Evolution MINING

APPENDIX B

Hydrological Assessment

COWAL GOLD OPERATIONS PROCESSING RATE MODIFICATION

Environmental Assessment
2018

Resource Strategies

hec
HYDRO ENGINEERING
& CONSULTING PTY LTD

REPORT

Cowal Gold Operations
Processing Rate Modification
Surface Water Assessment

Prepared for: Evolution Mining (Cowal) Pty Limited

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1.0 INTRODUCTION

1.1 EXISTING MINE AND MODIFICATION DESCRIPTION

Evolution Mining (Cowal) Pty Limited (Evolution) is the owner and operator of the Cowal Gold Operations (CGO) located approximately 38 kilometres (km) north-east of West Wyalong in New South Wales (NSW) (Figure 1).

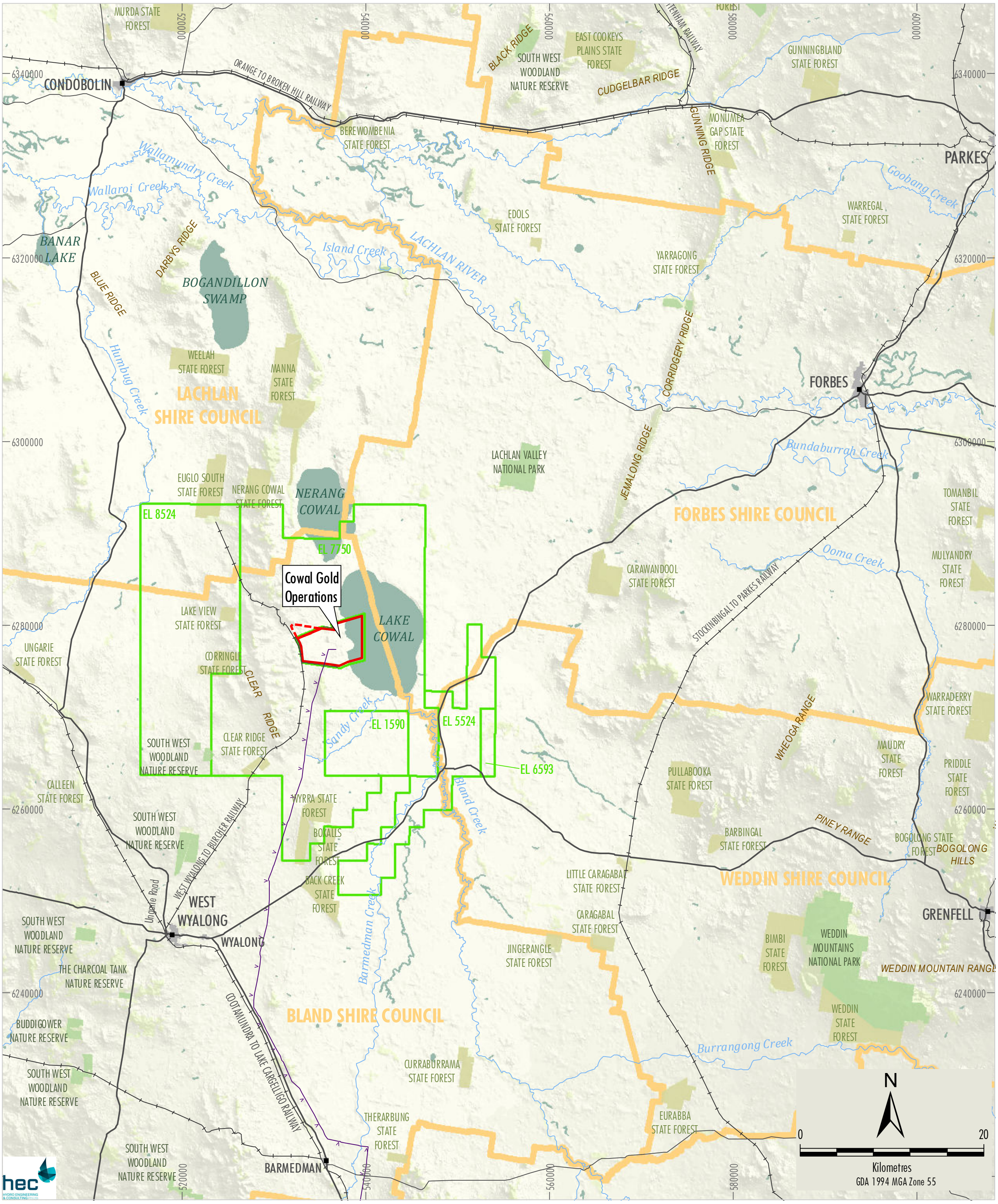
Mining operations at the CGO are approved to 31 December 2032 and are carried out in accordance with Development Consent DA 14/98 (as modified).

Evolution proposes to modify Development Consent DA 14/98 under section 75W of the NSW *Environmental Planning and Assessment Act, 1979* to facilitate an increased ore processing rate (to 9.8 million tonnes per annum [Mtpa]) (herein referred to as the Modification).

The main water-related activities associated with development of the Modification would include the following:

- Increasing the plant processing rate from 7.5 Mtpa to up to 9.8 Mtpa through secondary crushing and other upgrades.
- Duplicating the existing water supply pipeline across Lake Cowal to facilitate increased water usage at the processing plant (assuming that there would be no additional water supply sources required to meet project demand).
- Modification of the existing two Tailings Storage Facilities (TSFs) to form one larger TSF, which would also accommodate mine waste rock (referred to as the Integrated Waste Landform [IWL]).
- Relocation of water management infrastructure (i.e. the Up-Catchment Diversion System [UCDS] and approved location for contained water storage D10) and other ancillary infrastructure (e.g. internal roads and soil and ore stockpiles) elsewhere within Mining Lease (ML) 1535 and within Mining Lease Application (MLA) 1.
- Introducing the concurrent processing of oxide ore together with primary ore, rather than undertaking oxide ore processing in dedicated campaigns.
- Increased annual extraction of water from the CGO's external water supply sources.

This hydrological assessment report has been prepared by Hydro Engineering & Consulting Pty Ltd (HEC) in support of the Modification Environmental Assessment (EA) and draws on results of groundwater modelling contained in the reports by Coffey Services Australia Pty Ltd (Coffey) (2018) (Appendix A of the EA).



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LEGEND

- Mining Lease Boundary (ML 1535)
- Mining Lease Application (MLA 1)
- Exploration Licence (EL)
- National Park & Nature Reserve
- State Forest
- Local Government Area Boundary
- Electricity Transmission Line
- Railway

Source: © NSW Department of Finance, Services & Innovation (2017)

Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION

Regional Location

Figure 1

1.2 ASSESSMENT REQUIREMENTS

This report addresses the surface water and site water balance aspects of Secretary's Environmental Assessment Requirements issued to Evolution for the Modification.

Water – including:

- an assessment of the likely impacts of the proposed modification on the quantity and quality of surface and groundwater resources;

- an assessment of the likely impacts of the proposed modification on aquifers, watercourses, riparian land, water supply infrastructure and systems and other water users;

- a revised site water balance, including a description of additional site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply and transfer infrastructure and water storage structures;

- identification of any water licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000; and

- a detailed description of the proposed water management system, water monitoring program and measures to mitigate surface and groundwater impacts.

The guidelines used as a basis for assessing impacts in this report are shown below:

1	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a)	The surface water quality monitoring results from the existing CGO and surrounding areas have been compared to these guidelines where appropriate (Section 2.3.1).
2	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000b)	Surface water quality monitoring would continue to be conducted in accordance with these guidelines (Section 2.3).
3	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ANZECC/ARMCANZ, 1997)	The existing sewerage systems at CGO (with upgrades as required) would continue to be operated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004a).
4	National Water Quality Management Strategy: Guidelines for Sewerage System – Use of Reclaimed Water (ANZECC/ARMCANZ, 2000c)	The existing sewerage systems at CGO (with upgrades as required) would continue to be operated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004a) which makes reference to ANZECC/ARMCANZ (2000c).
5	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006)	The Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a) has been applied in accordance with this guideline, including consideration of the NSW Government Water Quality and River Flow Objectives (NSW Government, 2016).
6	State Water Management Outcomes Plan (NSW Office of Water, 2013)	The assessment includes consideration of the policy developed under the State Water Management Outcomes Plan and the *Water Management Act, 2000*, including the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* and *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* (refer this section).
7	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC, 2004b)	Surface water quality monitoring would continue to be conducted in accordance with these guidelines (Section 2.3).

8	Managing Urban Stormwater: Soils & Construction (Landcom, 2004) and associated Volume 2E: Mines and Quarries (DECCW, 2008)	Existing and planned erosion and sediment controls would be designed in accordance with Landcom (2004) and DECCW (2008) to control suspended solids in runoff.
10	Managing Urban Stormwater: Treatment Techniques (EPA, 1997)	Would be considered and applied as relevant to drainage design/management around mine infrastructure area.
11	Managing Urban Stormwater: Source Control (EPA, 1998)	Would be considered and applied as relevant to drainage design/management in mine infrastructure areas.
12	Floodplain Development Manual (DIPNR, 2005)	Not considered relevant to this assessment as there are no properties other than those owned by the proponent that could be affected by mine infrastructure in any floodplain.
13	Floodplain Risk Management Guide (DECCW, 2010)	Not considered relevant to this assessment as the Modification is outside areas which could be affected by current sea level rise predictions and there are no properties outside those owned by the proponent that could be affected by mine infrastructure in any floodplain.
14	A Rehabilitation Manual for Australian Streams (CRCCH and LWRRDC, 2000)	This guideline would be considered upon approval of the Modification.
15	Technical Guidelines: Bunding & Spill Management (now Storing and Handling Liquids: Environmental Protection - Participants Manual [DECC, 2009]; Environmental Compliance Report: Liquid Chemical Storage, Handling and Spill Management - Part B Review of Best Practice and Regulation [DEC, 2005])	Would be used in design of containment systems for hazardous chemicals and would be incorporated into standard operating procedures for spill response.
16	Environmental Guidelines: Use of Effluent by Irrigation (DEC, 2004a)	The surface water quality monitoring results from the existing CGO and surrounding areas have been compared to guidelines set in ANZECC/ARMCANZ (2000a) for use of water as irrigation water where relevant (Section 2.3).
17	Guidelines for Practical Consideration of Climate Change (DECC, 2007)	Considered in the interpretations of post-mine impacts (Section 5.3 and Section 6.2.2).
18	NSW State Rivers and Estuary Policy (NOW)	
19	NSW Guidelines for Controlled Activities (NOW)	

ANZECC/ARMCANZ = Australian and New Zealand Environment and Conservation Council/ Agriculture and Resource Management Council of Australia and New Zealand.

DEC = NSW Department of Environment and Conservation.

NOW = NSW Office of Water.

DECCW = NSW Department of Environment, Climate Change and Water.

EPA = NSW Environment Protection Authority.

DIPNR = NSW Department of Infrastructure, Planning and Natural Resources.

CRCCH and LWRRDC = Cooperative Research Centre for Catchment Hydrology and Land and Water Resources Research and Development Corporation.

DECC = NSW Department of Environment and Climate Change.

The objects of the NSW *Water Management Act 2000* which is the principal statute governing management of water resources in NSW, were also considered during the assessment. *The Water Management Amendment Act 2014* was passed in 2014 and the provisions commenced on 1 January 2015. The objects of the *Water Management Act 2000* include:

> *…to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:*
>
> (a) *to apply the principles of ecologically sustainable development, and*

(b) *to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*

(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:

(i) benefits to the environment, and

(ii) benefits to urban communities, agriculture, fisheries, industry and recreation, and

(iii) benefits to culture and heritage, and

(iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,

(d) to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,

(e) to provide for the orderly, efficient and equitable sharing of water from water sources,

(f) to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,

(g) to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,

(h) to encourage best practice in the management and use of water.

The groundwater-related components of the assessment are provided separately in the Hydrogeological Assessment prepared by Coffey (2018) (Appendix A of the EA). These include a discussion on the *NSW Aquifer Interference Policy 2012* and its implications for the Modification.

Under the *Water Management Act 2000*, the *Water Sharing Plan for the Lachlan Regulated River Water Source 2003* commenced on 1 July 2004 and was replaced on 1 July 2016. The *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* covers licensed surface water accessed from the Lachlan River.

The external make-up of water supply at CGO is provided to the site via the mine borefield pipeline which draws water from the eastern saline borefield, the Bland Creek Palaeochannel Borefield and water extracted from the Lachlan River via the Jemalong Irrigation Channel. Water is currently extracted from the Lachlan River using regulated flow licences purchased by Evolution on the open market under the *Water Sharing Plan for the Lachlan Regulated River Water Source 2016.* Between approximately 4,000 and 274,000 megalitres (ML) of temporary water has been traded annually since records began in the 2004 to 2005 season.

Under the *Water Management Act 2000*, the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* commenced on 14 September 2012.

The *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* applies to all unregulated water sources in the Lachlan catchment which occurs naturally on the surface of the ground, and in rivers, lakes and wetlands.

Within the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012,* CGO is located within the Western Bland Creek Water Source, which has a total surface water entitlement of 2,275 megalitres per year (ML/year) divided between 33 surface water licences (Department of Primary Industries [DPI] Water, 2017).

Specific consideration of the objects of the *Water Management Act 2000* are provided in Attachment 4 (Aquifer Interference Policy Considerations and Water Licensing Addendum) in the Main Report of the EA.

1.3 SUMMARY OF RELEVANT FINDINGS OF PREVIOUS ENVIRONMENTAL APPROVALS DOCUMENTATION

Cowal Gold Project Environmental Impact Statement (EIS) (North Limited, 1998).

- Surface water on the mine site was to be permanently isolated from Lake Cowal by the UCDS, directing runoff from areas unaffected by mining around the perimeter of the site, and an Internal Catchment Drainage System (ICDS), capturing all site runoff and seepage for re-use in the processing plant. In the longer term the ICDS would direct site runoff to the final void which would become a permanent sink for groundwater and surface runoff.
- The long term final void water balance was such that the final void was predicted to not spill under any conceivable climate conditions.
- The operational water balance prediction was for a moderately negative site water balance. External water supply would be required from the Bland Creek Palaeochannel Borefield.
- Mine waste rock material was predicted to have the potential to generate moderately saline seepage, particularly during the active mining phase. During the active mining phase, all runoff and seepage from the waste rock emplacements would be contained within the ICDS.
- The tailings storages were designed to be able to contain runoff from a 0.1 percent (%) annual exceedance probability (AEP) rainfall event. Any spill or seepage would be contained within the ICDS, ultimately reporting to the open pit.
- In the longer term, it was predicted there would be little potential for movement of surface water or groundwater from the waste rock emplacements or of seepage from the tailings storages.

Use of suitable soils and vegetation in rehabilitation of waste rock emplacements and the tailings storages was predicted to result in low salt fluxes in surface waters consistent with regional runoff water quality.

Cowal Gold Mine Extension Modification Hydrological Assessment (Gilbert & Associates, 2013) – Modification 11.

- There was no change proposed to the UCDS, directing runoff from areas unaffected by mining around the perimeter of the site, with the ICDS continuing to capture all site runoff and seepage for re-use in the processing plant.
- In order to effectively manage water within the ICDS and maintain water supply, some minor changes were proposed, including some re-direction of internal drainage from constructed mine landforms and construction of an additional raw water storage – D10.
- Augmentation of the external water supply pipeline (across Lake Cowal) was proposed increasing its capacity from 11 ML/day to 14 ML/day. This would also involve construction of another pump station which would be located outside the bounds of the Lake Cowal inundation limits and away from drainage paths. Any potential impacts of the pump station construction would be mitigated by appropriate design.
- Water balance modelling indicated that there were no external water supply shortfalls simulated, with the median peak annual water supply requirement from licensed Lachlan River extraction peaking at 2,924 ML. No spills were predicted in the water balance model from either of the contained water storages (D1 and D4) that could spill to Lake Cowal.
- Final void water balance modelling indicated that final void equilibrium water levels would be lower than those predicted in North Limited (1998) and would be approximately 80 metres (m) below spill level.
- It was concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

Cowal Gold Operations Mine Life Modification Hydrological Assessment (HEC, 2016) – Modification 13.

- There was no change proposed to the UCDS, directing runoff from areas unaffected by mining around the perimeter of the site, with the ICDS continuing to capture all site runoff and seepage for re-use in the processing plant.
- In order to effectively manage water within the ICDS and maintain water supply, some minor changes were proposed, including some re-direction of internal drainage from constructed mine landforms.
- The two TSFs were to be progressively raised for the remainder of the mine life, with the area between the two TSFs also used for storage of tailings.
- Two campaigns of oxide ore were to be processed – in 2020 and from 2030 to 2032. Due to the nature of the oxide ore, during these times the demand for process plant makeup water would increase.
- Water balance modelling indicated there were no external water supply shortfalls simulated, with the median peak annual water supply requirement from licensed Lachlan River extraction peaking at 2,853 ML. No spills were predicted in the water balance model from either of the contained water storages (D1 and D4) that could spill to Lake Cowal.
- Final void water balance modelling indicated that final void equilibrium water levels would be lower than those predicted in North Limited (1998) and would be more than approximately 80 m below spill level.
- It was concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

2.0 HYDROMETEOROLOGICAL SETTING

2.1 REGIONAL HYDROLOGY

CGO is located on the western side of Lake Cowal (refer Figure 2) and extends into the natural extent of Lake Cowal. Lake Cowal is an ephemeral, fresh water lake that forms part of the Wilbertroy-Cowal Wetlands which are located on the Jemalong Plain. Lake Cowal is in the lower reaches of the Bland Creek catchment. It also receives periodic inflows from the Lachlan River during periods of high flow[1] when flood waters enter Lake Cowal via two main breakout channels from the north-east. Breakout from the Lachlan River to Lake Cowal occurred in late 2010, in the first half of 2012 and again in 2016, but had not occurred prior to this since 1998.

Lake Cowal is a large oval shaped lake which, when full, occupies an area of some 105 square kilometres (km^2), holds some 150 gigalitres of water and has a depth of approximately 4 m when full. It overflows to Nerang Cowal, a smaller lake to the north. When flows are sufficient, the lakes ultimately overflow and drain into the Lachlan River via Bogandillon Creek. The Lachlan River is the major regional surface drainage, forming part of the Murray-Darling Basin. Flows in the Lachlan River near Lake Cowal are regulated by releases from Wyangala Dam.

The area surrounding the CGO site is drained by ephemeral drainage lines which flow to Lake Cowal. Bland Creek and all other tributaries of Lake Cowal are also ephemeral. Bland Creek drains a catchment of approximately 9,500 km^2 which ultimately reports to Lake Cowal at the creek's northern end. Flow records from a gauging station[2] on Bland Creek indicate that runoff is low, averaging about 5% of rainfall.

2.2 METEOROLOGY

The region experiences a semi-arid climate which is dominated by cool, wetter conditions in winter and hot and relatively dry conditions in summer. Table 1 summarises regional monthly and annual rainfall totals from Bureau of Meteorology (BoM) stations (Wyalong, Ungarie and Burcher Post Offices [PO]), as well as rainfall recorded at CGO since 2002.

Long-term regional rainfall averages[3] 456 millimetres (mm) per annum. Average annual rainfall recorded at the CGO from 2002 to August 2017 averaged 428 mm, which compares with an annual average of 443 mm recorded at Wyalong PO and 477 mm at Burcher PO for the same period.

Table 2 summarises regional monthly and annual pan evaporation totals from the nearest BoM pan evaporation stations. The nearest BoM pan evaporation station is located at the Condobolin Agricultural Research Station, approximately 65 km north of CGO. Annual pan evaporation averages 1,972 mm at this station.

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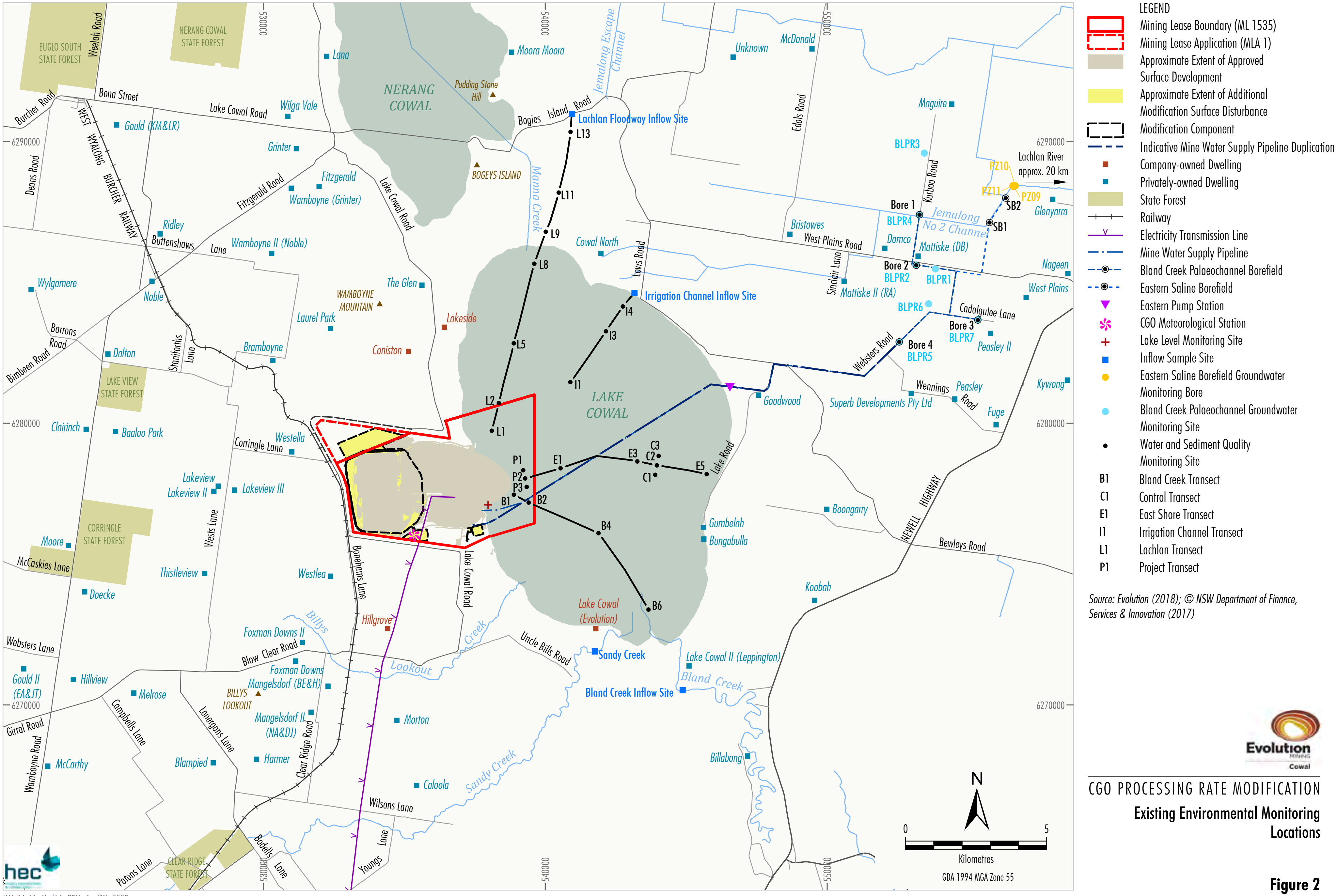
[1] Inflows from the Lachlan River occur when flows at Jemalong Weir exceed 15,000 to 20,000 ML/day – North Limited (1998).

[2] GS 412171 (Bland Creek at Marsden), which operated from 1998 to 2004.

[3] From SILO Data Drill - https://www.longpaddock.qld.gov.au/silo/datadrill/ for location 33° 39'S 147° 24'E



CGO PROCESSING RATE MODIFICATION

Existing Environmental Monitoring Locations

Figure 2

Table 1 Rainfall Data Summary

	Wyalong PO (073054*)		Ungarie PO** (050040*)		Burcher PO (050010*)		CGO	
	Jun-1895 – Sep-2017		Oct-1895 – Nov-2017		Jun-1937 – Sep-2017		Jan-2002 – Aug-2017†	
	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays	Mean Total (mm)	Mean No. Raindays
Jan	41.8	4.8	41.9	3.7	42.3	4.0	28.0	5.6
Feb	38.5	4.5	39.1	3.7	43.4	3.9	55.7	6.4
Mar	36.7	4.7	38.7	3.8	40.7	3.9	33.8	5.3
Apr	34.1	4.8	32.8	3.8	33.1	4.1	20.2	4.5
May	39.3	6.6	38.6	5.5	37.7	5.8	24.7	6.1
Jun	43.7	8.7	43.0	6.6	36.4	6.5	46.9	11.0
Jul	42.8	9.8	38.7	7.2	39.2	7.5	41.2	10.7
Aug	38.8	9.0	35.6	6.9	37.7	6.5	30.6	8.5
Sep	36.1	7.3	34.0	5.7	35.3	5.3	35.4	6.6
Oct	45.0	6.9	40.8	5.5	45.5	5.5	29.1	6.3
Nov	36.3	5.5	36.6	4.2	37.1	4.6	33.9	5.9
Dec	44.5	5.5	43.2	4.3	42.2	4.1	48.2	7.4
Annual	477.7	78.4	462.8	60.7	470.5	62.2	427.5	84.2

* BoM Station Number.

** Data contains numerous gaps in recent years and early in the 20th century.

† Manual gauge to December 2006, automatic weather station thereafter.

Note: Statistically, the sum of monthly means does not necessarily equal the annual mean.

Table 2 Evaporation Data Summary

	Pan evaporation Condobolin Agricultural Research Station (050052*)	Pan evaporation Condobolin Soil Conservation (050102*)	Pan evaporation Cowra Research Station (063023*)
	1973 – 2017	1971 – 1985	1965 – 2011
	Mean Total (mm)	Mean Total (mm)	Mean Total (mm)
Jan	310.0	235.6	229.4
Feb	248.6	200.6	180.8
Mar	210.8	161.2	148.8
Apr	129.0	102.0	90.0
May	74.4	58.9	49.6
Jun	48.0	36.0	30.0
Jul	49.6	43.4	34.1
Aug	77.5	68.2	49.6
Sep	117.0	96.0	78.0
Oct	179.8	142.6	124.0
Nov	234.0	189.0	165.0
Dec	297.6	235.6	217.0
Annual	1,972	1,569	1,388

* BoM Station Number.

Note: Statistically, the sum of monthly means does not necessarily equal the annual mean.

2.3 WATER QUALITY

2.3.1 Lake Cowal

Baseline water quality reported in the Cowal Gold Project EIS (North Limited,1998) was based on results of an intensive sampling programme conducted between 1991 and 1995 and included 34 monitoring locations along four transects across Lake Cowal. This has been supplemented by monitoring campaigns undertaken (when the lake re-filled) from November 2010 through to July 2014[4] and from August 2016 which included sampling of lake inflow from Sandy and Bland Creeks. The results of monitoring since 2010 have been summarised in Table 3 and Table 4. The following assessment has been conducted using water quality data results obtained from sampling in Lake Cowal over the period November 2010 to August 2017. Results from this assessment period are compared to relevant guideline values published in ANZECC/ARMCANZ (2000a) and with values obtained from sampling programs conducted during the baseline period prior to commencement of mining operations. Lake water quality monitoring locations are shown in Figure 2.

Average total nitrogen measured at the lake transect sites was 491 micrograms per litre (µg/L), which was higher than the maximum level recorded during the baseline period (257 µg/L) and the ANZECC/ARMCANZ (2000a) default trigger value for fresh water lakes (350 µg/L). It was, however, lower than the average concentration in lake inflows from Bland Creek and Sandy Creek over the assessment period (807 µg/L).

Average total phosphorous measured at the lake transect sites was 386 µg/L, which was lower than the baseline data (range 970 to 2,640 µg/L) and lower than the average at the lake inflow sites (Bland Creek and Sandy Creek – 468 µg/L). It was however higher than the ANZECC/ARMCANZ (2000a) default trigger value for fresh water lakes (10 µg/L).

Average pH measured at the lake transect sites was 8.0, which was slightly lower than the average over the baseline period (8.48), but slightly higher than the average at the lake inflow sites (7.5). The range of pH levels recorded at the lake transect sites (5.56 to 11.42)[5] was greater than that recorded at the lake inflow sample locations (5.78 to 9.39) and outside the trigger value range (6.5 to 8.0) published in ANZECC/ARMCANZ (2000a). The range measured at the lake transects during the baseline period was 7.72 to 9.8 (which is noted to also be outside the upper trigger level published in ANZECC/ARMCANZ [2000a]).

Average Electrical Conductivity (EC) (a measure of salinity) in lake water over the assessment period was 393 microSiemens per centimetre (µS/cm). This is lower than the average EC measured at the lake transect sites during the baseline period (881 µS/cm). The average EC readings in the lake during the assessment period were slightly higher than the average at the lake inflow sample locations (218 µS/cm) over the assessment period. Both the average lake inflows and lake transect readings during the baseline and assessment periods were well above the ANZECC/ARMCANZ (2000a) default trigger value for fresh water lakes (20 - 30 µS/cm).

The average turbidity level recorded at lake transect sites during the assessment period was 283 nephelometric turbidity units (NTU), compared to 111 NTU recorded during the baseline period. Average turbidity recorded at lake transects was lower than the average recorded at the lake inflow sample locations (360 NTU) during the assessment period. The levels recorded during the baseline and assessment period were well above the ANZECC/ARMCANZ (2000a) default trigger level for protection of slightly disturbed ecosystems (1 to 20 NTU).

4 Evolution advises that between 2014 and August 2016, lake water levels were too low (or the Lake dry) for effective sampling to occur.

5 Two field pH values greater than 10 were recorded in late February 2011. 90% of recorded pH values were less than 8.7.

Table 3 Summary of Lake Cowal Water Quality – Generic Parameters

Parameter (Units as stated)	Default Trigger Values[1]		Lake Cowal Baseline Water Quality (1991-1995)	Baseline Data Inflow Sites Only (1991-1992, Dec 93)	Baseline Data Lake Transects (1991-1995)	Lake Cowal Transect Monitoring (Nov 2010 - August 2017)	Lake Cowal Inflow Sites (Nov 2010 - August 2017)
	Protection of Aquatic Ecosystems	Stock Water Protection Low Risk Trigger Value					
Total N (µg/L)	350 µg/L for SE Aust. Freshwater Lakes and Reservoirs	No trigger values given	Not available	660 to 2,610 (1,200**)	61 to 257 (136**)	10 to 5,620 (491**)	10 to 2,700 (807**)
Total P (µg/L)	10 µg/L for SE Aust. Freshwater Lakes and Reservoirs	No trigger values given	Not available	29 to 216 (79**)	970 to 2,640 (1,667**)	10 to 1,980 (386**)	120 to 1,860 (468*)
pH (pH units) - field	6.5 to 8.0 pH for SE Aust. Freshwater Lakes and Reservoirs	No trigger values given	8.27 to 8.67	7.6 to 8.2	7.72 to 9.80 (8.48**)	5.56 to 11.42 (8.0**)	5.78 to 9.39 (7.5**)
EC (measured in field)/TDS	EC 20-30 µS/cm for SE Aust. Freshwater Lakes and Reservoirs	TDS triggers 2,500 mg/L dairy cattle, 5,000 mg/L sheep	222 to 1,557 µS/cm	382 to 1,260 µS/cm (726**)	160 to 3,130 µS/cm (881**)	2.09 to 1,801 µS/cm (393**)	34 to 871 µS/cm (218**)
Turbidity (NTU – measured in field)/TSS (mg/L)^	1 to 20 NTU Turbidity Triggers for slightly disturbed ecosystems - lakes	No triggers given	22 to 224 mg/L	0.62 to 234 (70.5**) NTU^ TSS 0.54 to 150 mg/L (37.9**)	7 to 566 (111**) NTU^ TSS 13 to 271 mg/L (103.4**)	7.8 to 2,562 (283**) NTU^ TSS 2 to 1,210 mg/L (126**)	13.4 to 2,819 (360**) NTU^ TSS 6 to 640 mg/L (102**)

mg/L: milligrams per litre.
EC: electrical conductivity.
TDS: total dissolved solids.
TSS: total suspended solids.
N: nitrogen.
P: phosphorous.
SE: south-east.
^ Catchments with highly dispersive soils will have high turbidity (ANZECC/ARMCANZ, 2000a).
** Average Value.
[1] Trigger values were taken from ANZECC/ARMCANZ (2000a). The NSW Water Quality Objectives do not differ from the ANZECC/ARMCANZ (2000a) guidelines.
Note: pH, turbidity, and EC data was derived from field samples, all other parameters were derived from laboratory analysis.
Conductivity in lakes and reservoirs is generally low, but will vary depending on catchment geology (ANZECC/ARMCANZ, 2000a).

Table 4 Summary of Lake Cowal Water Quality – Metals

Parameter (Units as stated)	Default Trigger Values[1]					Lake Cowal Baseline Water Quality (1991-1995)	Baseline Data Inflow Sites Only (1991-1992, Dec 93)	Baseline Data Lake Transects (1991-1995)	Lake Cowal Transect Monitoring (Nov 2010-August 2017)	Lake Cowal Inflow Sites (Nov 2010-August 2017)
	Protection Levels for Aquatic Ecosystems				Stock Water Protection Level					
	99%	95%	90%	80%	Low Risk Trigger Value					
As (Total) (µg/L)	0.8	13	42	140	500	2.6**	<0.1 to 3.5 (1.2**)	<0.5 to 3.98 (2.6**)	2 to 27 (6.3**)	1 to 26 (4.8**)
Cd (Total) (µg/L)	0.06	0.2	0.4	0.8	10	0.055**	<0.05 to 0.5 (0.1**)	<0.05 to 0.5 (0.06**)	0.1 to 1 (0.11**)	All samples less than or equal to the Level of Detection Limit (0.1)
Cu (Total) (µg/L)	1.0	1.4	1.8	2.5	1,000 µg/L cattle, 400 µg/L sheep	6**	1.6 to 7.5 (3.5**)	2.2 to 15.9 (5.8**)	1 to 31 (8.8**)	2 to 70 (11.1**)
Fe (Total) (µg/L)	No trigger values given				Not sufficiently toxic	-	-	-	360 to 33,600 (11,796**)	900 to 180,000 (18,933**)
Pb (Total) (µg/L)	1	3.4	5.6	9.4	100	2.9**	<0.5 to 7.2 (2.3**)	<0.5 to 6.5 (2.7**)	1 to 15 (5.5**)	1 to 97 (10.6**)
Mn (Total) (µg/L)	1,200	1,900	2,500	3,600	Not sufficiently toxic	-	-	-	55 to 470 (166**)	137 to 296 (217**)
Hg (Total) (µg/L) (inorganic)	0.06	0.6	1.9	5.4	2	>50% of samples less than the Level of Detection Limit (0.1)	<0.1 to 0.4 (0.2**)	<0.1 to 0.4 (0.13**)	All samples less than or equal to the Level of Detection Limit (0.1)	All samples less than or equal to the Level of Detection Limit (0.1)
Zn (Total) (µg/L)	2.4	8	15	31	20,000	12**	<3 to 22 (9.0**)	<3 to 30 (11.7**)	5 to 79 (20.7**)	5 to 234 (31**)
Ni (Total) (µg/L)	8	11	13	17	1,000	-	-	-	2 to 26 (11.2**)	3 to 77 (12.7**)

As: arsenic. Fe: iron. Hg: mercury. >: greater than.
Cd: cadmium. Pb: lead. Zn: zinc. <: less than.
Cu: copper. Mn: manganese. Ni: nickel.
** Average Value.
[1] Trigger values were taken from ANZECC/ARMCANZ (2000a). The NSW Water Quality Objectives do not differ from the ANZECC/ARMCANZ (2000a) guidelines.

Laboratory analysis of lake and inflow water quality samples included metals analyses for nine metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel and zinc). Mercury concentrations were at or below laboratory detection level at both lake transect and lake inflow sites during the assessment period. Cadmium concentrations were at or below laboratory detection level at lake inflow sites and one sample returned a concentration above the laboratory detection in the lake transect sites.

Average arsenic, cadmium and manganese concentrations at the lake transect sites were below ANZECC/ARMCANZ (2000a) default trigger levels for protection of slightly modified aquatic ecosystems (95% protection level), while average nickel concentration (11.2 µg/L) slightly exceeded the guideline value (11 µg/L). The average of all detectable metals concentrations, with the exception of arsenic and cadmium, at the lake transect sites were lower than the respective average concentrations measured at the lake inflow sites. The average lake transect site arsenic (6.3 µg/L), cadmium (0.11 µg/L – one sample above limit of detection), copper (8.8 µg/L), lead (5.5 µg/L) and zinc (20.7 µg/L) concentrations were greater than the corresponding baseline values. The average lake inflow site arsenic (4.8 µg/L), copper (11.1 µg/L), lead (10.6 µg/L) and zinc (31 µg/L) were greater than the corresponding baseline values.

In summary, notable results are:

- the range of pH was high relative to ANZECC/ARMCANZ (2000a) default triggers and baseline ranges, however, as discussed further below has been similarly elevated at sites near and distant to the CGO;
- average copper, lead and zinc concentrations were high relative to both ANZECC/ARMCANZ (2000a) default triggers and baseline however were lower than inflow site data and as discussed further below have been similarly elevated at sites on the opposite side of Lake Cowal;
- average turbidity was significantly higher than the ANZECC/ARMCANZ (2000a) default trigger value and higher than baseline levels, however as discussed further below turbidity levels have occurred uniformly at sites close to and distant from the CGO; and
- total phosphorous concentrations were significantly higher than the ANZECC/ARMCANZ (2000a) default trigger value for fresh water lakes however as discussed further below concentrations have been similar at sites both close to the CGO and on the other side of Lake Cowal and lower than inflow site data (it is also noted measured average total phosphorous is much less than the baseline average).

Because runoff and water within the CGO area is fully contained within the ICDS, there is no obvious causal link between the mining operations and water quality in the lake. Given that groundwater, including any seepage from on-site storages, would flow toward the mine pit (Coffey, 2016), the only plausible links between mining activity at CGO and lake water quality would be overflow from dams D1 and/or D4 (which are outside the ICDS), mine site dust fall-out onto the lake or runoff/wash-off from the outside batters of the perimeter waste emplacement when the Lake Temporary Isolation Bund is inundated. Both D1 and D4 storages are fitted with pump back systems and Evolution has advised[6] that they have never overflowed to date. The data supports that there is no evidence that the existing CGO has resulted in changes to water quality in Lake Cowal.

[6] Pers comm., Evolution.

Samples taken at transect sites P1, P2 and P3 are physically close to the Lake Temporary Isolation Bund and therefore more likely to reflect mine-related effects, whilst sites E3 and E4 are on the opposite side of the lake – refer Figure 2. A comparison of the monitored results from these sites for pH, copper, lead, zinc, turbidity and total phosphorous is shown in Figure 3 to Figure 8.

2.3.1.1 Comparison of Monitored pH Across Lake Cowal

The pH values were relatively elevated at lake sites close to the CGO (P1, P2, and P3) in February 2011 compared to sites on the opposite side of the lake (refer Figure 3). Elevated pH levels were also recorded near the CGO in February 2012 although similar levels were also measured on the opposite side of the lake at that time. Since the lake refilled in 2016 pH levels have been uniformly lower than previously and relatively consistent across the lake.

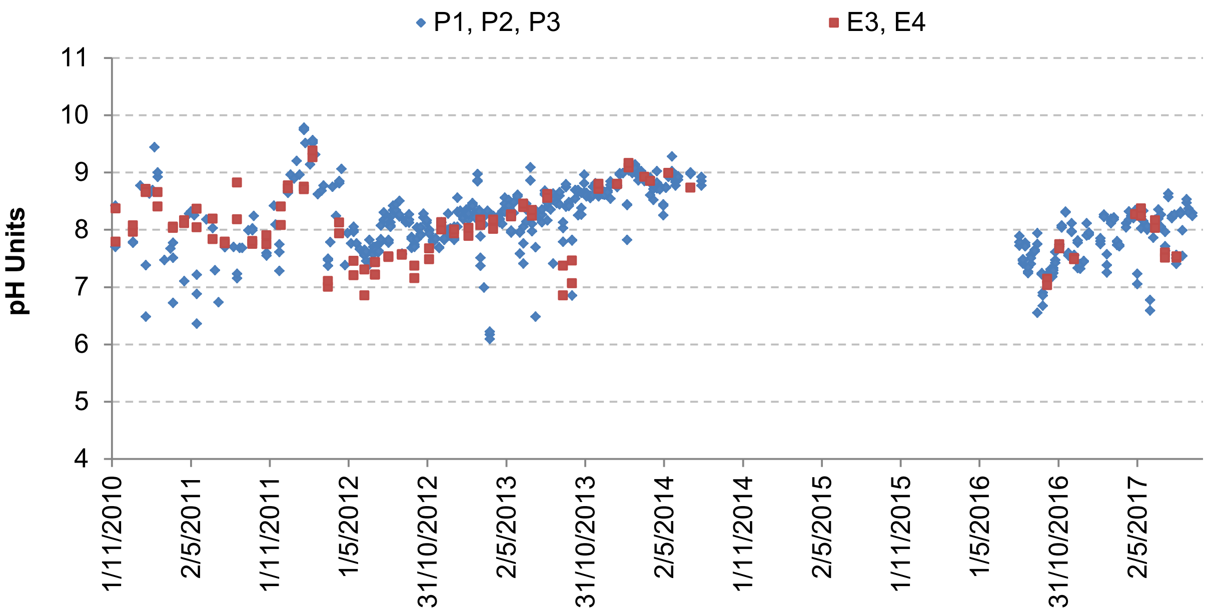


Figure 3 Field Measurement of pH at Selected Sites – Lake Cowal

To further assess whether there was a link between the elevated pH levels measured in February 2011 and proximity to the CGO, an assessment was conducted on pH levels recorded at all sites considered to be relatively close to the Lake Temporary Isolation Bund (E1, L1, P1, P2, P3, B1 and B2 – refer Figure 2) and all other sites in the lake from 2011 to 2017 – refer Figure 4. This assessment indicates that pH levels were similar at sites close to the CGO and at other (more distant) sites. In particular, there was a relatively elevated pH value recorded at site C1 (11.05) in February 2011 which suggests that pH has been similarly elevated at sites close to and distant from the CGO.

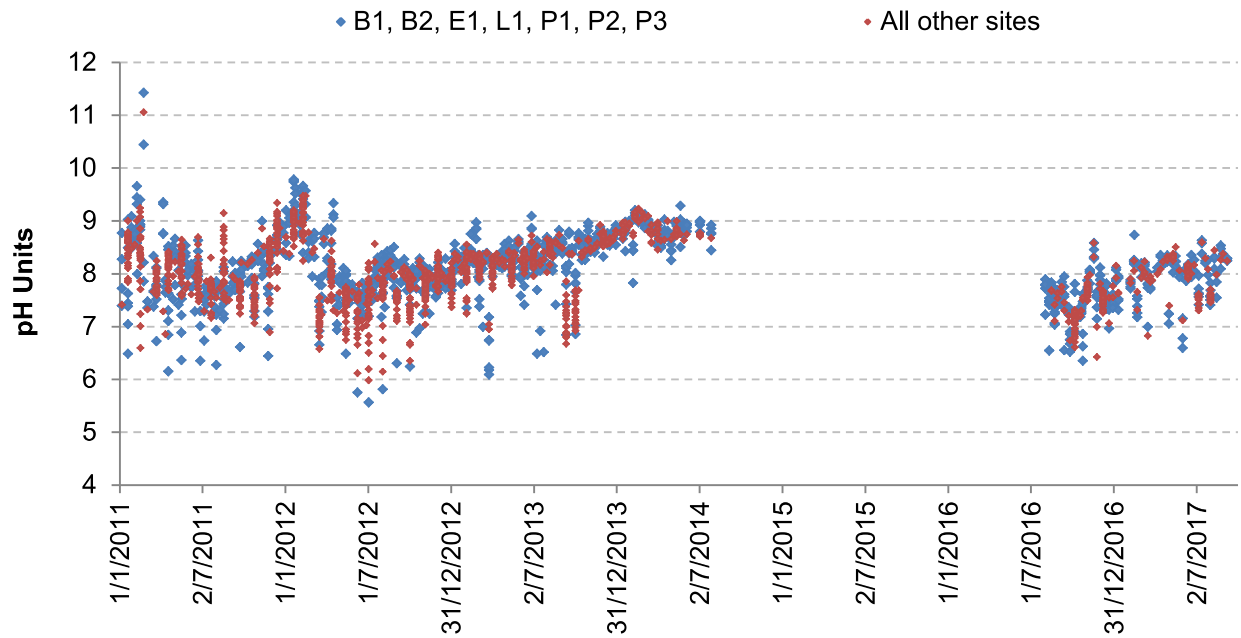


Figure 4 Field Measurements of pH – Lake Cowal

2.3.1.2 Comparison of Monitored Copper Concentrations Across Lake Cowal

The assessment of copper concentrations at sites close to the CGO and sites on the opposite side of the lake is presented in Figure 5. Results of this assessment indicate that copper concentrations have been similar at sites close to the CGO and at sites on the opposite side of the lake.

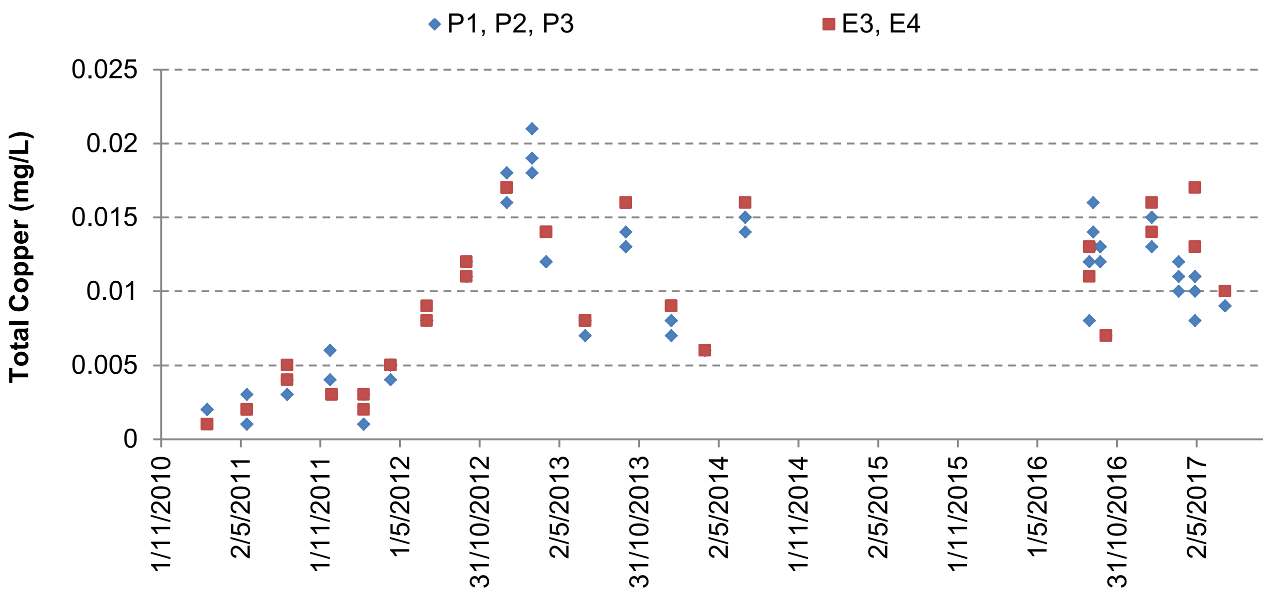


Figure 5 Recorded Copper Concentrations at Selected Sites – Lake Cowal

2.3.1.3 Comparison of Monitored Lead Concentrations Across Lake Cowal

The assessment of lead concentrations at sites close to the CGO and sites on the opposite side of the lake is presented in Figure 6. Results of this assessment indicate that lead concentrations have also been similar at sites close to the CGO and at sites on the opposite side of the lake.

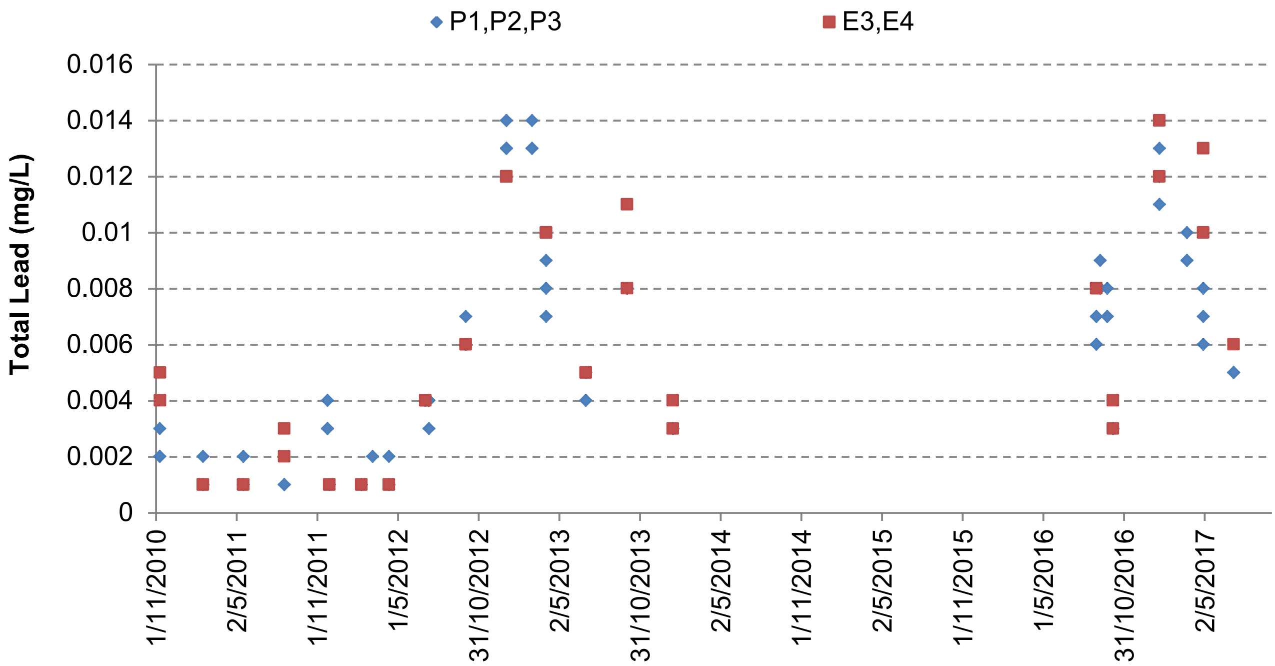


Figure 6 Recorded Lead Concentrations at Selected Sites – Lake Cowal

2.3.1.4 Comparison of Monitored Zinc Concentrations Across Lake Cowal

The assessment of zinc concentrations at sites close to the CGO and sites on the opposite side of the lake is presented in Figure 7. Results of this assessment indicate that zinc concentrations have also been similar at sites close to the CGO and at sites on the opposite side of the lake.

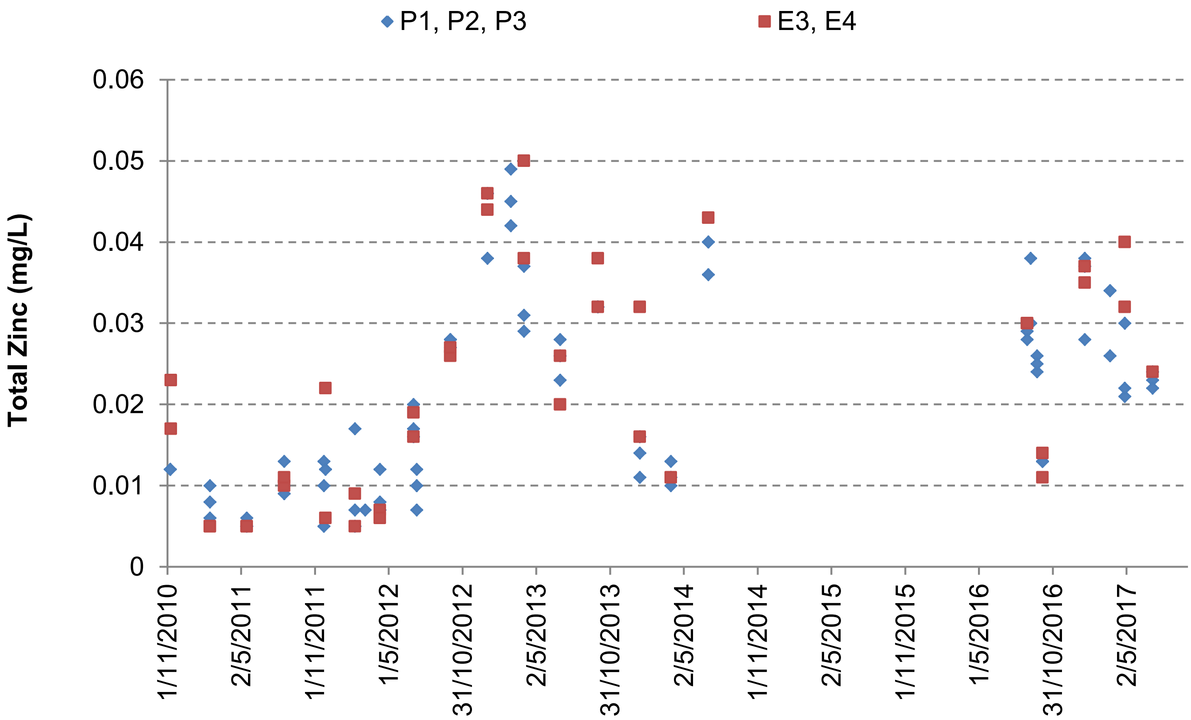


Figure 7 Recorded Zinc Concentrations at Selected Sites – Lake Cowal

2.3.1.5 Comparison of Monitored Turbidity Across Lake Cowal

The assessment of lake turbidity levels indicates a consistent trend of increasing turbidity from March to December 2012 and May to July 2014 at sites both close to the CGO and sites on the other side of the lake – refer Figure 8. It is noted that flood water entered Lake Cowal in March 2012.

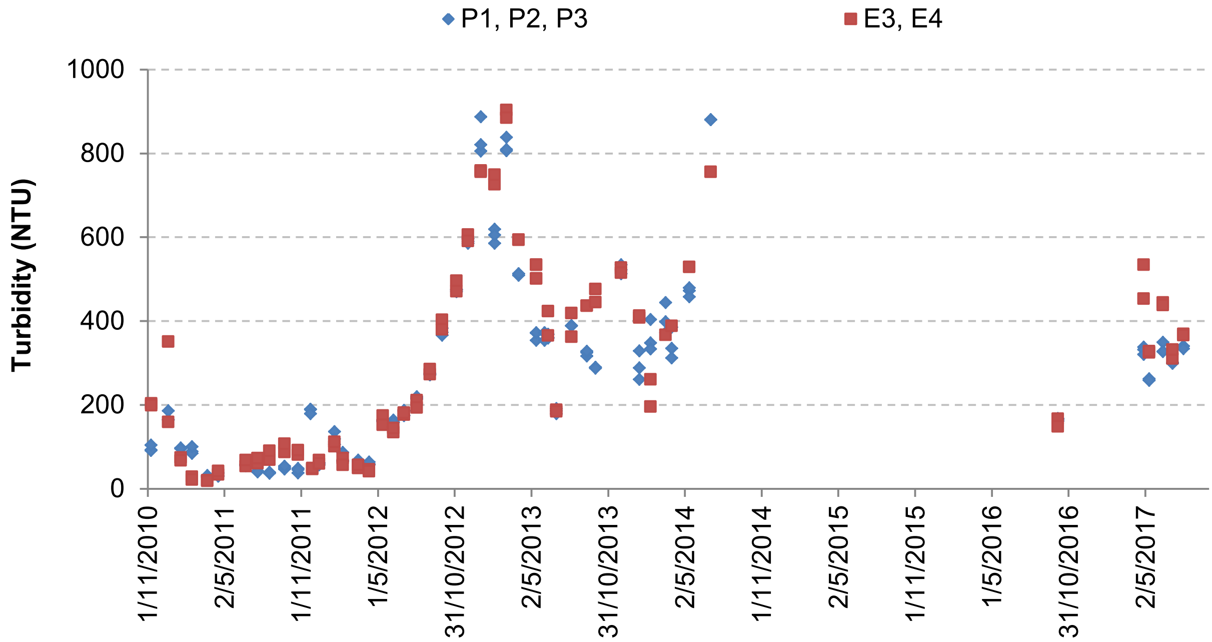


Figure 8 Field Measurements of Turbidity at Selected Sites – Lake Cowal

An assessment of the concurrent trends in lake turbidity and lake water level indicates a period of increasing turbidity followed by a gradual decline. This has occurred uniformly at sites close to and distant from the CGO.

2.3.1.6 Comparison of Monitored Phosphorous Concentrations Across Lake Cowal

Assessment of total phosphorous concentrations indicates that concentrations have been similar at sites both close to the CGO and on the other side of the lake (refer Figure 9).

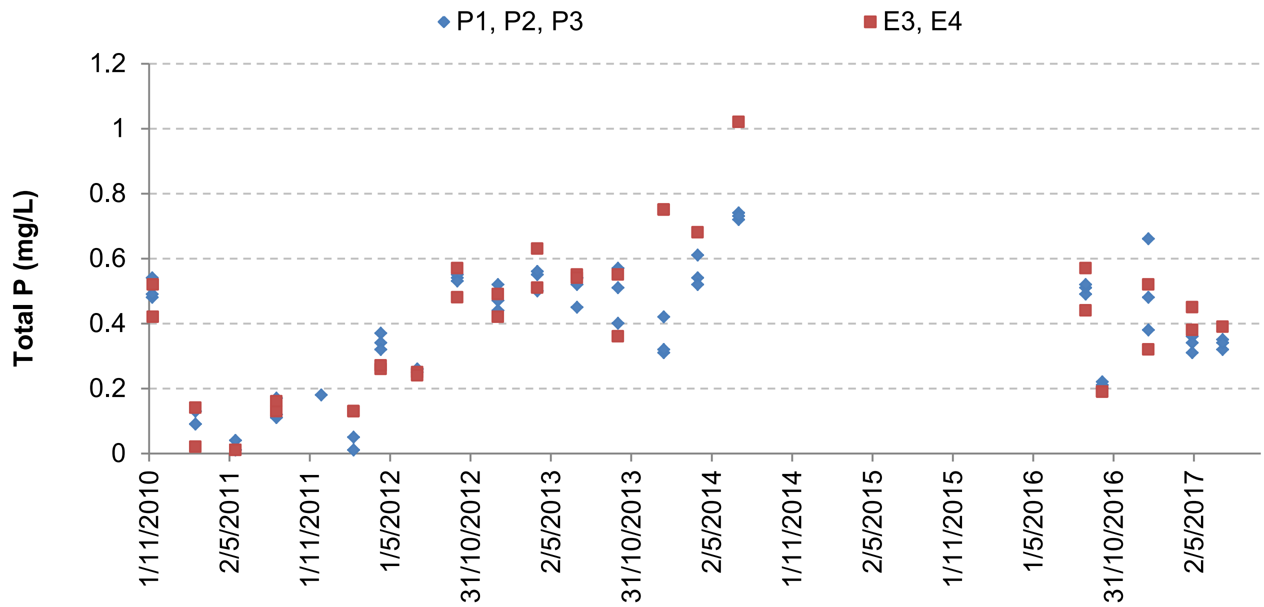


Figure 9 Recorded Total Phosphorous Concentrations at Selected Lake Sites and Lake Water Level

2.3.2 *Other Water Quality Monitoring*

The CGO has provided monitored pH, EC and TSS values in the UCDS from 2007 to September 2017. Recorded pH ranged from 5.9 to 11.16, EC between 25.8 and 19,530 µS/cm and TSS from 4 to 2,140 mg/L.

The CGO has also monitored pH, EC and TSS values for site contained water storages and the open pit over a similar period. Ranges of pH in these site storages have been recorded from 4.4 to 10.3, EC between 122 and 142,700 µS/cm and TSS from 1 to 3,300 mg/L. High recorded EC values reflect, at least in part, the use of water supplied from saline groundwater bores and saline groundwater inflow to the open pit.

2.4 HARVESTABLE RIGHT

Landholders in most NSW rural areas are allowed to collect a proportion of the rainfall runoff on their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right'. Maximum harvestable right dam capacity is the total dam capacity allowed under the harvestable right for a given property. It is based on 10% of the average regional rainfall runoff and takes into account local evaporation rates and rainfall periods.

The regulations (made under the *NSW Water Management Amendment Act, 2014*) relating to harvestable right exclude capture of drainage and/or effluent in accordance with best management practice, and dams constructed to control or prevent soil erosion. None of the storages on-site are used to harvest runoff from land and all storages are used to contain contaminated drainage, mine water or effluent in accordance with best management practice or are used to control soil erosion. It is concluded therefore that all of these storages should be excluded from consideration as a component of the harvestable right calculation.

2.5 GROUNDWATER

The groundwater levels and water quality in the CGO region are described separately in the Hydrogeological Assessment prepared by Coffey (2018) and is provided in Appendix A of the EA.

3.0 CURRENT CGO WATER MANAGEMENT AND WATER SUPPLY

3.1 DESCRIPTION

The CGO currently involves open pit mining and on-site ore processing. On-site ore processing involves crushing and grinding followed by a combined flotation and carbon-in-leach circuits. Tailings produced from the processing plant are deposited in two TSFs. Mine waste rock is placed in waste rock emplacements located to the north, south and east of the open pit (refer Figure 10).

The CGO water management system has been designed such that the approved CGO does not impact on the integrity of Lake Cowal. Mine infrastructure and landforms have been constructed within a contained catchment (i.e. the ICDS). The ICDS combines with the UCDS and the lake isolation system to protect Lake Cowal from CGO development activities. The lake isolation system comprises a Temporary Isolation Bund and a permanent isolation bund (i.e. Lake Protection Bund). The Lake Protection Bund comprises a large engineered embankment that provides a permanent barrier between the lake and the open pit. Runoff from areas upslope of the ICDS (i.e. areas undisturbed by mining) is diverted via the UCDS, around the CGO to Lake Cowal.

The main water demand for the approved CGO is for supply to the process plant. Since the commencement of primary ore processing in mid-2007, the CGO processing rate has averaged 7.2 Mtpa and the water demand[7] (total) has averaged 16.7 ML/day (of which up to approximately 7.6 ML/day on average was supplied by on-site recycling of return water and incident rainfall from the TSF decant ponds). Prior to mid-2007, during the initial oxide ore processing phase[8], the ore processing rate averaged 6.4 Mtpa and the water demand (total) averaged 33.7 ML/day. A higher water demand is required for oxide ore due to the finer, clayey nature of the ore.

The only other significant water demand is for haul road dust suppression. Monitoring data (to mid November 2017) indicates that this demand averages 0.62 ML/day.

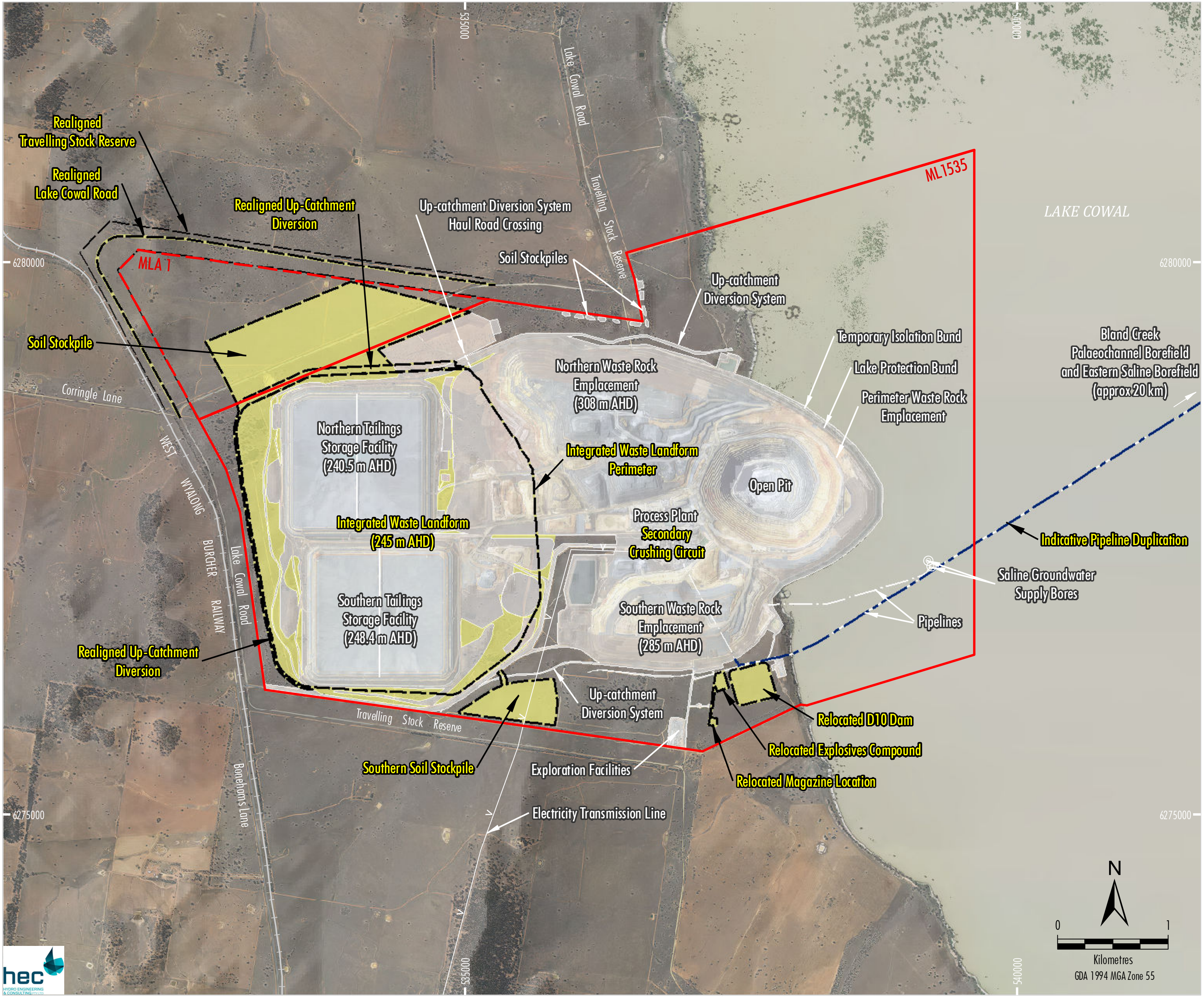
Water supply for the approved CGO involves re-use of mine process water (tailings water reclaim), capture and re-use of runoff from areas within the ICDS, groundwater seepage to the open pit and groundwater sourced from the saline groundwater supply bores within ML 1535 when Lake Cowal is dry. Other external make-up water supply is provided to the site via the mine borefield pipeline and is drawn from three sources (in order of priority):

1. The eastern saline borefield.
2. The Bland Creek Palaeochannel Borefield.
3. Water extracted from the Lachlan River via the Jemalong Irrigation Channel (Figure 11) using regulated flow licences purchased by or temporarily transferred to Evolution on the open market.

The various CGO water management system components and their linkages (via system transfers) are shown in schematic form in Figure 11.

[7] Based on data provided by Evolution to end of June 2017.

[8] Based on data provided as part of the Modification 11 Surface Water Assessment for period from August 2006 to April 2007 (refer Gilbert & Associates, 2013).



LEGEND

- Mining Lease Boundary (ML 1535)
- Mining Lease Application Boundary (MLA 1)
- Approximate Extent of Approved Surface Development
- Approximate Extent of Additional Modification Surface Disturbance
- Modification Component

Source: Evolution (2018); © NSW Department of Finance, Services & Innovation (2017)
Orthophoto: Evolution (Oct 2017)

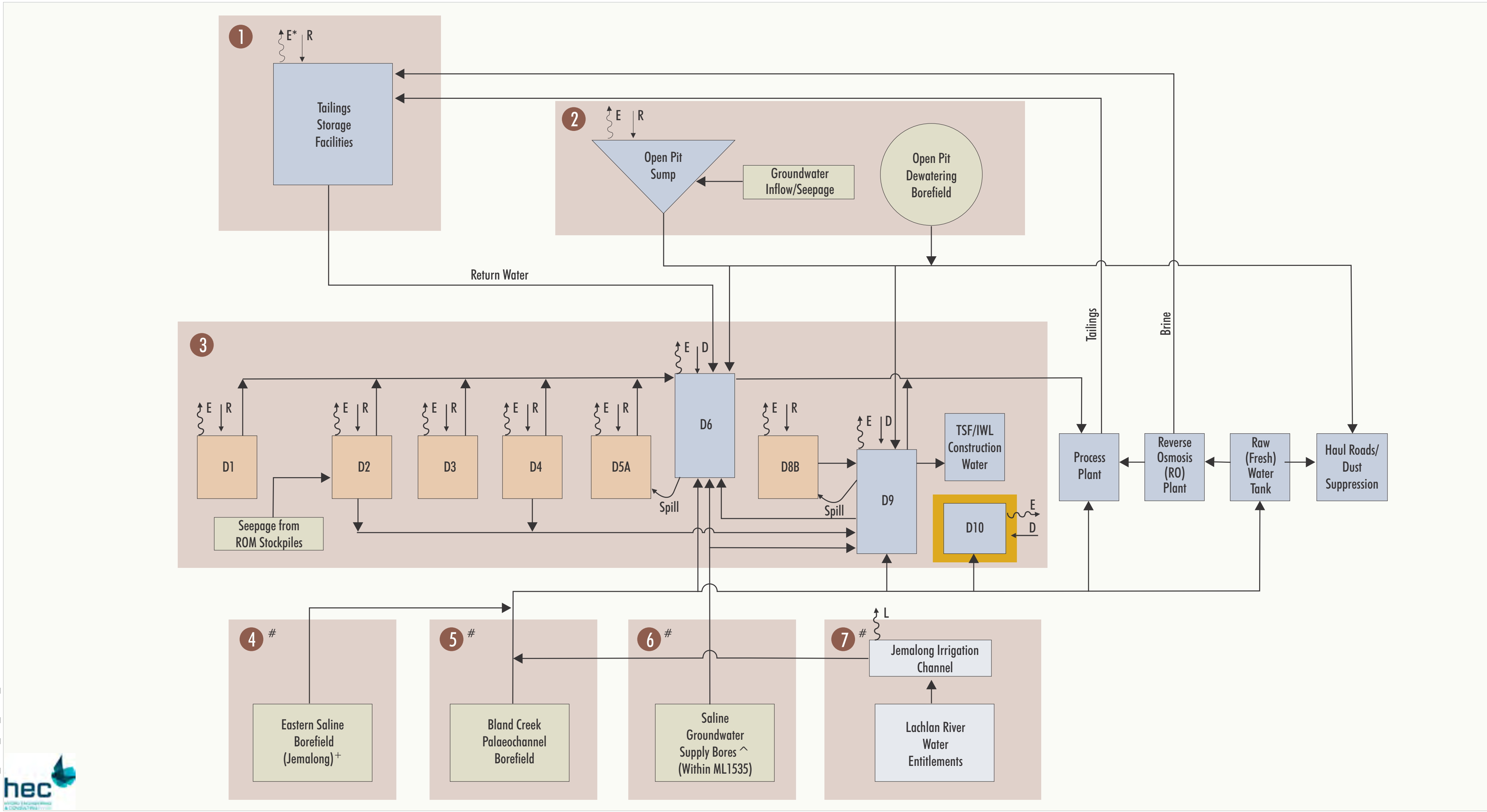
Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION

Modification General Arrangement

Figure 10

HAL-16-41_Mod14_PRM_AppSW_204A



HAL-16-41_Mod14_PRM_AppSW_001B

LEGEND

- R Rainfall Runoff
- D Direct Rainfall
- E Evaporation
- L Channel Losses
- Contained Water Storage
- Groundwater Supply Source
- 1 Water Supply Priority
- Modified Water Storage for the Modification

NOTES:

* Including tailings beach and pond evaporation.

+ Subject to separate approval under the *NSW Environmental Planning and Assessment Act, 1979.*

^ Not accessible when borefield is inundated by Lake Cowal.

Water supply priority from external sources subject to water market conditions.

CGO PROCESSING RATE MODIFICATION

CGO Water Management System Schematic

Figure 11

3.2 CONTAINED WATER STORAGES

The ICDS comprises a series of six internal drainage catchments (each served by a contained water storage for runoff collection) and two water supply storages. Details of the catchment areas and the capacities of the contained water storages are summarised in Table 5. With the exception of D5A, the contained water storages are designed to collect runoff generated from their contributing catchment during a 1% AEP rainfall event of 48 hours duration. Contained water storage D5A and water supply storages D6 and D9 are designed to contain runoff and/or incident rainfall from a 0.1% AEP rainfall event of 48 hours duration. With the exception of storages D1 and D4, all storages would (in the unlikely event) ultimately spill to the open pit. Storages D1 and D4 are equipped with pumps which facilitate dewatering of these storages such that they can be emptied in between rainfall events, as required. Runoff from the outer batters of the perimeter waste rock emplacement ponds against the Temporary Isolation Bund, which has a capacity for at least a 1% AEP rainfall event of 48 hours duration. Water that ponds in this area would be pumped to D6 (via D1 or D4) between rainfall events as required.

Table 5 Summary of Existing/Approved Internal Catchments and Contained Water Storages

Storage	Catchment/Function	Catchment Area (ha)*	Storage Capacity (ML)**
D1	Runoff from northern perimeter of the northern waste rock emplacement.	117	57.8
D2	Runoff/seepage from ROM pad, low grade ore stockpile and from the northern waste rock emplacement area.	335	198.2
D3	Runoff from perimeter catchment surrounding the open pit and the perimeter waste rock emplacement areas.	115	38.1
D4	Runoff from the southern perimeter of the southern waste rock emplacement.	51	62.3
D5A	Process plant area runoff collection.	90	78.6
D6	Process water storage. Main source of process plant make-up.	11	19.3
D8B	Runoff from southern waste rock emplacement and area between southern TSF and D9.	200	30.4
D9	Process water storage and storage for raw water.	Incident area	730.7
D10†	Process water storage and storage for raw water.	Incident area	1,500

ha = hectares

* Estimated from 2016 contour plans provided by Evolution.

** Calculated from as-built plans and confirmed by Evolution.

† Approved storage D10 is yet to be constructed. Planned volume decreased from 1,637 ML in HEC (2016).

3.3 PIT DEWATERING

Pit inflows occur via groundwater seepage, incident rainfall and rainfall runoff from areas surrounding the open pit. The catchment area draining to the open pit varies from approximately 110 ha in 2016 up to 132 ha at the end of processing. The open pit would also be the final water containment point in the event of overflow from any of the contained water storages (except D1 and D4 which are emptied by pumping) or in the highly unlikely event of a spill from the TSFs.

Inflows to the open pit accumulate in a sump in the pit floor and are pumped to storage D6.

Groundwater inflow predictions made as part of the Cowal Gold Project EIS (North Limited, 1998) were for quite high groundwater inflow rates. Significantly lower groundwater inflow rates have been encountered in practice as described in Coffey (2018).

3.4 WASTE ROCK EMPLACEMENT WATER MANAGEMENT

Mine waste rock from open cut mining operations is placed in three waste rock emplacement areas: the northern, southern and perimeter waste rock emplacements. The northern and southern waste rock emplacements are integral with the perimeter waste rock emplacement which is a component of the permanent lake isolation system. The outside faces of the northern and southern waste rock emplacements form part of the perimeter catchment limits of the approved CGO. The northern waste rock emplacement is the largest of the emplacement areas.

Runoff from the external face of the northern waste rock emplacement reports to contained water storage D1 which has been constructed below the external (north-eastern) toe of the northern waste rock emplacement area and is dewatered by pumping to storage D6.

Runoff from the external face of the southern waste rock emplacement reports to contained water storage D4 which has been constructed below the external (south-eastern) toe of the southern waste rock emplacement area and is dewatered by pumping to storage D6 or D9.

Runoff from the perimeter waste rock emplacement area reports to the storage which forms between the toe of the perimeter waste rock emplacement and the Temporary Isolation Bund. Water that accumulates in this storage is returned to D6 as required.

3.5 TAILINGS STORAGE FACILITY WATER MANAGEMENT

Tailings material is deposited into the two TSFs (i.e. northern tailings storage facility [NTSF] and southern tailings storage facility [STSF]) as a slurry, normally under sub-aerial conditions. The TSFs comprise confining embankments raised above the surrounding natural surface and, as such, their catchment area comprises only the area inside the confining embankments – estimated to be approximately 148 ha for the NTSF and 139 ha for the STSF[9]. Tailings are discharged to only one TSF at any given time. Once the tailings level has risen to its design level, discharge is switched to the other TSF while the confining embankment of the first TSF is raised.

In general, tailings are deposited through a 450 mm nominal diameter polyethylene pipeline which runs from the process plant to the TSFs and around their perimeter embankments. There are spigots (smaller pipe sections) exiting from the deposition pipeline around the circumference of each TSF, which deposit tailings around the perimeter of the inside of the TSF. Within each spigot is a gate valve which is used to alternate the locations of the deposition, allowing for intermittent drying times of the deposited tailings and for a consistent tailings beach height around the perimeter of the operational TSF. Tailings are discharged around the perimeter of the TSF and solids settle as they flow towards the centre of each TSF. Rainfall runoff and free water liberated during settling and consolidation of the tailings (termed ‘bleed’ water) accumulate in an internal (central) decant pond witin each TSF. Water within the decant pond (from rainfall) of the inactive TSF may be pumped to the active TSF. Water from the decant pond of the active TSF is pumped to storage D6 for re-use in the process plant. The TSFs have been designed to maintain a minimum freeboard sufficient to store at least the contingency 0.1% AEP rainfall event at all times[10].

[9] Estimated from 2016 contour plan provided by Evolution.

[10] 1:1,000 AEP rainfall is calculated using procedures described in Institution of Engineers Australia (1998) by interpolation in between the 1:100 AEP rainfall and the probable maximum precipitation (PMP). The 1:100 AEP rainfall is obtained from the BoM. The PMP is calculated using methods published by BoM (2003).

4.0 FUTURE CGO WATER MANAGEMENT AND WATER SUPPLY

4.1 WATER MANAGEMENT

4.1.1 Staged Future Development

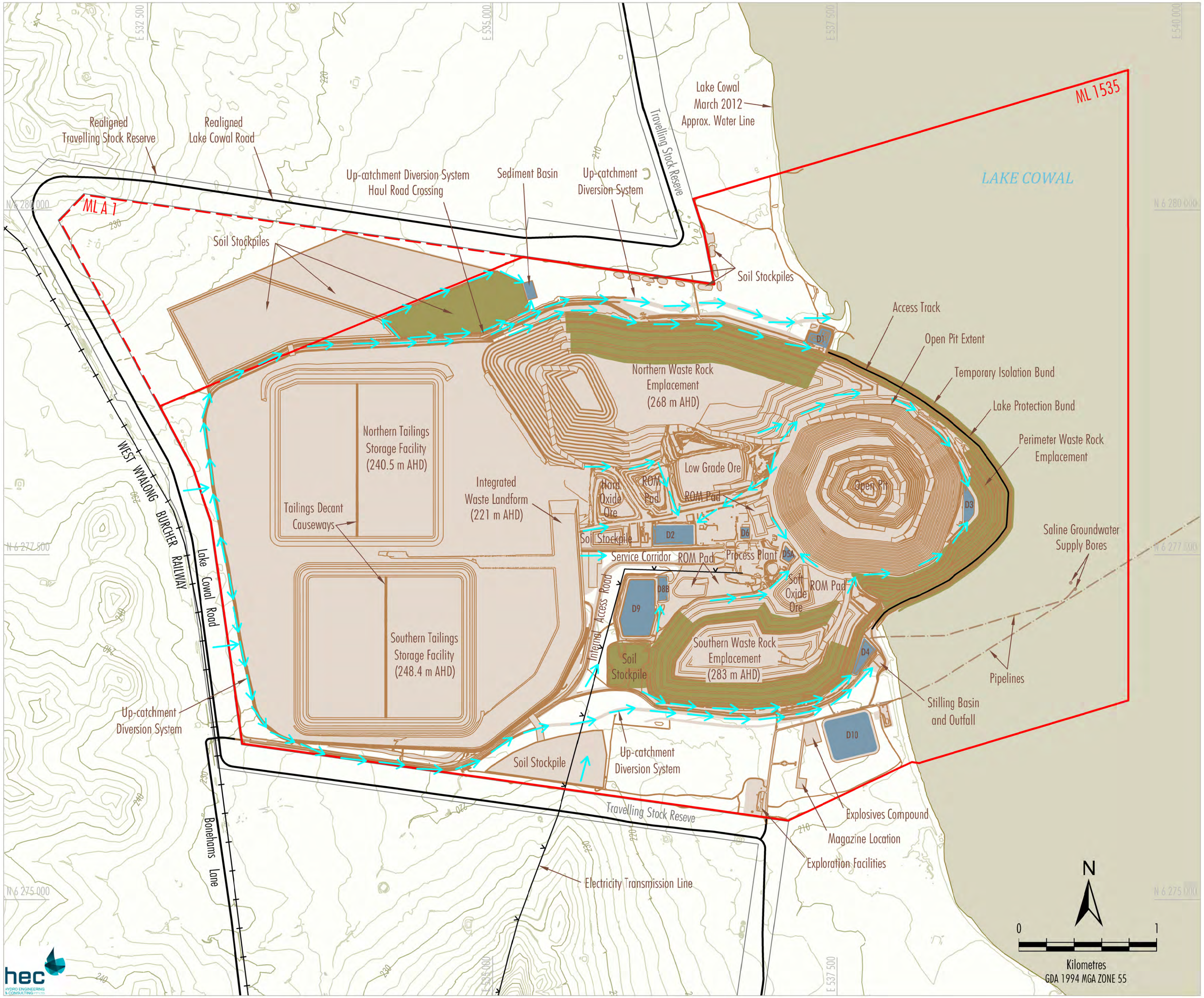
The future development of the CGO surface facilities is shown in a series of stage plans (Figure 12 to Figure 15) showing the layout of surface facilities and drainage at 2020, 2024, 2030 and the end of mining. Part of the Modification involves development of the IWL, encompassing the two existing TSFs (refer Section 4.1.2). This expanded landform will also involve reconstruction of the UCDS and the ICDS.

By 2020 (Figure 12), the UCDS and ICDS would have been reconstructed outside the planned ultimate extent of the IWL. The two would be constructed as parallel excavated drains around the planned perimeter of the IWL, with the inner drain comprising the ICDS and the outer drain the UCDS. Prior to construction, topsoil would be stripped from the plan area of the reconstructed UCDS and ICDS and stockpiled. Both the UCDS and ICDS would commence (i.e have their highest invert levels) adjacent to the western perimeter of the IWL, approximately at the point adjacent to the area between the two existing TSFs. From this point, both would drain to either the north and around the northern boundary of the IWL or to the south. The northern limb of the ICDS would link into toe drainage north of the northern waste rock emplacement which discharges to storage D1. Similarly the northern limb of the reconstructed UCDS would link into the existing UCDS near the north-western corner of the northern waste rock emplacement. The southern limb of the ICDS would discharge into the catchment of storage D8B. The southern limb of the reconstructed UCDS would link into the existing UCDS near the south-western corner of the STSF. The capacities of the reconstructed UCDS and ICDS would be the same as the existing UCDS[11] and ICDS. A haul road crossing over the northern limbs of the ICDS and UCDS would be constructed to allow access to an expanded soil stockpile area which would be located outside the UCDS, within MLA 1. The crossing would be constructed to maintain the capacities of the UCDS and ICDS. Design concepts for the reconstructed UCDS are provided in Section 4.1.3 below.

Also by 2020, placement of soil would occur in the stockpile area within MLA 1. Prior to placement of soil material in this stockpile area, upslope runoff would be directed around the area via a system of diversion drains/bunds. Runoff from the soil stockpile area itself would be directed to a currently approved sediment basin to be constructed at the eastern boundary of the stockpile area. The upslope stockpile diversions and the sediment basin would be constructed and maintained in accordance with the guidelines in Landcom (2004) and DECCW (2008). The northern waste rock emplacement would have expanded westwards towards the NTSF up to an elevation of 268 m Australian Height Datum (AHD). The IWL perimeter embankment would have been partially constructed (south-eastern portion) using waste rock material. Storage D10 (new water storage) would be constructed (refer Section 3.2) to the south-east of the southern waste rock emplacement and outside the UCDS. Storage D10 would be constructed in a similar fashion to existing storage D9 with a cut to fill confining embankment, with only its catchment area comprising its own surface area. Duplication of the existing water supply pipeline across Lake Cowal would be completed.

The open pit extent has increased slightly and, as a result, D5 has been augmented as D5A, which has been constructed with adequate capacity to capture all runoff generated from its contributing catchment during a 0.1% AEP rainfall event of 48 hours duration.

[11] The UCDS has a 0.1% AEP design conveyance capacity - North Limited (1998).



Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION

Conceptual General Arrangement Year 16 (2020)

Figure 12

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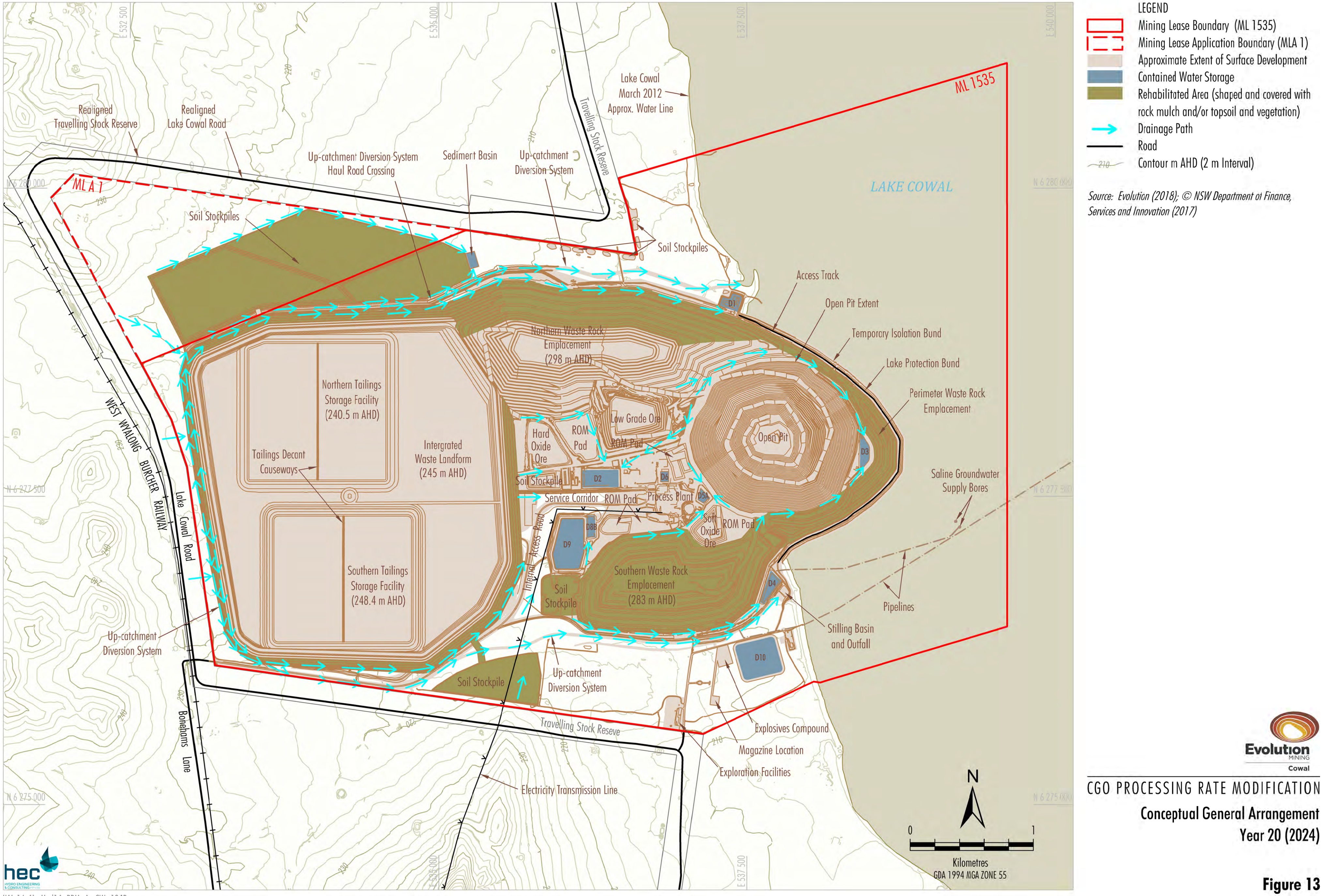


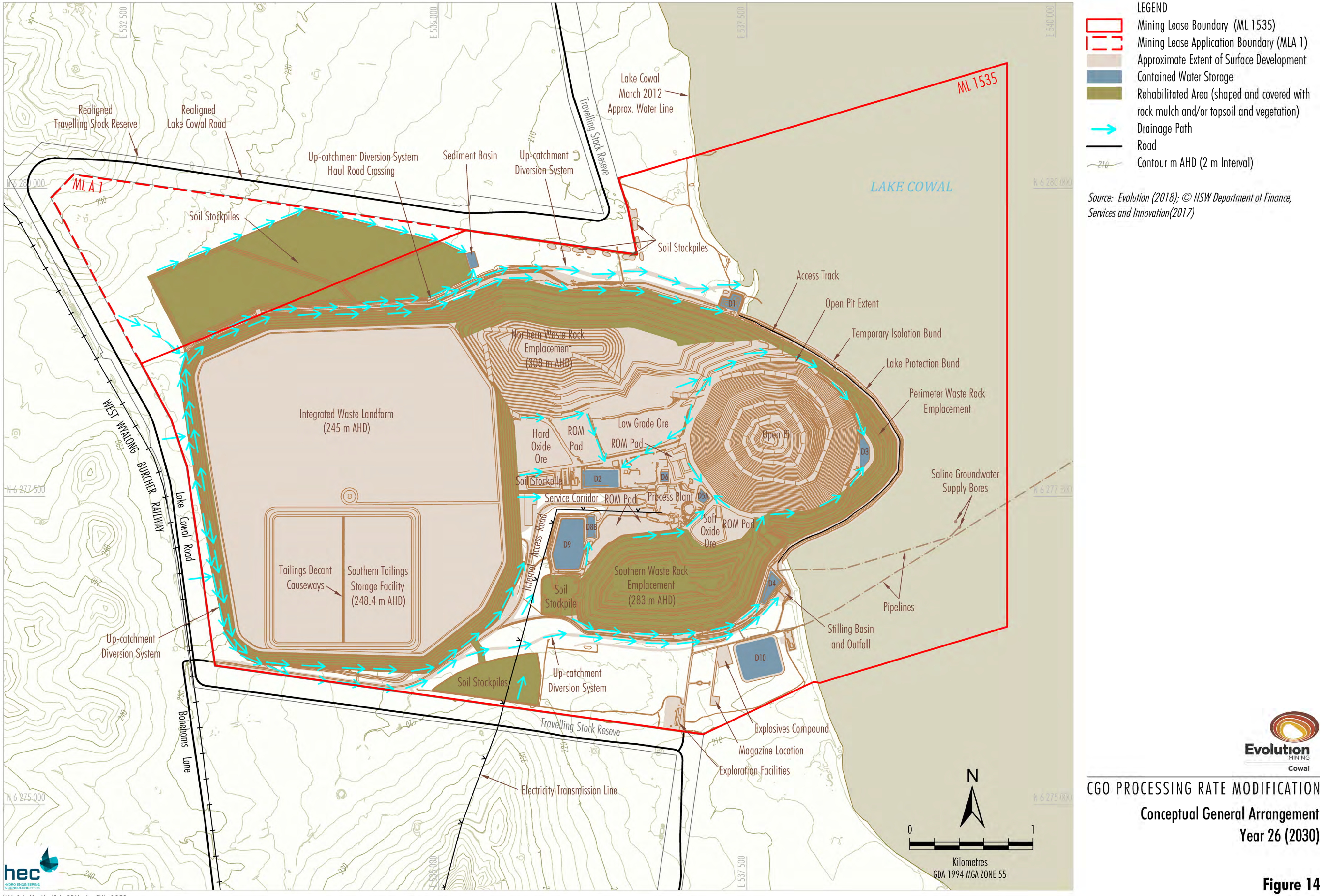
Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION

Conceptual General Arrangement Year 20 (2024)

Figure 13

HAL-16-41_Mod14_PRM_AppSW_104B



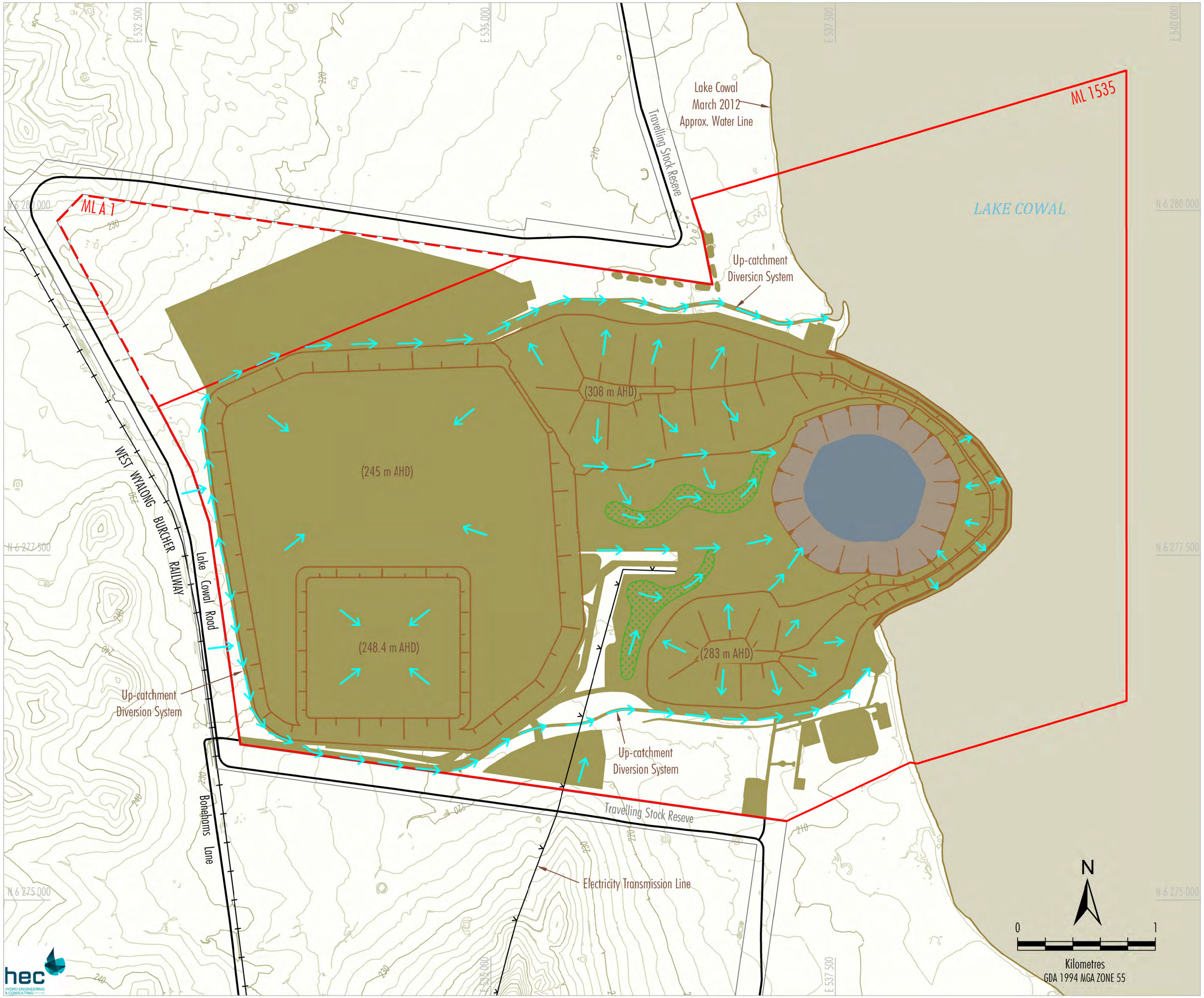
Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION

Conceptual General Arrangement
Year 26 (2030)

Figure 14

HAL-16-41_Mod14_PRM_AppSW_105B



Evolution Mining Cowal

CGO PROCESSING RATE MODIFICATION

Conceptual General Arrangement Post-mining

Figure 15

HAL-16-41_Mod14_PRM_AppSW_106A

In addition, the explosives compound and magazine would be located outside of the UCDS. Water management at this infrastructure would be consistent with the principles in the current Water Management Plan (Evolution, 2015), including:

- minimising disturbance areas;
- containment of potentially contaminated water; and
- recycling of contained water.

Accordingly, water management of this infrastructure would involve a contained catchment, with captured water stored and pumped back to the CGO water management system.

Soil recovered from the foundation of the expanded northern waste rock emplacement, D10 and the IWL area would be placed either in existing stockpiles within ML 1535 or the planned stockpile located within MLA 1. Any works outside the UCDS (e.g. D10 construction, pipeline duplication, soil stockpile development) would include erosion and sediment control measures designed in accordance with Landcom (2004) and DECCW (2008). Disturbance areas would be minimised during construction by restricting construction vehicles to designated access roads/tracks or along the pipeline corridor construction area itself. During the burial of the pipeline, a temporary silt curtain would be erected around the disturbed area to trap fine sediment and prevent suspended material migrating into the main body of the lake (North Limited, 1998 and Appendix D of Landcom, 2004). Temporary sediment traps and sediment filters (eg. straw bale sediment filter, sediment fences) would be installed where necessary downslope of disturbance areas in accordance with Section 6.3.7 of Landcom (2004). The temporary erosion and sediment control systems would remain in place until all earthwork activities are completed and the disturbed area is rehabilitated.

By 2024 (Figure 13) the perimeter embankment of the IWL would have reached its full planned extent. The northern waste rock emplacement would have expanded slightly and reached a maximum elevation of 298 m AHD. The low grade ore stockpile north-east of storage D2 would have been developed further. Rehabilitation would have advanced on the southern waste rock emplacement, around the perimeter of the northern waste rock emplacement and in parts of the IWL embankments.

Toward the end of the mine life (Figure 14 and Figure 15) the waste rock emplacements would have been completed to their maximum elevation and rehabilitation works would be well advanced (refer also Section 6.0).

Runoff from waste rock emplacements (including the batters of the IWL) would continue to be directed to contained water storages. A geochemical assessment was prepared as part of the Modification 13 EA by Geo-Environmental Management (2016). The assessment report states that:

> *Because the waste rock, pit wall rock, low grade ore, ROM ore and tailings are expected to be relatively geochemically similar to those from the current pit configuration no changes to the site water quality monitoring programs for the pit, waste rock emplacements, low grade ore stockpile, ROM ore stockpile, and tailings storage facilities are expected to be necessary. However, it is recommended that these programs be reviewed on an annual basis, and modified as necessary, in order to maintain and rationalise these programs.*

4.1.2 Integrated Waste Landform

As outlined in Section 4.1.1, the IWL is proposed to encompass the existing TSFs and provide adequate tailings storage capacity for the planned mine life.

The confining embankment of the IWL would be constructed as a zoned earth and rockfill embankment using select mine waste material, including a low permeability compacted oxide (clayey) zone. The initial (Stage 1) embankment will be constructed around the south-eastern perimeter of the IWL (refer Figure 12). Seven stages of embankment construction are planned between 2020 and 2024, with the final embankment reaching a crest level of 245 m AHD. The embankment would integrate with and key into the northern embankment of the existing NTSF and the southern embankment of the existing STSF. A cut-off trench would be constructed beneath the IWL along its full perimeter to control seepage. Water for use in embankment construction (for fill conditioning and dust suppression) would be sourced from storage D2 or, if there was insufficient water in D2, from D9.

Full peripheral discharge is planned for the IWL in a manner similar to the existing TSFs as described in Section 3.5, with tailings discharge cycled around the IWL perimeter. Initially (e.g. during Stage 1) discharge may only occur from the initial embankment. Ultimately, as the tailings beach forms around the full periphery of the IWL, tailings will infill the areas around and between the existing TSFs and cover the existing NTSF embankment.

A single central decant is planned for water reclaim, located between the existing STSF and NTSF (refer Figure 13), comprising a pontoon mounted decant pump located within a circular (in plan) coarse rockfill decant structure. Water reclaim would continue to be pumped to storage D6. During the initial operation of the IWL (e.g. during Stages 1-3) temporary pumping may be required from water which accumulates between the edge of the initially forming tailings beach and the central decant; or alternatively trenches or diversion drains may be excavated to facilitate drainage to the central decant prior to the tailings beach establishing from the perimeter embankment to the central decant. Evolution have indicated that it is expected there will be a reduction in the rate of recovery of water from settling and consolidation of tailings within the IWL during approximately the first three years of the operation of the IWL. Such a reduction in the reclaim rate has been included in water balance modelling (refer Section 5.0).

4.1.3 Reconstructed Up-Catchment Diversion System

The alignments of the existing and proposed reconstructed UCDS are shown in Figure 10. The existing UCDS comprises, along most of its length, a trapezoidal cross-section excavated drain and a bund on its downslope (mine) side. Along the western side of the IWL (which comprises the majority of the UCDS that would be reconstructed), the drain has an approximate base width of between 1 to 2 m, side slopes of 1V:5 to 7H and follows the existing surface topography.

The objective of the reconstructed UCDS would be to mimic the existing UCDS dimensions and profiles. Channel stabilisation (e.g. using durable rockfill or stilling basins) may be required at the intersection with existing gully lines and the transition into the existing UCDS. Vegetation will likely form a pivotal role in the medium and longer-term stability of the reconstructed UCDS and revegetation would be addressed as an integral part of the design.

An erosion and sediment control plan would be developed and implemented ahead of the UCDS reconstruction. Erosion and sediment control measures may include:

- stabilisation of any exposed dispersive soils using gypsum and rapid revegetation (eg. topsoil and hydromulch/jute mesh);
- the use of silt fence, straw bale filters or temporary sumps to capture sediment;
- temporary upslope diversions;
- fecing to exclude stock and larger native fauna; and
- a vegetation specification.

These measures would be developed in accordance with Landcom (2004) and DECCW (2008) guidelines.

An underdrainage system is planned along the IWL eastern perimeter embankment to assist in water recovery and seepage mitigation. The underdrainage system will comprise two internal sumps with pumps installed within inclined bores to recover seepage. Recovered seepage would be pumped to either the central decant or storage D6.

The final IWL outer embankment profile will have an overall slope of 1V:4H, including intermediate benches.

4.2 WATER SUPPLY

4.2.1 General

The main water demand for the CGO would continue to be the requirements of the process plant as well as dust suppression (e.g. haul roads) and other potable and non-potable uses. Water demand is linked to ore processing rates and the type of ore being processed. Proposed future ore processing at the CGO is summarised as follows:

- The primary ore processing rate would rise from the current average 7.2 Mtpa to between 7.3 to 9.4 Mtpa from 2018 to 2029.
- Between 2019 and 2029, oxide ore would be concurrently processed at 0.4 Mtpa. A peak combined processing rate of 9.8 Mtpa would occur in 2024.
- From 2030 onwards, the primary ore processing rate would reduce, while the oxide ore processing rate would increase for two years, reaching a peak of 6.8 Mtpa in 2031.

Annual proposed processing tonnages are given in Table 6.

Table 6 Proposed CGO Ore Processing Rates

Year	Oxide Ore (Mt)	Primary Ore (Mt)	Total (Mt)
2018	0	7.4	7.4
2019	0.4	7.4	7.8
2020	0.4	7.5	7.9
2021	0.4	8.2	8.6
2022	0.4	9.0	9.4
2023	0.4	9.1	9.5
2024	0.4	9.4	9.8
2025	0.4	9.4	9.7
2026	0.4	9.1	9.5
2027	0.4	7.3	7.7
2028	0.4	7.3	7.7
2029	0.4	7.3	7.7
2030	5.0	4.5	9.5
2031	6.8	2.0	8.8
2032	0	3.3	3.3

Mt = Million tonnes.

Note: Descrepancies in totals due to rounding.

It is estimated that the average process plant demand (total) at the above processing rates would be 21.9 ML/day for 2019 to 2029 while processing mainly primary ore, while the average water demand (total) in 2031, when oxide ore processing peaks, would be 35.5 ML/day (refer Section 5.0).

Water supply would continue to be sourced primarily from on-site sources, with make-up from external water supply sources. The order of priority of water supply sources would be:

1. Reclaim from the IWL decant pond.

2. Pumping from the open pit dewatering bores and sump.
3. Water from contained water storages (transferred to either storage D6 or D9 as indicated on Figure 12).
4. Groundwater from the eastern saline borefield via the mine borefield pipeline.
5. Groundwater from the Bland Creek Palaeochannel borefield via the mine borefield pipeline (consistent with existing licensed limits – refer Section 4.2.4).
6. Groundwater from the saline groundwater bores located with ML 1535 when lake conditions allow.
7. Water accessed from the Lachlan River via the Jemalong Irrigation Channel using regulated flow licences purchased by Evolution on the open market.

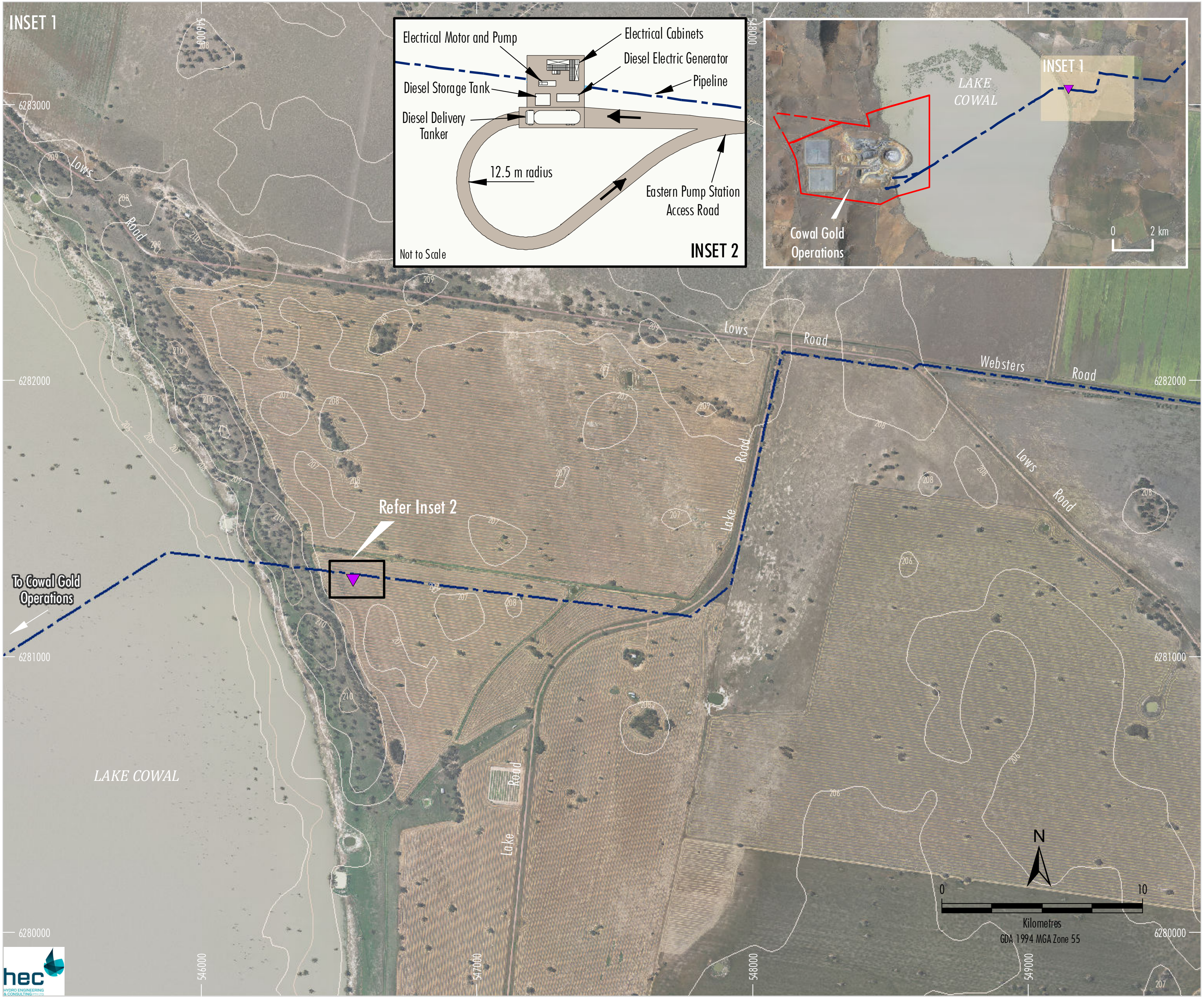
In order to maintain a secure water supply for the increased processing rates and during the majority oxide ore (higher water demand) processing period, Evolution will augment the CGO water supply system by:

A. Construction of the approved process water storage D10 with a design capacity of 1,500 ML.
B. Increasing the capacity of the external water supply pipeline (the capacity of the pipeline across Lake Cowal, supplying water from sources 4, 5 and 7 above, was approved for upgrade via the construction of a new pump station, as described in Modification 11) from 11 ML/day to 14 ML/day.

The increased water supply pipeline capacity and storage D10 construction is expected to be commissioned in December 2019. Note that both these works were approved as part of Modification 11 – only the timing of their implementation has changed as part of the current Modification, as well as the location of storage D10 and its capacity.

Storage D10 would effectively act as an enlarged storage D9, with water shared between the storages and used to provide make-up supply to the process plant. The proposed system would be managed such that storages D9 and D10 were as full as possible at the commissioning of the IWL in 2021 and at the start of the predominantly oxide ore processing campaign in 2030 (supplied by on-site sources and the increased capacity of the external water supply pipeline). Water balance model simulation of the proposed system (Section 5.0) indicates that storages D9 and D10 may draw down during the early stages of IWL operation and during the predominantly oxide ore processing campaign.

The increased capacity of the external pipeline will include construction of the approved eastern pump station located outside the bounds of the Lake Cowal full level and away from drainage paths. The approved pumping station will be located in a secure fenced area served by a graded road on the eastern side of Lake Cowal (Figure 16). The approved access road will be designed to provide "all weather" access to the pumping station. Note that these works were approved as part of Modification 11.



LEGEND
Mining Lease Boundary (ML 1535)
Mining Lease Application Boundary (MLA 1)
Mine Water Supply Pipeline (Including Pipeline Duplication)
Eastern Pump Station Location

Source: Evolution (2018); © NSW Department of Finance, Services & Innovation (2017)
Orthophoto: Evolution (Oct 2017)

Evolution MINING Cowal

CGO PROCESSING RATE MODIFICATION
Eastern Pump Station

Figure 16

HAL-16-41_Mod14_PRM_AppSW_202A

4.2.2 Saline Groundwater Supply Bores

Currently, two saline groundwater supply bores are located within ML 1535 to the south-east of the open pit (Figure 10). Continued operation of the existing saline groundwater supply bores is proposed for the mine life.

Pumping tests (Coffey, 2009) indicate that a borefield of approximately four bores could supply up to 1 ML/day of saline water (with an EC of approximately 40,000 μS/cm) from the saline groundwater supply bores for use in the process plant. During periods when Lake Cowal is inundated, the bores would be shut-down and capped. Therefore the bores would operate in drier times and be rested in wetter times. At various times during the mine life, sourcing water from the saline groundwater supply bores would reduce demand on the other external water supply sources.

4.2.3 Eastern Saline Borefield

The eastern saline borefield is located approximately 10 km east of Lake Cowal's eastern shoreline (Figure 2). Pump tests (Groundwater Consulting Services Pty Ltd, 2010) indicated that two bores could supply approximately 1.5 ML/day of saline water (with an EC of approximately 12,000 μS/cm). Average extraction since commissioning of the borefield has been approximately 0.4 ML/day (Coffey, 2018). The borefield is currently approved for the life of the mine.

4.2.4 Bland Creek Palaeochannel Borefield

Extraction from the Bland Creek Palaeochannel Borefield (Bores 1 to 4) would continue for the mine life.

Groundwater extraction from the Bland Creek Palaeochannel borefield is limited by daily and annual licensed volumetric limits, as follows:

- maximum daily rate: 15 ML/day; and
- maximum annual extraction: 3,650 ML.

Extraction would be managed to maintain groundwater levels above established Department of Industry - Water (DI - Water) (formerly DPI Water) trigger levels.

Although Coffey (2018) have modelled continuous extraction of 5.9 ML/day (note: combined between the eastern saline borefield and the Bland Creek Palaeochannel Borefield) as being sustainable with respect to maintaining groundwater levels above the DI - Water trigger levels, it is intended that sourcing water from this borefield would continue in a similar manner as occurs currently, by alternating between this source and the Lachlan River to manage groundwater levels and provide flexibility with respect to extraction rates and the availability of temporary water in the Lachlan River during "good" years.

4.2.5 Lachlan River

The proposed external water supply arrangements for the remaining mine life involve continued purchase of temporary water from the Lachlan River regulated water source. CGO's high security and general security zero allocation water access licences enable trade of temporary water.

This supply source has proven to be reliable throughout the operating history of the approved CGO – Table 7 summarises annual extraction volumes, from records supplied by Evolution. In 2017, up to 30 June, there had been no extraction.

Table 7 Annual CGO Lachlan River Extraction Volumes

Year	Approximate Volume (ML)
2007	2,400
2008	1,980
2009	1,600
2010	0
2011	857
2012	438
2013	1,113
2014	1,841
2015	1,661
2016	135
2017	0*

ML = megalitres
* To 30 June 2017.

DI - Water trading records show that between approximately 4,000 ML and 274,000 ML of temporary water has been traded annually in the Lachlan River Regulated Water Source since records began in the 2004 to 2005 season. All general security accounts were reset on 8 March 2012 to 136% following the first spill of Wyangala Dam since December 2000. From 1 July 2011 to 1 July 2015, the available water determinations (AWDs) were zero but since then has ranged from 4% on 7 August 2015, 16% on 2 September 2015, 5% on 2 October 2015, 18% on 1 July 2016, 25% on 15 July 2016, 9% on 5 September 2016, 5% on 10 April 2017, 2% on 15 June 2017 and zero on 1 July 2017. As at 14 August 2017[12], AWDs for general security accounts were 2%, with high security accounts at 100%. DPI-Water will continue to closely monitor rainfall and river inflows as well as usage in the valley to determine when subsequent changes to AWDs are made. As at 17 February 2018, Wyangala Dam reservoir was at 72.7 % of capacity[13].

Future water supply requirements (from external water sources and ultimately licensed extraction from the Lachlan River) have been estimated using a water balance model (refer Section 5.0). The median predicted annual demand from the Lachlan River peaks at approximately 2,854 ML. In relation to the projected CGO requirements during the Modification, it appears that, based on DI - Water trading records, there has in previous years been adequate temporary water available on the market from this source.

[12] NSW Water Register (DPI Water, 2017) http://www.water.nsw.gov.au/water-licensing/registers
[13] Refer http://realtimedata.water.nsw.gov.au/water.stm

5.0 SIMULATED PERFORMANCE OF WATER MANAGEMENT SYSTEM

The ability of the water management system to achieve its operational objectives was assessed by simulating the dynamic behaviour of its water balance over the remaining mine life (from the start of July 2017) under a range of different climatic conditions that may be encountered. A water balance model of the CGO water management system has been developed to simulate its behaviour. The model structure is generally as per the schematic in Figure 11, with planned new raw water storage D10 modelled as an expansion to D9 from September 2019 onwards (refer Section 4.2.1).

The structure of this section is as follows:

- A description of the model structure, set-up data and assumptions (Section 5.1).
- Details of model predictions for the remaining mine life (Section 5.2).
- A qualitative assessment of the possible effects of climate change on model results (Section 5.3).
- A summary of water storage interaction with Lake Cowal (Section 5.4).

5.1 MODEL DESCRIPTION

5.1.1 General

The water balance model developed for the CGO simulates all the inflows, outflows, transfers and changes in storage of water on-site at each model time step (i.e. 4-hourly basis). The model simulates changes in stored volumes of water in all site storages (contained water storages, TSFs, the IWL and open pit) in response to inflows (rainfall runoff, groundwater inflow, tailings water, groundwater bore extraction and licensed extraction from the Lachlan River) and outflows (evaporation, process plant use and dust suppression use).

For each storage, the model simulates:

Change in Storage = Inflow – Outflow

Where:

Inflow includes rainfall runoff, groundwater inflows to the open pit, water liberated from settling tailings ('bleed' water – for the TSFs and IWL) and all pumped inflows from other storages, groundwater bores or the Lachlan River (via the Jemalong irrigation channel).

Outflow includes evaporation and all pumped outflows to other storages or to a water use[14].

Runoff from all mine areas (i.e. within the ICDS) is modelled as reporting to one of the contained water storages or the open pit. Pumping rates between model storages were set based on information consistent with that provided for the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013).

[14] The model also provides for and tracks spill if the simulated storage capacity of a water storage is ever exceeded.

The main water use at the CGO is for supply to the Process Plant. As indicated in Section 4.2.1, a priority system is in use (and was modelled) for supply to contained water storage D6 (the main supply source for the Process Plant). Supply is first drawn from the TSFs (return water), the open pit and contained water storages. Make-up supply is then sourced (to top-up storages D6 and D9/D10) from the three water supply borefields (refer Section 4.2.1). Ultimate make-up supply is then drawn from Lachlan River water entitlements. Lachlan River water is sourced via the Jemalong Irrigation channel – a channel loss rate of 1.3 ML/day was assumed based on information provided as part of the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013). The model was used to assess the future make up water supply requirements under the range of model conditions simulated.

Contained water storages D1 and D4 (which capture runoff from waste rock emplacement areas) are reliant upon pumping to transfer accumulated water to the remainder of the ICDS. Pump extraction rates assumed in the model are summarised in Table 8.

Table 8 Modelled Pump Rates

From	To	Modelled Pump Rate (L/s)
D1	D6	200†
D4	D6	85
D4	D9	20
D5	D6	83
D2	D6	93
D2	D9	93
D3	D6	50
D8B	D9	93
TSF and IWL Reclaim	D6	180*
Open Cut Sump	D6 or D9/D10	23

L/s = litres per second

* Rate assumed doubled during 2030-31 during predominantly oxide ore processing.

† Rate assumed doubled from current rate due to catchment expansion resulting from IWL.

Whilst not simulated in the model, runoff from the outer batter of the perimeter waste rock emplacement (which collects between the Lake Protection Bund and Temporary Isolation Bund) would be pumped back to D6 (via D1 or D4). In the model this was dewatered by pumping to either storages D6 or D9 as a priority, even if this led to spill of storages D6 or D9 (which spill internally within the ICDS – ultimately reporting to the open pit).

5.1.2 Climatic Data

A total of 128 years of daily rainfall and pan evaporation data (from 1889 to 2016) used in the model was sourced from the SILO Data Drill[15]. The Data Drill rainfall data was compared with the CGO rainfall data record (for the period from 2002 to August 2017) and found to be well correlated – refer Figure 17 which shows a plot of monthly rainfall totals from the CGO record versus monthly rainfall totals from Data Drill.

[15] The Data Drill is a system which provides synthetic data sets for a specified point by interpolation between surrounding point records held by the BoM. Refer https://www.longpaddock.qld.gov.au/silo/datadrill/.

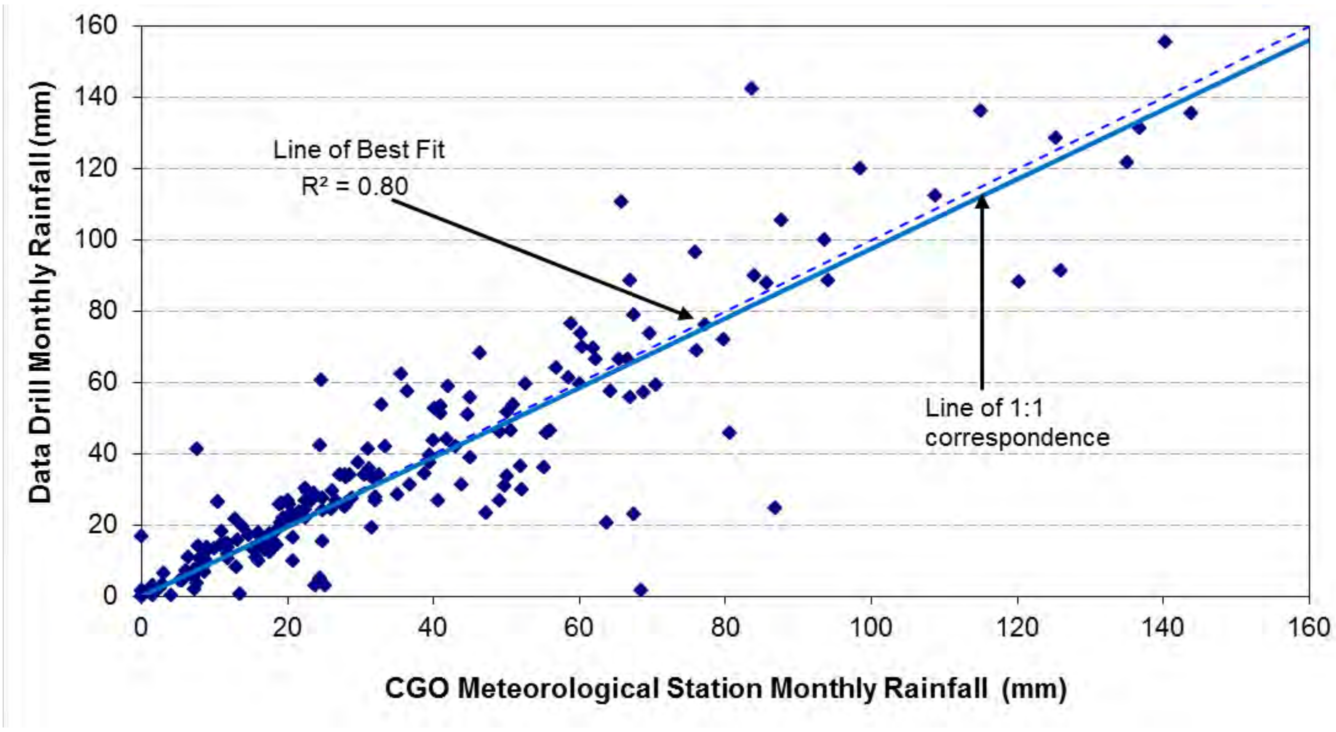


Figure 17 Monthly Rainfall Comparison – CGO Meteorological Station and Data Drill

Monthly pan evaporation factors (to convert pan evaporation to estimates of open water evaporation) were obtained from pan factors given in McMahon *et al*. (2013) for the nearest available location (Table 9).

Table 9 Seasonal Evaporation Pan Factors

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wagga Wagga AMO Pan Factor*	0.81	0.81	0.81	0.86	0.94	0.98	1.07	1.10	1.05	0.99	0.89	0.84

* From McMahon *et al*. (2013), located approximately 160 km south of CGO.

The model was run repeatedly, simulating 128 possible mine life "sequences", each approximately 16 years in length (corresponding to the remaining mine life). The sequences were formed by moving along the Data Drill record one year at a time with the first sequence comprising the first 16 years in the record, the second sequence years 2 to 17 in the record while the third sequence comprised years 3 to 18 and so on. The start and end of the Data Drill record was 'linked' so that additional sequences, which included years from both the beginning and end of the historical record, were combined to generate additional climatic sequences. Using this methodology 128, 16-year sequences of daily rainfall and evaporation were formulated for use in the model simulations. CGO recorded daily rainfall data was used from November 2006 onwards[16] instead of the Data Drill.

[16] Date of commencement of automatic weather station operation.

5.1.3 Runoff Simulation

The Australian Water Balance Model (AWBM) (Boughton, 2004) was used to simulate runoff from rainfall on the various catchments and landforms across the CGO area. The AWBM is a nationally-recognised catchment-scale water balance model that estimates streamflow from rainfall and evaporation. Modelling of the following six different sub-catchment types was undertaken:

- natural surface/undisturbed;
- waste rock emplacements;
- rehabilitated areas;
- hardstand (including roads and infrastructure areas);
- open pit; and
- tailings.

AWBM parameters for undisturbed areas were taken from model calibrations undertaken for a regional stream[17]. The rainfall-runoff model was calibrated as part of the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013). Table 10 gives the AWBM parameters used in the model.

Table 10 Water Balance Model AWBM Parameters

Parameter	Natural Surface	Waste Rock	Rehabilitated Areas	Hardstand	Open Pit	Tailings
C_1 (mm)	10	5	21	2	5	0
C_2 (mm)	101.3	75	56	6	15	50
C_3 (mm)	202.7	-	120	-	-	-
A_1	0.234	0.4	0.13	0.5	0.34	0.07
A_2	0.333	0.6	0.43	0.5	0.66	0.93
A_3	0.433	-	0.44	-	-	-
BFI	0.21	0.4	0.2	0.0	0.1	0.0
K_{base} (day^{-1})	0.806	0.97	0.92	-	0.9	-
K_{surf} (day^{-1})	0.5	0.2	0.2	0.1	0.1	0.2

Note: An evapotranspiration factor of 0.85 was used in the model as recommended by Boughton (2006).

5.1.4 Groundwater Inflow and Borefield Supplies

Groundwater inflow to the open pit was set to a time-varying rate as predicted by groundwater modelling (Coffey, 2016). Figure 18 summarises the predicted inflow rate.

The maximum pumped rate from the saline groundwater supply bores within ML 1535 was set to 0.7 ML/day (equivalent to 1 ML/day for 5 days/week). These bores are only available as a water source when the water level in Lake Cowal is low enough to allow access. Rather than simulating the water level in Lake Cowal as part of the water balance model, the availability of these bores was approximated by comparing the annual rainfall total for the given model year against long term median annual rainfall – if the annual rainfall in any simulated year was above the long term median, the bores were assumed unavailable.

[17] GS410048 - Kyeamba Creek at Ladysmith.

The maximum pumped rate from the eastern saline borefield was set to 1.5 ML/day and these bores were assumed available for the duration of the mine life (refer Section 4.2.3).

Extraction from the Bland Creek Palaeochannel bores was controlled according to the following approved limits (refer Section 4.2.4):

- A maximum daily extraction rate of 15 ML/day.
- A maximum annual extraction rate of 3,650 ML.

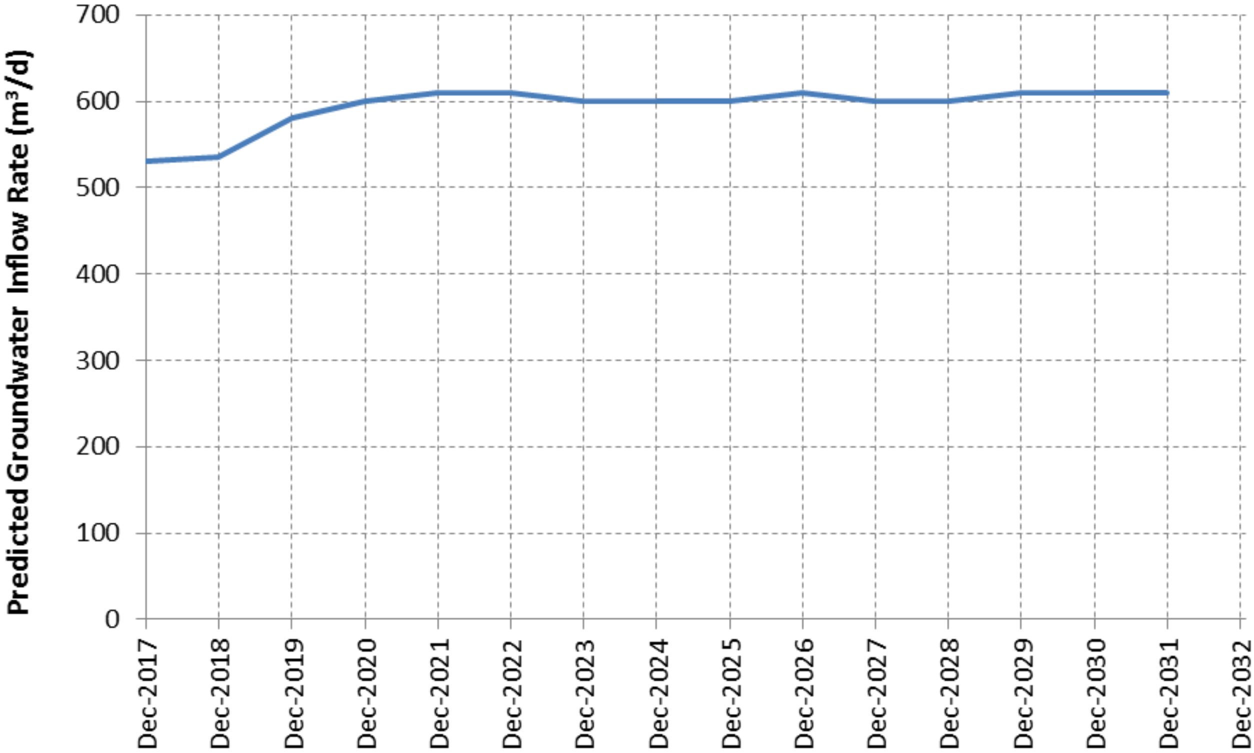


Figure 18 Predicted Open Pit Groundwater Inflow Rate

For modelling purposes, the latter annual volume was converted to a daily rate of 10 ML/day and used as the maximum daily extraction rate.

Supply via the mine borefield pipeline (i.e. Bland Creek Palaeochannel Borefield, eastern saline borefield and Lachlan River water entitlements) to storages D9/D10 was limited to 14 ML/day maximum rate (refer Section 4.2.1).

5.1.5 CGO Water Demands

The process plant make-up water demand (total) is required to replace water pumped to the TSFs and IWL with process tailings. Process plant water demand (total) was based on projected future processing tonnages (refer Section 4.2.1 and Table 6) and assumed tailings solids concentrations. For primary ore (based on the average tailings solids concentration monitored for the 2 years to December 2010[18]) a solids concentration of 52% applies (note recent data provided by Evolution is consistent with this assumed tailings solids concentration). This solids concentration was assumed to apply up to and including 2029 (a period during which oxide ore would only comprise a minor portion of the ore processed). The maximum calculated process plant demand during these years is 24.8 ML/day.

[18] Data provided for the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013).

The tailings solids concentration during a previous period (2006/2007) of processing of oxide ore alone (i.e. no primary ore) averaged 37%. For the two years towards the end of the mine life where oxide ore is planned to exceed primary ore the tailings solids concentration was estimated by interpolation between 52% and 37% on the basis of planned relative tonnes of oxide and primary ore (refer Table 6). This resulted in solids concentrations of 44.1% and 40.4% in 2030 and 2031 respectively and corresponding process plant demands of 33.0 ML/day and 35.5 ML/day.

A portion of process plant make-up water is required to be of high quality (low salinity water). This water is used in areas such as the semi-autogenous grinding mill and ball mill cooling towers, carbon elution circuit and scientific instrumentation. This water is produced from a reverse osmosis (RO) plant at CGO. The RO plant is fed by water from external water supplies only (Bland Creek Palaeochannel borefield, eastern saline borefield and Lachlan River water entitlements) and brine from the RO plant is discharged to the TSFs. The modelled RO plant demand was set at 0.288 ML/day as advised by Evolution.

Demand for haul road dust suppression water was set to an average 0.61 ML/day, varying monthly from 0.19 ML/day up to 1.05 ML/day, based on monitored data provided by Evolution. Dust suppression demand was set to zero on days with 10 mm of rain or more.

Water is also required for IWL embankment construction works which would be on-going until 2024. A constant demand rate of 0.25 ML/day was set in the model for this purpose (assumed drawn from D2) plus an additional 0.015 ML/day from 2020 to 2024 for for IWL embankment construction works, as advised by Evolution.

5.1.6 IWL Initial Reclaim Water Losses

During the initial stages of the operation of the IWL, tailings will be discharged over areas that have not previously received tailings and there is likely to be a reduction in the rate of reclaim water available. These initial water losses have been estimated on behalf of Evolution by CMW Geosciences. These reductions, expressed as a percentage of water that would otherwise be available, are summarised in Table 11 as a function of time. These were applied as a percentage reduction to the calculated tailings bleed water rate.

Table 11 IWL Initial Water Bleed Water Reductions

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	20.8%	35.2%	42.1%	49.9%	71.1%	71.4%	71.1%	71.2%	71.1%	70.4%	33.5%	66.8%
2022	84.4%	84.9%	85.2%	85.6%	86.0%	86.3%	86.3%	86.2%	85.9%	85.6%	22.2%	36.9%
2023	44.4%	74.3%	74.4%	75.1%	75.0%	75.2%	75.1%	75.1%	75.0%	74.6%	74.0%	73.9%
2024	90.8%	93.7%	94.4%	95.2%	97.3%	99.1%	99.1%	98.4%	97.1%	96.5%	93.0%	93.6%

5.2 SIMULATED FUTURE PERFORMANCE

The calibrated model was used to simulate the likely performance of the water management system over the simulated 128 climatic sequences. The model was run commencing at 1 July 2017 with storage volumes and mine conditions as they were at that date (based on data supplied by Evolution). The simulation was run until 30 June 2032[19] with the following parameters set (refer Section 4.2.1):

- Borefield pipeline capacity 14 ML/day at 100% availability from December 2019 (11 ML/day prior to this date).
- Oxide tailings bleed reduction = 2% (per model calibration – refer Modification 11 Surface Water Assessment – Gilbert & Associates [2013]) – assumed to occur in 2030 and 2031 when processing of oxide ore dominates.
- Bland Creek Palaeochannel Borefield daily extraction rate limited to 6 ML/day[20].
- No limit on extraction from Lachlan River entitlements. If borefield supplies are inadequate to meet the demands for water importation to the CGO, water is sourced from the Lachlan River and is limited only by the capacity of the borefield pipeline (i.e. 14 ML/day).

Model results are presented in the sub-sections below.

5.2.1 Overall Water Balance

Figure 19 summarises model predicted system inflows and outflows for the remaining mine life averaged over all climatic sequences.

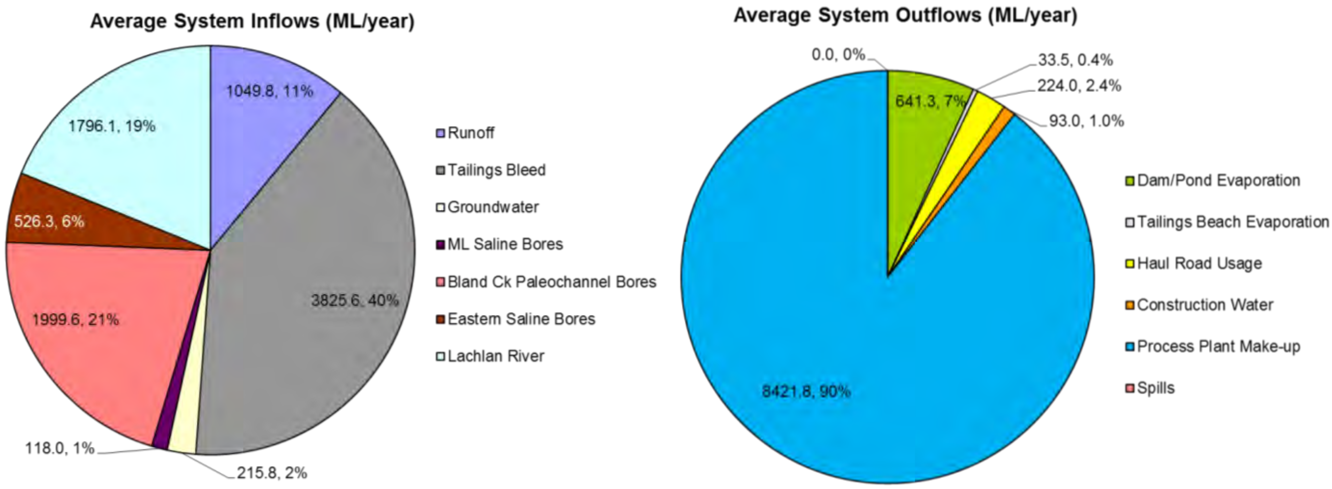


Figure 19 Average Modelled System Inflows and Outflows

Predicted total inflows average 9,531 ML/year while outflows average 9,414 ML/year.

Note that model results show an average of 2,000 ML/year would be sourced from the Bland Creek Palaeochannel Bores which is equivalent to 5.47 ML/day. This is above the long-term average of 4.4 ML/day predicted in the Hydrogeological Assessment (Coffey, 2018) however if restrictions were placed on this value, the result would be an increase in the simulated volume of water sourced from the Lachlan River.

Table 12 summarises water balance model results in terms of system inflows and outflows for median, 10th percentile (dry) and 90th percentile (wet) 16-year total rainfall scenarios.

[19] Although the modified mine life extends to the end of 2032, for modelling purposes it was assumed from the reduced processing rate for 2032 (refer Table 6) that processing in the final year would only occur unitl mid-year.

[20] Long-term average remained below the 4.4 ML/day modelled in the Hydrogeological Assessment (Coffey, 2018).

Table 12 Water Balance Model Results (Averaged over Remaining Mine Life ML/year)

	10th percentile Rainfall Sequence (Dry)	Median Rainfall Sequence	90th percentile Rainfall Sequence (Wet)
Inflows* (ML/year)			
Catchment Runoff	833	1,114	1,152
Tailings Bleed	3,826	3,826	3,826
Open Pit Groundwater	216	216	216
Saline Groundwater Supply Bores (within ML 1535)	139	104	118
Bland Creek Palaeochannel Bores	2,077	1,965	1,954
Eastern Saline Bores	536	522	518
Lachlan River Licensed Extraction**	1,892	1,760	1,757
Total Inflow	**9,519**	**9,505**	**9,541**
Outflows (ML/year)			
Evaporation	625	718	734
Haul Road Dust Suppression	225	224	223
IWL Embankment Construction Water	92	93	93
Process Plant Supply	8,422	8,422	8,422
Spills	0	0	0
Total Outflow	**9,364**	**9,457**	**9,472**

ML/year = megalitres per year

* Runoff recovered from the outside batters of the perimeter waste rock emplacement has not been simulated. Recovery would increase catchment runoff and would reduce by a corresponding amount the demand for water from external sources.

** Modelled volume of water actually reaching CGO – excludes irrigation channel losses (refer Section 5.1.1).

5.2.2 CGO External Water Demand

The demand from external sources (the eastern saline borefield, the Bland Creek Palaeochannel borefield and licensed extraction from Lachlan River water entitlements) in Table 12 for the median rainfall sequence averages 4,247 ML/year. This compares with 3,768 ML/year predicted as part of the Modification 13 Surface Water Assessment (HEC, 2016). Therefore modelling indicates that reliance on external sources is likely to slightly increase as a result of the Modification.

Figure 20 to Figure 22 show predicted annual water demands from external sources. Figure 20 to Figure 22 plot the median annual water demands, the 90th percentile demand (i.e. the demand that was predicted not to be exceeded in 90% of the simulated 128 climatic sequences) and the 10th percentile demand (i.e. the demand that was predicted not to be exceeded in 10% of the simulated 128 climatic sequences). These percentile plots indicate predicted annual volume ranges within which the predicted annual volumes could vary, within these risk or confidence limits/levels.

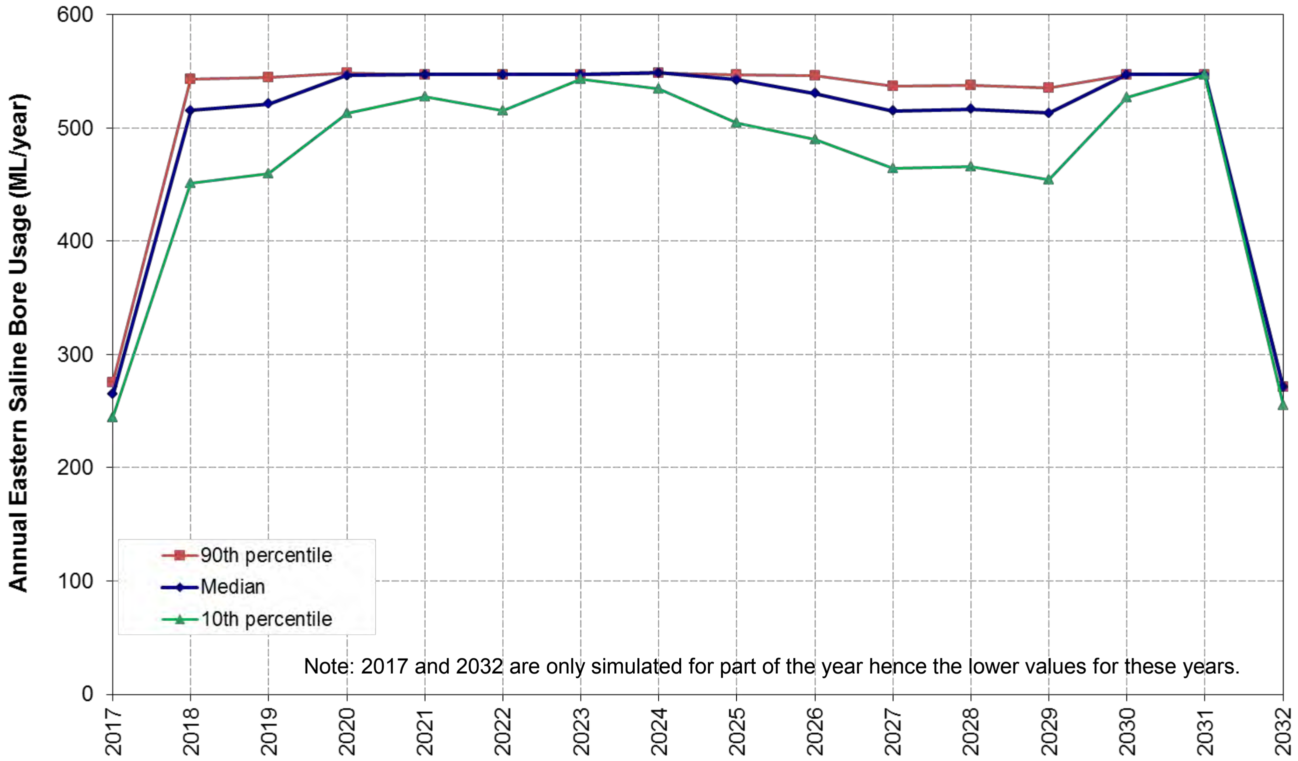


Figure 20 Predicted Annual Eastern Saline Borefield Usage

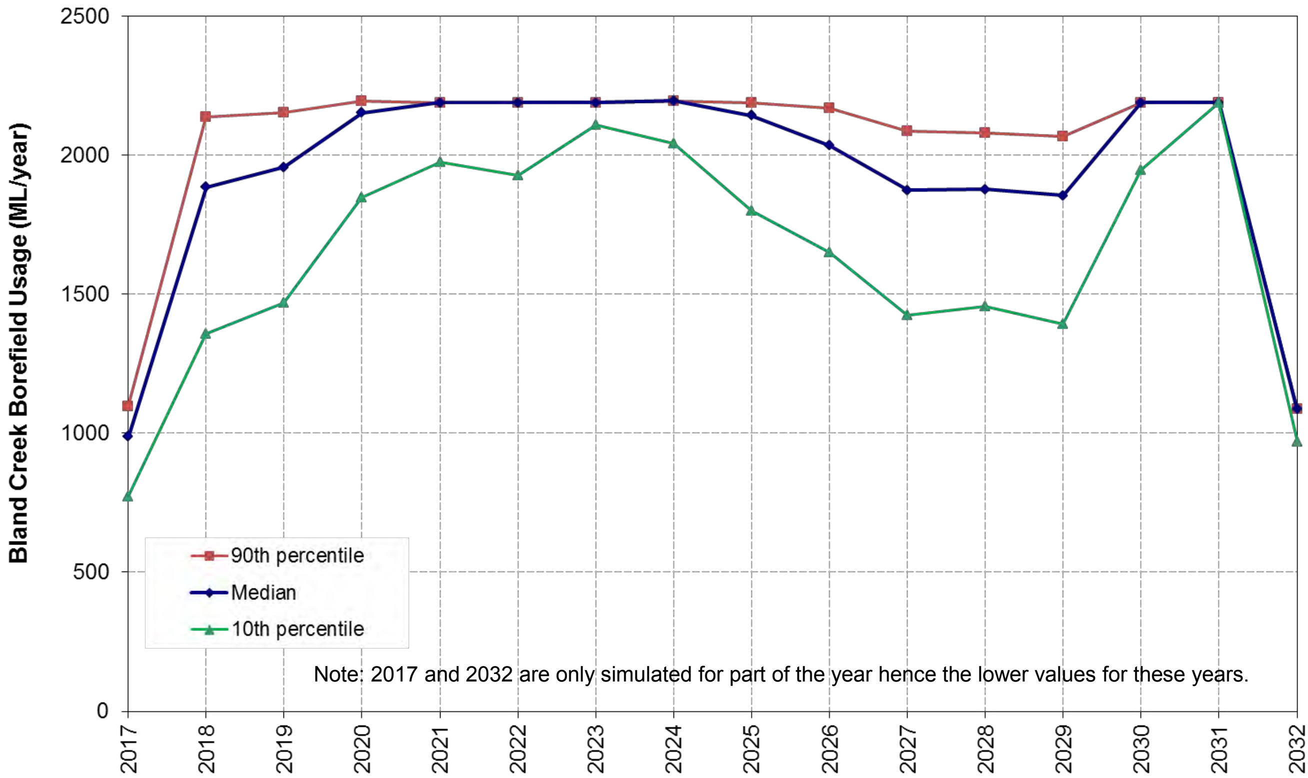


Figure 21 Predicted Annual Bland Creek Palaeochannel Borefield Usage

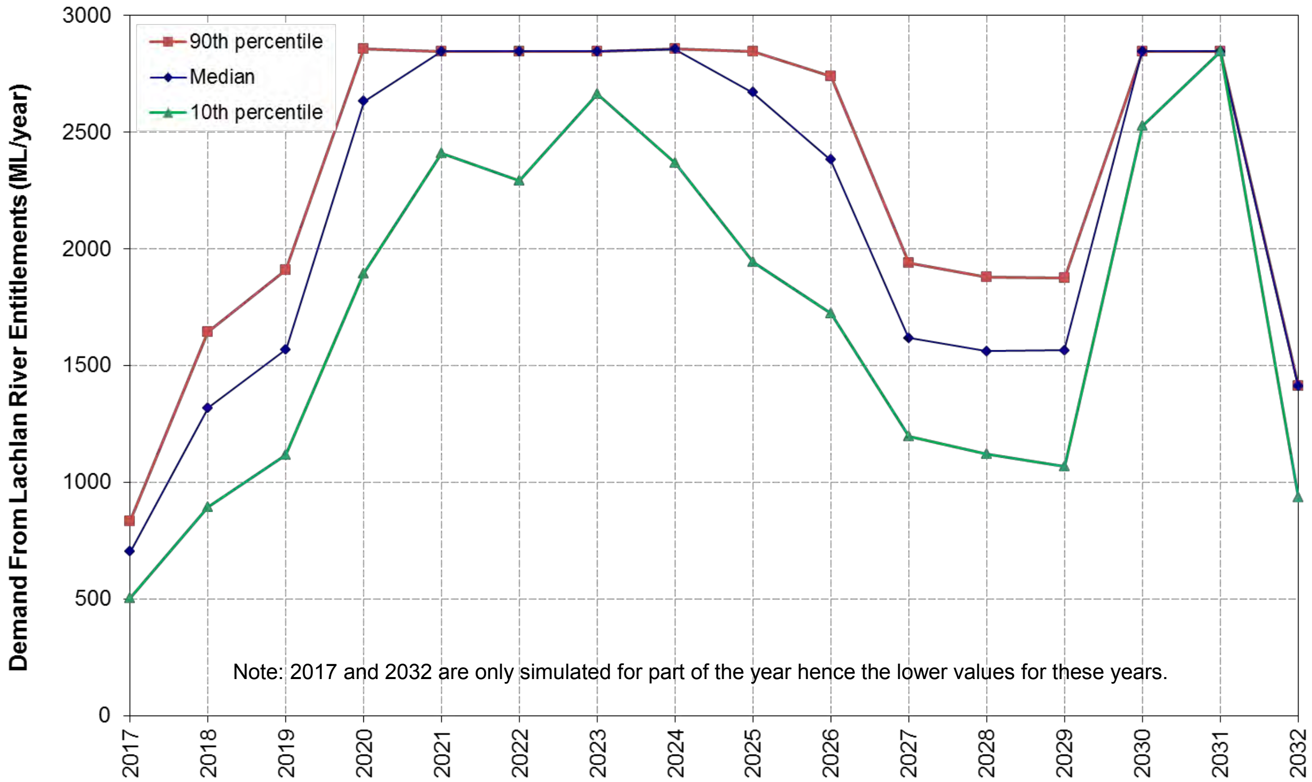


Figure 22 Predicted Annual Demand from Lachlan River Entitlements

Figure 22 shows that the predicted annual demand from licensed extraction from the Lachlan River is higher ahead of and during the early years of the operation of the IWL (which is planned to commence in 2021) and during the planned predominantly oxide ore processing years (2030 and 2031). The predicted annual demands are higher than those forecast as part of the Modification 13 Surface Water Assessment (HEC, 2016). This is due to the higher planned processing rates and reduced reclaim associated with early operation of the IWL.

Non-negligible (>20 ML) supply shortfalls were simulated in 13% of the 128 climatic sequences simulated. These were simulated to occur either towards the end of the early stage of the IWL (2023 to 2024) or towards the end of the planned predominantly oxide ore processing period (2031).

5.2.3 Maximum Pit Water Volume

The maximum water volume experienced in the open pit in all 128 simulated climatic sequences was 1,361 ML. However, the risk of such a large water volume is low. Model results indicate that there is only a 5% risk of exceeding a pit water volume of 568 ML and a 50% chance that a pit water volume of 5 ML will be exceeded at any time during the remaining mine life.

5.3 CLIMATE CHANGE EFFECTS AND WATER BALANCE IMPLICATIONS

Recent (post 1950) changes to temperature are evident in many parts of the world including Australia. The Intergovernmental Panel on Climate Change (IPCC) has, in its most recent (fifth) assessment (2013), concluded that:

> *Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, and in global mean sea level rise; and it is extremely likely to have been the dominant cause of the observed warming since the mid-20th century.*

Predicting future climate using global climate models (GCMs) is now undertaken by a large number of research organizations around the world. In Australia much of this effort has been conducted and co-ordinated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). CSIRO and BoM have recently published a comprehensive assessment of future climate change effects on Australia and future projections (CSIRO and BoM, 2015a). This is based on an understanding of the climate system, historical trends and model simulations of climate response to future global scenarios. Simulations have been drawn from an archive of more than 40 GCMs developed by groups around the world. Modelling has been undertaken for four Representative Concentration Pathways (RCPs) used by the latest IPCC assessment, which represent different future scenarios of greenhouse gas and aerosol emission changes and land-use change.

Predictions of future climate from these various models and RCPs have been used to formulate probability distributions for a range of climate variables including temperature, mean and extreme rainfall and potential evapotranspiration. Predictions are made relative to the IPCC reference period 1986 to 2005 for up to 13 future time periods between 2030 and 2090. Predictions for 2030 are relatively insensitive to future emission scenarios because they largely reflect greenhouse gases that have already been emitted. Longer term predictions become increasingly more sensitive to future emission scenarios.

Assessments of likely future concurrent rainfall and evapotranspiration changes have been undertaken using the online Climate Futures Tool (CSIRO and BoM, 2015b). Projected changes from all available climate models are classified into broad categories of future change defined by these two variables, which are the most relevant available parameters affecting rainfall runoff. The Climate Futures Tool excludes GCMs which were not found to perform satisfactorily over the Australian region. The assessments assumed a conservatively high emissions scenario – RCP 8.5 (representing a future with little curbing of emissions, with a carbon dioxide level continuing to rapidly rise to the end of the century). An assessment was performed for 2035 (i.e. close to the planned end of CGO life) for the Murray Basin region of the continent which showed the mean annual change from the reference period to be -3.2% change (i.e. a reduction) in rainfall and 4.1% change (i.e. an increase) in evapotranspiration.

These effects are likely to, in the longer term, lead to reductions in rainfall runoff in the project area. However, the implications of climate change predictions on water management are unlikely to be significant over the remaining mine life because they are small compared to the natural climatic variability.

5.4 INTERACTION WITH LAKE COWAL

No spills were predicted in the water balance model from either of the contained water storages (D1 and D4) that could spill to Lake Cowal in any of the 128 possible climate sequences modelled. This outcome is contingent upon pumped dewatering of these storages in between rainfall events. Pump extraction rates of 200 L/s and 105 L/s for storages D1 and D4 were assumed respectively (refer Table 8).

As part of the Cowal Gold Project EIS (North Limited, 1998) a model of the Lake and its catchment was used to investigate the effects that the mine would have on the water balance dynamics of Lake Cowal including changes to average water levels in the Lake and changes to the frequency and volume of spills. The isolation of the mine area catchment from the Lake via the UCDS and the lake isolation bund would also reduce, to a small degree, inflows to the Lake as a result of on-site containment and use of water that would otherwise have drained from this area into the Lake. This effect would be increased slightly as part of the Modification due to the development of the IWL and the realignment of the UCDS. The effects of the mine catchment excision from the Lake catchment were assessed as part of the Cowal Gold Project EIS using the lake water balance model. It was found that in comparison with pre-mining inflows, the exclusion of the mine site catchments would reduce average inflow by less than 1%. The effect of the additional area that would be excised from the Lake Cowal catchment is approximately 0.64 km^2 or 4.7% of the total area currently excised. The effects of this catchment reduction on the water balance of the Lake would be too small to have any noticeable effect on the Lake water balance.

6.0 POST-CLOSURE WATER MANAGEMENT SYSTEM

6.1 EIS POST-CLOSURE MANAGEMENT CONCEPTS

The post-closure water management strategy described in the Cowal Gold Project EIS (North Limited, 1998) included concepts for runoff minimisation from waste rock emplacements and TSFs, and the provision of stable drainage channels to drain site surface water to the final void. These concepts are described below.

6.1.1 Waste Rock Emplacements

At the completion of mining, the top surface of the northern and southern waste rock emplacement areas were to be graded such that any surface runoff would flow toward the final void. A cover layer comprising low salinity sub-soil and topsoil was to be laid over the graded top surface of the waste rock emplacements. The cover material and thicknesses were to be selected consistent with the overall objective of minimising runoff from the emplacement surface by encouraging infiltration and storage of rainfall in a relatively thick cover layer where it would be available for surface vegetation.

Deep rooting, high transpiration capacity vegetation species were to be utilised as cover vegetation to take-up and use the available moisture in the cover layer. The final surface of the waste rock emplacement areas was to be purposely left with a high degree of irregularity to provide surface retention of excess rainfall for longer term infiltration and take-up in the surface cover and plant system. A network of low energy drainage swales were to be provided on both waste rock emplacement areas for drainage of any net runoff to the final void. The external faces of the waste rock emplacements were to be constructed in a regular series of batters and berms. The berms were to be constructed with reverse grades to prevent overflow of berm runoff over the batters. Runoff retention areas and deep vegetated soil cover layers were proposed as concepts to minimise net runoff.

6.1.2 Tailings Storages

Concepts developed for rehabilitation of the external batters and berms of the tailings storages involved a similar approach as those developed for the outer faces of the waste rock emplacements. The concepts developed for the top surface (i.e. tailings) included retention of the final inverted cone shape of the final beach surface which would, by virtue of the planned peripheral tailings discharge regime, slope downward from the embankment perimeters toward the central decant area. The final surface was to be covered with a relatively thick layer of low salinity sub-soil and topsoil to support a deep rooting plant cover. A capillary break layer between the final tailings surface and the cover was also identified as a requirement of the surface rehabilitation to prevent salt rise into the overlying soil cover layer. Planned surface irregularities, mounds and swale-like channels were also proposed for transient retention of surface runoff, to enhance moisture retention within the cover system and to provide a formal pathway for any net runoff under extreme conditions to be diverted to the final void.

6.1.3 Final Void

The final open pit was to be left as a void. The UCDS and the ICDS were to be retained. Surface drainage from the CGO area was to be diverted to the final void via a series of low energy swales. Drainage from areas upslope of the CGO area would flow to Lake Cowal via the UCDS and pre-mine creek lines.

At the completion of mining and processing, pit dewatering operations would cease and groundwater and inflows from rainfall runoff from the CGO area would accumulate in the open pit. Final void water and solute balance model simulations conducted as part of the EIS showed that, in the long-term, the void would fill over a considerable period of time to a level some 22 to 24 m below the original ground level at the low point in the perimeter of the open pit. Modelling also indicated that water levels would fluctuate seasonally by a few metres above and below this level. The quality of final void water was predicted to be dominated by the naturally high salinity of the surrounding groundwater which had reported salinity in the range of 31,000 to 38,000 mg/L – predominantly sodium chloride. The final void water levels were such that it was predicted to act as a permanent sink for the surrounding groundwater system. Because the void had no outflow - other than direct evaporation, the salinity of void waters was predicted to continue to increase in the longer term due to evapo-concentration. The quality of void water was also predicted to vary with depth due to stratification which would occur due to temperature and salinity differentials.

6.2 MODIFICATION POST-CLOSURE WATER MANAGEMENT

The concepts developed for the EIS are generally considered to remain valid for the post-closure situation for the Modification. The changes occasioned by the Modification in relation to post-closure relate principally to the IWL and the realigned UCDS which would remain a permanent feature. Concepts developed for rehabilitation of the external batters and berms of the tailings storages in the EIS and Modification 13 are directly applicable to the IWL. The shaping, surface covering and surface treatments proposed in the EIS for the waste rock emplacement areas and the tailings surfaces are equally applicable. Evolution is undertaking on-going waste rock emplacement rehabilitation trials (using a number of different combinations of rock mulch, topsoil and gypsum) as well as rehabilitation trials on the current TSFs. Results of these trials will inform the final design of the waste rock emplacement and IWL rehabilitation. Consistent with the 2014 Independent Monitoring Panel Report recommendations (Bell & Miller, 2014), Evolution would continue to monitor rehabilitation trials with a view to continually refine its approach to achieving large-scale sustainable rehabilitation.

The implications of changes associated with the Modification on the final void water balance are described in the following sub-sections.

6.2.1 Final Void Water Balance

The final void would, as a result of the Modification, be larger in surface area and deeper than the original (EIS) void but would be of the same dimensions as the void proposed as part of Modification 13 (HEC, 2016). However, the catchment area reporting to the final void would, in total, be slightly increased from that proposed as part of Modification 13 – the total catchment would increase from an estimated 13.59 km^2 to 14.23 km^2 (including the incident area of D10) or a relative 4.7% increase. Groundwater inflows to the final void were re-estimated as part of this Modification (Coffey, 2018). The inflows are predicted to be significantly lower than those that were originally predicted (in the EIS [North Limited, 1998]) and similar to those predicted for Modification 11 and Modification 13.

A final void water balance model was set up as part of the Modification 11 Surface Water Assessment (Gilbert & Associates, 2013) to simulate the behaviour of the final void water body. The model results indicated that the final void would fill slowly reaching an equilibrium water level between approximately relative level (RL) 125 m and RL 135 m (approximately 80 m below spill level) over several hundred years. This is lower than the original predictions (North Limited, 1998) due to lower groundwater inflows and higher evaporation rates from the larger water surface area in the void.

The Modification 13 hydrological assessment (HEC, 2016) concluded that the final void water level would be slightly lower than that predicted as part of the Modification 11 Surface Water Assessment, due to the increase in depth of the final void and its water surface area. Given the slight increase in final void catchment area proposed as a result of the current modification, it is likely that equilibrium final void water levels would rise slightly, but, given the significant depth below spill level predicted for Modification11, the equilibrium water level should continue to remain well below the spill level.

The void water quality would reflect the influence of the high salinity in the groundwater. Given that the only outflow from the final void would be evaporation, salinity is predicted to increase trending to hyper-salinity. Due to the slightly higher catchment area, it is expected that this trend to hyper-salinity would be slightly slower for the Modification than for Modification 13. Water quality in the final void at any given point in time will vary with depth as a result of mixing and stratification processes that will occur as a result of temperature and salinity differentials.

6.2.2 Implications of Climate Change on Final Void Water Balance

Longer term climate change predictions have potential implications for post mine water management and specifically the water balance of the final void. In this regard the currently most accepted scenarios (refer Section 5.3) would see a reduction in overall rainfall, an increase in evaporation and a corresponding decrease in rainfall excess. This would translate to reduced surface water runoff inflow to the final void and reduced incident rainfall over the surface of the void. There would also be increased evaporation loss for the void surfaces and as a consequence lower average water levels in the final void.

7.0 POTENTIAL SURFACE WATER IMPACTS AND MITIGATION MEASURES

The following recommendations are made in consideration of the surface water management issues assessed for this Modification:

- The changes to water management outlined in this report be implemented in accordance with accepted and best practice management.
- The monitoring program and associated annual water management system performance reviews continue to be undertaken over the remaining CGO life.
- The soil and erosion control plan be reviewed and revised to incorporate changes necessitated by the Modification.

7.1 OPERATIONAL PHASE

Due to the increased CGO water demand there are potential impacts on Lachlan River flows. Future water demand would be met (in part) by sourcing water from Lachlan River regulated flows (licensed extraction purchased on the open market). Given the provisions inherent in the *Water Management Act, 2000* regarding environmental flows, the impact of sourcing additional regulated flow from the Lachlan River would be neutral because if not extracted by Evolution for use at CGO the licenses could be either purchased and the same water extracted by others or the water could be used by the existing licence holders if they were unable to sell the water on the open market.

Overall, there has been no apparent causal link between the mining operations and water quality changes in Lake Cowal and it is concluded that there would be a low risk of more than a negligible hydrological impact on Lake Cowal due to the Modification.

7.2 POST-CLOSURE

Post-closure surface water impacts would include possible risks of structural instability of final mine landforms affecting Lake Cowal water quality (salinity and turbidity/sedimentation). There is also the risk of discharge from the final void water body to Lake Cowal and the potential for reduced inflow to Lake Cowal as a result of the increased catchment area of the final void.

Previous final void water balance modelling (Gilbert & Associates, 2013) has indicated that the final void water level should stabilise well below spill level and below the local water table level and it is likely that this water level would be similar to those predictions as a result of the Modification (refer Section 6.2.1). The majority of the CGO site post-closure would continue to drain to the final void and would therefore have no impact on the water quality of Lake Cowal. The final profiles of the waste rock emplacements, IWL and lake isolation system have been designed to effectively preclude instability which could cause impact on the Lake (North Limited, 1998). Stabilisation of the outer batters of the mine waste rock emplacements (using rock mulch and vegetation) would be undertaken well ahead of mine closure, allowing time for "proving" the stability of these batters.

Evolution is undertaking batter rehabilitation trials (using a number of different combinations of rock mulch, soil and vegetation). Results of these trials will inform the final design of the waste rock emplacement rehabilitation and will also allow prediction of sediment generation rates likely to be generated from the final landform to the Lake. North Limited (1998) predicted final landform sediment generation rates that were of the same magnitude as (albeit somewhat greater than) those predicted from the site under pre-mine conditions. However given the direction of most of the site runoff to the final void, the area reporting to Lake Cowal would be reduced and therefore so would the net sediment yield to Lake Cowal. Likewise the majority of salt generated from the final landform would be directed to the final void which is predicted to trend towards hyper-saline conditions in the long term (regardless of salt influx).

The salt concentration from the rehabilitated outer waste rock emplacement to Lake Cowal would be expected to reduce with time as salts present in the near surface layers were removed by natural leaching. In the longer term the predicted steady state TDS concentration in runoff from the waste rock dump is not likely to exceed 100 mg/L (North Limited, 1998) or an EC of approximately 150 µS/cm. This is less than the minimum value in the baseline data for Lake Cowal of 222 µS/cm (refer Table 3). Salt fluxes were predicted to be extremely small compared with inflows to the Lake from Bland Creek and the Lachlan River.

The reduced catchment area reporting to Lake Cowal as a result of the Modification would comprise an estimated 0.64 km^2. This catchment area reduction is negligible relative to the catchment area reporting to Lake Cowal – for example it represents 0.007% of the 9,500 km^2 catchment area of Bland Creek, which is only one of the tributaries of Lake Cowal.

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