.

The Proponent notes that the Tailings Storage Facility would continue to be a prescribed dam under the *Dams Safety Act 1978*, with a significance category of "High C." Knight Piésold (2015) undertook an assessment of the stability of the Tailings Storage Facility embankment under worst case operating scenarios and a 1 in 10 000 year return period maximum design earthquake. That assessment determined that the embankment would be stable under both static and post seismic loadings based on comparison with the Australian National Committee on Large Dams minimum factors of safety.

2.6.6 Operation of the Facility

2.6.6.1 Tailings Placement

The concentrate tailings would typically be co-deposited with the flotation tailings. Mixing of these tailings streams would occur at the processing plant and the streams would be pumped to the Tailings Storage Facility in the same pipeline. However, during operation of the paste fill plant, a proportion (or potentially all) of the flotation tailings would be used for paste fill. As a result, during those periods, it would be primarily concentrate tailings that would be deposited into the Tailings Storage Facility. As a result, tailings within the facility would typically comprise thin layers of concentrate tailings interspersed with slightly thicker layers of mixed concentrate and flotation tailings.

Tailings would be discharged to the modified facility in the same manner as for the approved facility, namely, via a series of spigots located on the crest of the embankment. Deposition would occur up the valley, forming a beach of tailings against the embankment, with the supernatant water forming a pond in the vicinity of the decant tower (**Figure 9**). Accumulated water would be pumped back to the processing plant for reuse. The tailings deposition method and facility operation would ensure that the final tailings density is improved by deposition and drying.

Measures to be implemented to manage environmental risks associated with the disposal of cyanide within the facility are described in Section 2.5.4.4.

2.6.6.2 Management of Supernatant Water

Supernatant water, namely water that separates from the tailings and flows to the supernatant pond, would flow across the tailing beach to the supernatant pond from where it would be pumped back to the processing plant for reuse. This subsection describes the management of that water. The following subsection describes management of cyanide concentrations within that water.

Knight Piésold (2015) identify that the operational volume of the supernatant pond would be approximately 5ML or 5 000m^3. In order to determine the amount of water that would return to the processing plant, as well as the likely volume of the supernatant pond during the life of the facility, Knight Piésold undertook a facility water balance under the following four climatic scenarios. In each case, the relevant climatic conditions were assumed to occur in each year of operation of the facility. For example, to the 1 in 100 year AEP wet scenario, monthly rainfall figures for the wettest year in 100 years were repeated for each year of operation.

- Average climatic scenario.

  Under average climatic conditions, Knight Piésold (2015) determined that the supernatant pond would remain at or close to the operational volume of 5 000m^3. During Year 6, the operational volume would increase briefly to 14 800m^3. Over the life of the facility, an average of 41% of the water in the tailings slurry would be recovered for reuse.

- 1 in 100 year AEP wet scenario.

  Under 1 in 100 year AEP wet climatic conditions, Knight Piésold (2015) determined that the supernatant pond would remain at or close to the operational volume of 5 000m^3 most of the time, with the pond volume increasing to 44 200m^3 during Year 6. The increased pond volumes would not encroach on the Tailings Storage Facility embankment.

- 1 in 100 year AEP dry scenario.

  Under 1 in 100 year AEP dry climatic conditions, Knight Piésold (2015) determined that the supernatant pond would remain at or close to the operational volume of 5 000m^3 in all months. Over the life of the facility, an average of 19% of the water in the tailings slurry would be recovered for reuse.

- Storm events.

  Knight Piésold (2015) undertook an assessment of the operation of the facility under a range of storm events to ensure compliance with the NSW Dam Safety Committee guideline *DSC3F – Tailings Dams.* That assessment may be summarised as follows.

  – Operational Freeboard.

    The operational freeboard is the vertical distance between the top of the tailings and the adjacent embankment crest. The final operational freeboard would be approximately 1 400mm, significantly in excess of the required 500mm.

  – Environmental Containment Freeboard.

    The environmental containment freeboard is the vertical distance between the operational pond limit and the emergency spillway crest. For a “High C” consequence category facility, *DSC3F – Tailings Dams* requires sufficient freeboard to contain a 1 in 100 year AEP, 72-hour rainfall event. In light of community concern in relation to overtopping of the Tailings Storage Facility, the Proponent has elected to increase this to the freeboard required for a "High B" consequence category facility, namely a 1 in 1 000 year AEP, 72-hour rainfall event. Knight Piésold (2015) determined that the elevation of the operation pond limit at the end of the life of the facility would be 714.9m AHD. This would be lower than the proposed final stage spillway level of 715.1m AHD. In addition, as discussed in the following subsection, the Proponent has adjusted the timing of lifts for the Tailings Storage Facility embankment to ensure that there would be sufficient stormwater storage capacity for a 1 in 1 000 year AEP rainfall event during all stages of the facility. As a result, the enlarged facility would not discharge during a 1 in 1 000 year AEP rainfall event during the operational life of the facility.

– Total Freeboard.

  The total freeboard is the vertical distance between the operational pond limit and the crest of the embankment. The design storm event for a "High C" consequence category facility is the 1:100,000 AEP, critical duration storm. The peak decant pond level during passage of a 1:100,000 AEP, 72 hour storm is RL715.6 m, or 0.5m below the final crest level..

Supernatant water would be returned to the process water pond from one of two decant towers located in the upstream section of the facility. An initial decant tower would be constructed during Stage 1 of the facility, to be replaced with a second decant tower as shown on **Figure 9**. Each decant town would comprise an access cause way and slotted concrete riser pipe surrounded by coarse waste rock. The decant tower would be equipped with a submersible pump that would pump supernatant water back to the processing plant via the return water pipeline.

2.6.6.3 Dilution Modelling

The Tailings Storage Facility is designed to contain all supernatant or decant water and incident rainfall up to a 1 in 1 000 year AEP 72-hour rainfall event without discharge via the emergency spillway. In the event that sufficient water was to accumulate within the Tailings Storage Facility to be discharged via the emergency spillway, that water would include some cyanide. In order to further quantify the risk associated with discharge of supernatant water from the Tailings Storage Facility, Knight Piésold (2015) undertook an assessment of the operation of the facility under a range of extreme rainfall events to determine the likely dilution within the facility and, in the event of a discharge, further dilution that may be expected on discharge to Spring Creek.

In summary, the assessment took into account the following.

- Anticipated month by month tailings deposition for the 65 month life of the facility.
- Construction of the proposed lifts, and associated increase in the capacity of the facility, during the life of the Project.

- Operation of the facility under average rainfall conditions to determine the anticipated supernatant pond volume each month. As noted in in the previous subsection, the facility is expected operate under a water deficit under the majority of climatic conditions and the supernatant pond volume would return to the minimum operational volume of 5 000m^3 reasonably quickly following a rainfall events. As a result, average climatic conditions were determined to be the appropriate starting point for the modelling.
- Based on the above, the available stormwater storage capacity within the facility each month was determined.

Knight Piésold then undertook an assessment of the anticipated stormwater volumes that would enter the facility under the following extreme rainfall events. The rainfall depth associated with each event is presented in parenthesis.

- 1 in 10 year, 72-hour event magnitude (253mm).
- 1 in 100 year, 72-hour event magnitude (435mm).
- 1 in 200 year, 72-hour event magnitude (507mm).
- 1 in 500 year, 72-hour event magnitude (616mm).
- 1 in 1,000 year, 72-hour event magnitude (705mm).
- 1 in 2,000 year, 72-hour event magnitude (789mm).
- 1 in 5,000 year, 72-hour event magnitude (890mm).
- 1 in 10,000 year, 72-hour event magnitude (936mm).
- 1 in 50,000 year, 72-hour event magnitude (1 152mm).
- 1 in 100,000 year, 72-hour event magnitude (1 216mm).
- 1 in 200,000 year, 72-hour event magnitude (1 296mm).
- 1 in 10 million year, 72-hour event magnitude (1 728mm).

In estimating the stormwater volumes that would enter the facility, Knight Piésold conservatively assumed that the clean water diversion around the facility may fail and stormwater from upslope of the facility would not be diverted around the facility. As complete failure of the diversion is unlikely, the modelling is conservative and is likely to overstate the risk of overtopping.

Based on the above, Knight Piésold determined, on a month-by-month basis for each of the above rainfall scenarios:

- whether the facility had sufficient capacity to store the anticipated stormwater; and if not
- the volume of water that would be expected to discharge from the facility and the anticipated dilution factor.

Table 14 presents the results of the overtopping and dilution assessment, which may be summarised as follows.

- The minimum stormwater storage capacity, and thus the period of greatest risk of overtopping in the event of an extreme rainfall event, occurs in month 41, immediately prior to the construction of Lift 4 when approximately 137 369m^3 of stormwater storage capacity would be available
- The rainfall event that would result in the lowest dilution and thus the highest concentration of cyanide being discharged via the emergency spillway would be a 1 in 10 000 year AEP 72-hour event. This event would result in approximately 186 000m^3 of water being deposited within the facility. Assuming an operating supernatant pond volume of approximately 14 800m^3, this would result in an average dilution rate of approximately 13 times.
- A 1 in 2 000 year AEP rainfall event would result in overtopping of the Tailings Storage Facility during 4 months of the modelled 65 month life of the facility. The probability of overtopping the facility once during the 65 month life under a 1 in 2 000 year rainfall event is 0.05%.
- A 1 in 10 million year AEP or Maximum Probable Flood rainfall event would result in overtopping of the Tailings Storage Facility during 59 months of the modelled 65 month life of the facility. The probability of a 1 in 10 million year rainfall event during the 65 month life of the Tailings Storage Facility would be 0.00005%.

As a result, the scenario with the greatest risk of occurring (0.05%) would be a 1 in 2 000 year AEP rainfall event. The minimum dilution under this scenario would be approximately 28 times.

In addition, Knight Piésold (2015) also undertook an analysis of dilution of water discharged from the emergency spillway to Spring Creek and downstream. That assessment was undertaken using *Hydrologic Modelling System HECHMS, Version 3.4*. The model identified 14 sub-catchments (see **Figure 10**) within and surrounding the Project Site, including:

- Spring Creek upstream of the Tailings Storage Facility (Sub-catchments SC07 and SC08);
- Spring Creek downstream of the Tailings Storage Facility and upstream of Major Creek (Sub-catchments SC05 and SC06);
- Majors Creek upstream of Spring Creek (Sub-catchments SC10 to SC14); and
- Majors Creek downstream of Spring Creek (Sub-catchments SC01 to SC04).

Table 14
Internal Tailings Storage Facility Dilution Results

						1 in 1,000 year, 72 hr				1 in 2,000 year, 72 hr				1 in 10,000 year, 72 hr				1 in 10 million year, 72-hr			
Year	Month	Cumulative Tailings Volume	TSF Storage Volume	Stormwater Storage Capacity	Operating Pond Volume (Average)	Runoff Volume	Available airspace at spillway invert	Discharge	Dilution	Runoff Volume	Available airspace at spillway invert	Discharge	Dilution	Runoff Volume	Available airspace at spillway invert	Discharge	Dilution	Runoff Volume	Available airspace at spillway invert	Discharge	Dilution
		m^3	m^3	m^3	m^3	m^3	m^3	m^3		m^3	m^3	m^3		m^3	m^3	m^3		m^3	m^3	m^3	
1	Aug-16	4,076	219,562	215,485	5,150	134,165	76,170	No	N/A	149,537	60,798	No	N/A	176,438	33,897	No	N/A	321,374	None	111,039	62
	Sep-16	11,891	219,562	207,671	5,139	134,154	68,378	No	N/A	149,526	53,006	No	N/A	176,427	26,105	No	N/A	321,363	None	118,831	63
	Oct-16	18,738	219,562	200,823	5,211	134,226	61,386	No	N/A	149,598	46,014	No	N/A	176,499	19,113	No	N/A	321,435	None	125,823	62
	Nov-16	33,847	219,562	185,715	5,413	134,428	45,874	No	N/A	149,800	30,502	No	N/A	176,701	3,601	No	N/A	321,637	None	141,335	59
	Dec-16	46,177	219,562	173,384	5,477	134,492	33,415	No	N/A	149,864	18,043	No	N/A	176,765	None	8,858	32	321,701	None	153,794	59
2	Jan-17	67,912	219,562	151,650	5,295	134,310	12,045	No	N/A	149,682	None	3,327	28	176,583	None	30,228	33	321,519	None	175,164	61
	Feb-17	72,101	219,562	147,461	5,000	134,015	8,446	No	N/A	149,387	None	6,926	30	176,288	None	33,827	35	321,224	None	178,763	64
	Mar-17	91,308	450,509	359,201	5,139	134,154	219,908	No	N/A	149,526	204,536	No	N/A	176,427	177,635	No	N/A	321,363	32,699	No	N/A
	Apr-17	104,831	450,509	345,677	5,077	134,092	206,508	No	N/A	149,464	191,136	No	N/A	176,365	164,235	No	N/A	321,301	19,299	No	N/A
	May-17	124,894	450,509	325,615	5,121	134,136	186,359	No	N/A	149,508	170,987	No	N/A	176,409	144,086	No	N/A	321,345	None	850	63
	Jun-17	144,397	450,509	306,112	5,115	134,130	166,866	No	N/A	149,502	151,494	No	N/A	176,403	124,593	No	N/A	321,339	None	20,343	63
	Jul-17	170,169	450,509	280,339	5,141	134,156	141,043	No	N/A	149,528	125,671	No	N/A	176,429	98,770	No	N/A	321,365	None	46,166	63
	Aug-17	192,492	456,217	263,726	5,142	134,157	124,427	No	N/A	149,529	109,055	No	N/A	176,430	82,154	No	N/A	321,366	None	62,782	63
	Sep-17	201,801	456,217	254,416	5,028	134,043	115,344	No	N/A	149,415	99,972	No	N/A	176,316	73,071	No	N/A	321,252	None	71,865	64
	Oct-17	220,801	456,217	235,416	5,071	134,086	96,259	No	N/A	149,458	80,887	No	N/A	176,359	53,986	No	N/A	321,295	None	90,950	63
	Nov-17	238,015	456,217	218,202	5,004	134,019	79,179	No	N/A	149,391	63,807	No	N/A	176,292	36,906	No	N/A	321,228	None	108,030	64
	Dec-17	256,408	456,217	199,809	5,000	134,015	60,794	No	N/A	149,387	45,422	No	N/A	176,288	18,521	No	N/A	321,224	None	126,415	64
3	Jan-18	271,874	456,217	184,343	5,000	134,015	45,328	No	N/A	149,387	29,956	No	N/A	176,288	3,055	No	N/A	321,224	None	141,881	64
	Feb-18	290,954	456,217	165,263	5,000	134,015	26,248	No	N/A	149,387	10,876	No	N/A	176,288	None	16,025	35	321,224	None	160,961	64
	Mar-18	308,939	456,217	147,278	5,000	134,015	8,263	No	N/A	149,387	None	7,109	30	176,288	None	34,010	35	321,224	None	178,946	64
	Apr-18	329,490	688,823	359,332	5,046	134,061	220,226	No	N/A	149,433	204,854	No	N/A	176,334	177,953	No	N/A	321,270	33,017	No	N/A
	May-18	342,597	688,823	346,225	5,053	134,068	207,104	No	N/A	149,440	191,732	No	N/A	176,341	164,831	No	N/A	321,277	19,895	No	N/A
	Jun-18	344,988	688,823	343,835	5,596	134,611	203,628	No	N/A	149,983	188,256	No	N/A	176,884	161,355	No	N/A	321,820	16,419	No	N/A
	Jul-18	359,753	688,823	329,070	5,076	134,091	189,903	No	N/A	149,463	174,531	No	N/A	176,364	147,630	No	N/A	321,300	2,694	No	N/A
	Aug-18	393,906	696,444	302,538	5,135	134,150	163,253	No	N/A	149,522	147,881	No	N/A	176,423	120,980	No	N/A	321,359	None	23,956	63
	Sep-18	412,022	696,444	284,423	5,035	134,050	145,338	No	N/A	149,422	129,966	No	N/A	176,323	103,065	No	N/A	321,259	None	41,871	64
	Oct-18	421,676	696,444	274,768	5,000	134,015	135,753	No	N/A	149,387	120,381	No	N/A	176,288	93,480	No	N/A	321,224	None	51,456	64
	Nov-18	431,513	696,444	264,931	5,000	134,015	125,916	No	N/A	149,387	110,544	No	N/A	176,288	83,643	No	N/A	321,224	None	61,293	64
	Dec-18	452,425	696,444	244,019	5,000	134,015	105,004	No	N/A	149,387	89,632	No	N/A	176,288	62,731	No	N/A	321,224	None	82,205	64
4	Jan-19	472,324	696,444	224,121	5,000	134,015	85,106	No	N/A	149,387	69,734	No	N/A	176,288	42,833	No	N/A	321,224	None	102,103	64
	Feb-19	497,414	696,444	199,030	5,000	134,015	60,015	No	N/A	149,387	44,643	No	N/A	176,288	17,742	No	N/A	321,224	None	127,194	64
	Mar-19	521,360	696,444	175,084	5,000	134,015	36,069	No	N/A	149,387	20,697	No	N/A	176,288	None	6,204	35	321,224	None	151,140	64
	Apr-19	541,639	696,444	154,805	5,023	134,038	15,744	No	N/A	149,410	372	No	N/A	176,311	None	26,529	35	321,247	None	171,465	64
	May-19	554,005	696,444	142,439	5,043	134,058	3,338	No	N/A	149,430	None	12,034	30	176,331	None	38,935	35	321,267	None	183,871	64
	Jun-19	566,638	861,897	295,258	5,064	134,079	156,115	No	N/A	149,451	140,743	No	N/A	176,352	113,842	No	N/A	321,288	None	31,094	63
	Jul-19	582,178	861,897	279,719	5,070	134,085	140,564	No	N/A	149,457	125,192	No	N/A	176,358	98,291	No	N/A	321,294	None	46,645	63
	Aug-19	597,585	870,917	273,332	5,083	134,098	134,150	No	N/A	149,470	118,778	No	N/A	176,371	91,877	No	N/A	321,307	None	53,059	63
	Sep-19	610,342	870,917	260,574	5,010	134,025	121,539	No	N/A	149,397	106,167	No	N/A	176,298	79,266	No	N/A	321,234	None	65,670	64
	Oct-19	621,791	870,917	249,126	5,000	134,015	110,111	No	N/A	149,387	94,739	No	N/A	176,288	67,838	No	N/A	321,224	None	77,098	64
	Nov-19	635,362	870,917	235,554	5,000	134,015	96,539	No	N/A	149,387	81,167	No	N/A	176,288	54,266	No	N/A	321,224	None	90,670	64
	Dec-19	641,202	870,917	229,715	5,000	134,015	90,700	No	N/A	149,387	75,328	No	N/A	176,288	48,427	No	N/A	321,224	None	96,509	64
5	Jan-20	652,238	870,917	218,678	5,000	134,015	79,663	No	N/A	149,387	64,291	No	N/A	176,288	37,390	No	N/A	321,224	None	107,546	64
	Feb-20	657,711	870,917	213,206	5,000	134,015	74,191	No	N/A	149,387	58,819	No	N/A	176,288	31,918	No	N/A	321,224	None	113,018	64
	Mar-20	668,803	870,917	202,113	5,000	134,015	63,098	No	N/A	149,387	47,726	No	N/A	176,288	20,825	No	N/A	321,224	None	124,111	64
	Apr-20	683,078	870,917	187,838	5,003	134,018	48,817	No	N/A	149,390	33,445	No	N/A	176,291	6,544	No	N/A	321,227	None	138,392	64
	May-20	691,603	870,917	179,314	5,033	134,048	40,232	No	N/A	149,420	24,860	No	N/A	176,321	None	2,041	35	321,257	None	146,977	64
	Jun-20	700,187	870,917	170,729	5,057	134,072	31,601	No	N/A	149,444	16,229	No	N/A	176,345	None	10,672	35	321,281	None	155,608	64
	Jul-20	707,213	870,917	163,703	5,073	134,088	24,542	No	N/A	149,460	9,170	No	N/A	176,361	None	17,731	35	321,297	None	162,667	63
	Aug-20	709,299	1,015,305	306,006	8,220	137,235	160,551	No	N/A	152,607	145,179	No	N/A	179,508	118,278	No	N/A	324,444	None	26,658	39
	Sep-20	716,544	1,015,305	298,760	6,231	135,246	157,283	No	N/A	150,618	141,911	No	N/A	177,519	115,010	No	N/A	322,455	None	29,926	52
	Oct-20	740,316	1,015,305	274,989	5,006	134,021	135,962	No	N/A	149,393	120,590	No	N/A	176,294	93,689	No	N/A	321,230	None	51,247	64
	Nov-20	750,449	1,015,305	264,856	5,000	134,015	125,841	No	N/A	149,387	110,469	No	N/A	176,288	83,568	No	N/A	321,224	None	61,368	64
	Dec-20	750,170	1,015,305	265,134	6,835	135,850	122,450	No	N/A	151,222	107,078	No	N/A	178,123	80,177	No	N/A	323,059	None	64,759	47
6	Jan-21	761,404	1,015,305	253,900	5,000	134,015	114,885	No	N/A	149,387	99,513	No	N/A	176,288	72,612	No	N/A	321,224	None	72,324	64
	Feb-21	776,396	1,015,305	238,909	5,000	134,015	99,894	No	N/A	149,387	84,522	No	N/A	176,288	57,621	No	N/A	321,224	None	87,315	64
	Mar-21	783,532	1,015,305	231,773	5,000	134,015	92,758	No	N/A	149,387	77,386	No	N/A	176,288	50,485	No	N/A	321,224	None	94,451	64
	Apr-21	801,844	1,015,305	213,461	5,007	134,022	74,433	No	N/A	149,394	59,061	No	N/A	176,295	32,160	No	N/A	321,231	None	112,776	64
	May-21	803,297	1,015,305	212,008	6,552	135,567	69,889	No	N/A	150,939	54,517	No	N/A	177,840	27,616	No	N/A	322,776	None	117,320	49
	Jun-21	806,475	1,015,305	208,830	7,717	136,732	64,380	No	N/A	152,104	49,008	No	N/A	179,005	22,107	No	N/A	323,941	None	122,829	42
	Jul-21	807,574	1,015,305	207,730	10,429	139,444	57,857	No	N/A	154,816	42,485	No	N/A	181,717	15,584	No	N/A	326,653	None	129,352	31
	Aug-21	814,535	1,015,305	200,769	10,957	139,972	49,841	No	N/A	155,344	34,469	No	N/A	182,245	7,568	No	N/A	327,181	None	137,368	30
	Sep-21	815,302	1,015,305	200,003	12,283	141,298	46,421	No	N/A	156,670	31,049	No	N/A	183,571	4,148	No	N/A	328,507	None	140,788	27
	Oct-21	815,237	1,015,305	200,067	14,747	143,762	41,557	No	N/A	159,134	26,185	No	N/A	186,035	None	716	13	330,971	None	145,652	22
	Nov-21	829,926	1,015,305	185,378	8,580	137,595	39,202	No	N/A	152,967	23,830	No	N/A	179,868	None	3,071	21	324,804	None	148,007	38
	Dec-21	838,832	1,015,305	176,473	5,101	134,116	37,256	No	N/A	149,488	21,884	No	N/A	176,389	None	5,017	35	321,325	None	149,953	63

Source: Knight Piésold (2015) - After Table 4.8

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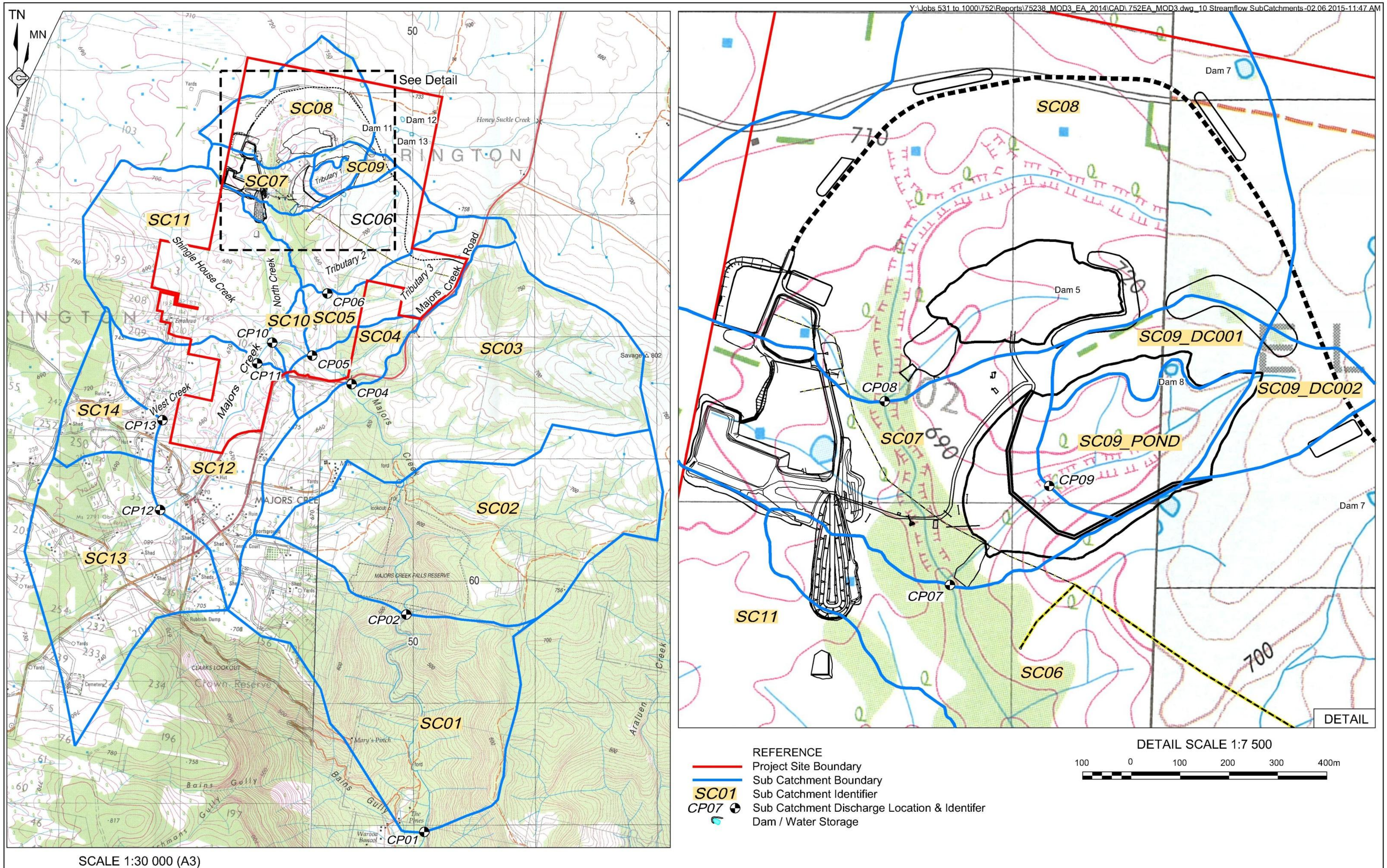

Figure 10
STREAMFLOW MODELLING SUB-CATCHMENTS

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