

Appendices

Appendix A

PRCP Schedule

Appendix B

Community Consultation Register

Appendix B Community Consultation Register

DATE	STAKEHOLDER	CONSULTATION TYPE	INFORMATION PROVIDED	ISSUES RAISED	HOW ISSUES WERE CONSIDERED	RESPONSE/OUTCOMES	COMMITMENTS
01/08/19	Adjoining landholders (8 in attendance)	Community Meeting	- Rehabilitation plan and update - Environment and Community activities - FY19 performance - Organisational chart	No issues raised.	N/A	Positive response to mine site rehabilitation activities	None required
27/11/19	Adjoining landholders (26 in attendance)	Annual Community Meeting	- Annual General Mine Site Update 'Looking Forward, Looking Back'; - FY19 Performance; 'The year that was' presentation; - Organisational structure; - General mine site information and progression; - Key environmental activities in 2019; - Introduction to the <i>Mineral and Energy Resources (Financial Provisioning) (MERFP) Act 2018</i> and the requirement for a Progressive Rehabilitation and Closure Plan (PRCP) and Environmental Rehabilitation Cost for the Callide Mine. - Rehabilitation Update; - Post Mining Landuse Examples and Consideration (to facilitate further discussion at the next meeting); and - Potential beneficial reuse of pit water post closure.	No issues raised.	N/A	Positive response to an introduction to the <i>Mineral and Energy Resources (Financial Provisioning) (MERFP) Act (2018)</i> requirements Positive response to the potential of beneficial pit water reuse.	A commitment was made by Batchfire Resources to hold a meeting early 2020 to provide detailed information regarding: - Batchfire Resources obligations under the MERFP Act 2018; and - Potential for beneficial pit water reuse
26/02/20	Adjoining Landholders (6 in attendance) Banana Shire Council (4 in attendance)	Community Meeting	- MERFP Act Legislation Overview; - Progressive Rehabilitation and Closure Plan Requirements including PRCP Plan and Schedule; - Estimated Rehabilitation Cost; - Rehabilitation Plan; - Environment and Community Update; - Community Sponsorship; and - Potential beneficial reuse of pit water during and post closure based on the present pit water quality (low salinity).	No issues raised.	N/A	Positive response of community members regarding the legal requirement to undertake progressive rehabilitation under the PRCP. General positive comments on the quality of progressive rehabilitation at the Callide Mine. The community noted that the Callide Mine Financial Assurance will be replaced by the Environmental Rehabilitation Cost. Positive response on the potential for beneficial water reuse.	Pit water salinity modelling will be undertaken as part of the Callide PRCP to predict salt levels in pit lakes post closure. Batchfire indicated that a Life of Mine plan was being developed and would be provided to the community for feedback.

DATE	STAKEHOLDER	CONSULTATION TYPE	INFORMATION PROVIDED	ISSUES RAISED	HOW ISSUES WERE CONSIDERED	RESPONSE/OUTCOMES	COMMITMENTS
17/06/20	Banana Shire Council (13 in attendance)	Banana Shire Council site visit and meeting	- Boundary Hill East Familiarization Tour and information on proposed final land use; and - The Banana Shire Council Mayor and Councillors visited Boundary Hill East to investigate the potential use of the area as a waste management facility.	Could the proposed Boundary Hill East (Waste) Resource Management Facility be classified as a Final Landuse in the Callide PRCP?	The Banana Shire Council scheduled a workshop with all stakeholder including Batchfire and The Department of Environment and Science (DES) to discuss the approval pathway for the proposed Boundary Hill East (Waste) Resource Management Facility.	Workshop Scheduled for October 2021 at the Banana Shire Council offices.	Batchfire committed to participate in the workshop scheduled for 6/10/21, to further discuss the matter.
5/10/21 6/10/21	DES	Site Visit and workshop participation	- Visual inspection of progressive rehabilitation areas; and - Information relating to waste management as a possible post mining land use for Boundary Hill East	Workshop identified that the proposed Boundary Hill East (Waste) Resource Management Facility is not an approved activity in the Callide Mine Environmental Authority	Issue discussed and considered during workshop	As the proposed Boundary Hill East (Waste) Resource Management Facility is not an approved activity in the Callide Mine Environmental Authority this final landuse has not been adopted for the present Callide PRCP.	None Required.
17/11/21	Gaangalu Nation people (Traditional Owners)	Site visit of proposed rehabilitation sites.	- Visual inspection of proposed rehabilitation areas over the next three years; - Discussion of proposed PRCP rehabilitation outcomes; and - Life of Mine Plan	No issues raised.	N/A	Positive response showing areas to be rehabilitated in the near future and information relating to the Callide PRCP.	Additional Life of Mine and proposed final landuse maps would be provided at next meeting (13/5/22 – refer below).
10/12/21 to 11/12/21 17/12/21 to 18/12/21	Biloela Community	Callide Mine PRCP display at the Biloela Shopping World. Feedback forms	- Proposed PRCP Life of Mine Final Landuse maps - PRCP information pamphlets with feedback forms on final landuse options	No issues raised.	N/A	General positive response appreciating the update on rehabilitation activities (past and future) at the Callide Mine.	None Required.
01/04/22; 05/04/22; 06/04/22; and 08/04/22	Callide Mine Coal Mine Workers	Town Hall Style	- Proposed Life of Mine Final Landuse maps; - PRCP information pamphlets with feedback forms on final landuse options; - Proposed rehabilitation schedule/time frames; and - Information on the potential for beneficial water reuse post closure.	Some workers expressed concern about mine closure in relation to loss of jobs and livelihood. Feedback suggested the final land use incorporate areas suitable for recreational uses including walking tracks and fishing areas	Batchfire explained life of mine and associated time frames for mine closure. Batchfire considered suggestions in light of the proposed post mining land uses and Batchfire's PRCP obligations	Workers had a better understanding of time frames associated with Callide Mine closure activities. Recreational areas were not considered an appropriate post mining land use for the Callide Mine	None Required.
05/04/22	General public	Batchfire website	- Life of Mine Plan and proposed final landuse maps; and - Request for feedback	No issues raised.	N/A	None required	None Required.
04/05/22	Adjoining and underlying landholders	Email and offer to meet at personal residence to provide information on the Callide PRCP.	Callide PRCP Information brochure and feedback form	N/A	N/A	Two landholders requested personal meeting. One landholder provided an email response (dated 20/6/22 provided below)	Meetings scheduled with landholders (24/05/22 and 22/08/22 – refer below).

DATE	STAKEHOLDER	CONSULTATION TYPE	INFORMATION PROVIDED	ISSUES RAISED	HOW ISSUES WERE CONSIDERED	RESPONSE/OUTCOMES	COMMITMENTS
13/05/22	Gaangalu Nation people (Traditional Owners)	Meeting	Update on the development of the Callide PRCP, life of mine plan and proposed final landuse for comment.	How does the MERFP Act interact with cultural heritage legislation? Can cultural heritage be protected or designated in the closure plan?	Batchfire considered the issues raised in light of the MERFP Act and the relevant cultural heritage legislation	Batchfire determined and advised the Gaangalu Nation people that: - The PRCP and cultural heritage legislation regimes do not directly interact and are administered by different government departments; and - There is no legal reason a PRCP could not designate a Post Mining Land Use of 'Area of Cultural Significance' or similar, where it is appropriate.	The Gaangalu Nation people and Batchfire agreed to discuss the potential to establish a cultural heritage conservation zone in the Callide PRCP at the next cultural heritage committee meeting (31/10/22 – refer below)
17/05/22	Banana Shire Council	Meeting and presentation	- PRCP Life of Mine Plan and proposed final landuse; and - Potential for beneficial reuse of water post closure.	No issues raised.	N/A	Positive response to keeping the Banana Shire Council informed on the Callide PRCP and proposed rehabilitation outcomes.	Pit water salinity modelling will be undertaken as part of the Callide PRCP to predict salt levels in pit lakes post closure. This info will contribute to further consideration of the potential beneficial water reuse.
24/05/22	Adjoining landholder (1 in attendance)	Meeting	- PRCP Life of Mine Plan and proposed final landuse maps; and - PRCP information brochure and feedback form.	The Callide Timber Reserve may have impacted Koala populations since the 1980's. Was Batchfire doing anything about it?	Proposed final land use options will consider the protection of koala habitat.	The majority of the proposed final landuse is Bushland which would be more suitable for Koalas than Grazing final landuse. Environmental Offsets may assist to protect koala habitat.	Batchfire is proposing Environmental Offsets in the Callide Timber Reserve to protect Koala habitat.

DATE	STAKEHOLDER	CONSULTATION TYPE	INFORMATION PROVIDED	ISSUES RAISED	HOW ISSUES WERE CONSIDERED	RESPONSE/OUTCOMES	COMMITMENTS
20/06/22	Adjoining landholder	Email Feedback Form	Response to Callide PRCP Information brochure and feedback form	Expressed desire for land to be returned as close as possible to its original state. Would not want restricted access to the land, or for it to become unmaintained National Park fire hazard. Suggest land be leased for light grazing so the land is cared for. Consider possibility of public access for hiking and motorbike riding.	Batchfire considered suggestions in light of the proposed post mining land use and PRCP obligations.	Provided proposed final landuse maps showing that most areas will be returned to the pre mining landuse of Bushland which will allow for light grazing to manage wildfires. The request for public access for hiking and motorbike riding is noted.	No further commitments required.
24/06/22	Queensland Mine Rehabilitation Commissioner. Principal Engagement Officer – Office of the Queensland Mine Rehabilitation Commissioner	Site visit for the purpose of reviewing the PRCP process and rehabilitation outcomes of coal mine sites	- Proposed Life of Mine Final Landuse maps; - PRCP information pamphlets with feedback forms on final landuse options - Visual inspection of Progressive Rehabilitation Areas; and - Information on development of the Callide Mine PRCP.	No issues raised regarding PRCP development or proposed post mining land use..	N/A	No response required by Batchfire	None Required.
02/08/22	Adjoining landholder (1 in attendance)	Meeting Feedback form	- PRCP Life of Mine Plan and proposed final landuse maps; and - Callide PRCP information brochure and feedback form.	The stakeholder proposed Bushland final landuse at Trap Gully as this is what it was prior to mining activity.	Batchfire considered suggestions in light of the proposed post mining land use and PRCP obligations	Batchfire provided Callide Mine proposed final landuse maps to the stakeholder which showed the majority of final landuse at Trap Gully was Bushland.	None Required.
27/09/22	Maynard Cattle Company	Meeting	Information relating to the potential for beneficial water reuse.	No issues raised.	N/A	Stakeholder interested in the potential for a future irrigation project.	Batchfire to consider options for this separately to the PRCP.
31/10/22	Gaangalu Nation people (Traditional Owners)	Meeting	- PRCP update and final landuse consultation; - Information on the potential for cultural heritage areas to be recognised as a final landuse in the Callide PRCP; and - Update on mine site rehabilitation program.	Will the PRCP provide any additional protection or improved management to cultural heritage areas?	Batchfire considered the issue in light of existing cultural heritage agreements and processes.	The Gaangalu Nation people agreed that it was not appropriate to address areas of cultural heritage significance in the Callide Mine PRCP, but rather through existing cultural heritage agreements and processes.	Batchfire committed to managing cultural heritage matters through existing cultural heritage agreements and processes.

Appendix C

Land Outcome Documents

Appendix C1

Environmental Authority (EA)

Permit

Environmental Protection Act 1994

Environmental authority EPML00720413

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: EPML00720413

Environmental authority takes effect on 26 May 2025

Environmental authority holder(s)

Name(s)	Registered address
BATCHFIRE CALLIDE PTY LTD	'S2', Level 11, 141 Queen Street, Brisbane Qld 4000, Australia
BATCHFIRE CALLIDE NO. 2 PTY LTD	'S2', Level 11, 141 Queen Street, Brisbane Qld 4000, Australia

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Schedule 3 - 13: Mining black coal	ML5632, ML5641, ML5653, ML5654, ML5655, ML5662, ML6993, ML6994, ML700059, ML80030, ML80092, ML80093, ML80107, ML80115, ML80117, ML80118, ML80122, ML80151, ML80186
Ancillary 08 – Chemical storage 3: storing more than 500m ³ of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3 under subsection (1)(c)	ML 80030, ML 5655, ML5632, ML5653, ML5654, ML5655, ML5662, ML6994, ML700059, ML80030, ML80093, ML80117, ML80118, ML80122, ML80186
Ancillary 08 – Chemical storage 5: storing 200m ³ or more of chemicals that are liquids, other than chemicals mentioned in items 1 to 3, under subsection (1)(d)	ML5662

Environmentally relevant activity/activities	Location(s)
Ancillary 33 - Crushing, milling, grinding or screening Crushing, grinding, milling or screening more than 5000t of material in a year	ML5632, ML5641, ML5653, ML5654, ML5655, ML5662, ML6993, ML6994, ML700059, ML80030, ML80092, ML80093, ML80107, ML80115, ML80117, ML80118, ML80122, ML80151, ML80186
Ancillary 63 - Sewage Treatment 1: Operating sewage treatment works, other than no-release works, with a total daily peak design capacity of (b-i) more than 100 but not more than 1500EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme	ML5632, ML5641, ML5653, ML5654, ML5655, ML5662, ML6993, ML6994, ML700059, ML80030, ML80092, ML80093, ML80107, ML80115, ML801170, ML80118, ML80122, ML80151, ML80186

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days)

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

- a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority – on the nominated day; or

- b) if the authority states a day or an event for it to take effect – on the stated day or when the stated event happens; or
- c) otherwise – on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Planning Act 2016* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.



Signature

26 May 2025

Date

Ben Byrd
Department of the Environment, Tourism, Science
and Innovation
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Business Centre (Coal)
Department of the Environment, Tourism, Science
and Innovation
PO Box 3028
EMERALD QLD 4720
Phone: (07) 4987 9320
Email: CRMining@des.qld.gov.au

Privacy statement

Pursuant to section 540 of the EP Act, the Department is required to maintain a register of certain documents and information authorised under the EP Act. A copy of this document will be kept on the public register. The register is available for inspection by members of the public who are able take extracts, or copies of the documents from the register. Documents that are required to be kept on the register are published in their entirety, unless alteration is required by the EP Act. There is no general discretion allowing the Department to withhold documents or information required to be kept on the public register. For more information on the Department's public register, search 'public register' at www.qld.gov.au. For queries about privacy matters please email privacy@des.qld.gov.au or telephone 13 74 68.

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Other permits required

This permit only provides an approval under the *Environmental Protection Act 1994*. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access state controlled roads), the Department of Resources (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

Conditions of environmental authority

The environmentally relevant activity(ies) conducted at the location as described above must be conducted in accordance with the following site-specific conditions of approval. This environmental authority consists of the following Schedules and Appendices:

Schedule A	General
Schedule B	Air
Schedule C	Surface water
Schedule D	Groundwater
Schedule E	Acoustic
Schedule F	Land
Schedule G	Regulated Structures
Schedule H	Waste
Schedule I	Sewage Treatment
Schedule J	Offsets

Schedule A – General	
Condition number	Condition
A1	All reasonable and practicable measures must be taken to prevent or minimise environmental harm caused by the activities authorised by this environmental authority.
A2	The activities conducted under this environmental authority on the Boundary Hill South Mining Area (ML80186) must not exceed the disturbance footprint in Appendix 2, Figure 1 – Callide Mine Boundary Hill South authorised disturbance footprint .
A3	Mining activities must not be carried out in the Mount Murchison Nature Refuge (Protected Area Plan number PA 1111) as shown in Appendix 2, Figure 3 – Mount Murchison Nature Refuge , except for activities necessary to comply with the conditions of the mining lease, environmental authority, or other legislative obligations, such as managing tracks, fences, firebreaks, and communication infrastructure.
A4	The holder of this environmental authority is authorised to extract five (5) million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from ML80186 (Boundary Hill South Mining Area).

A5	Maintenance of measures, plant and equipment The holder of this environmental authority must: (a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; (b) maintain such measures, plant and equipment in a proper and efficient condition; (c) operate such measures, plant and equipment in a proper and efficient manner; and (d) ensure all instruments and devices used for the measurement or monitoring of any parameter under any condition of this environmental authority are properly calibrated.
A6	Monitoring Except where specified otherwise in another condition of this environmental authority, all monitoring records or reports required by this environmental authority must be kept for a period of not less than five (5) years.
A7	Management plans and reports All management plans and reports required under any condition of this environmental authority must be developed by an appropriately qualified person(s).
A8	Upon request from the administering authority, copies of monitoring results, records, registers, management plans, reports, and spatial information required by the conditions of this environmental authority must unless otherwise specified be made available and provided to the administering authority within fourteen (14) days.
A9	Notification of emergencies, incidents and exceptions The holder of this environmental authority must notify the administering authority by written notification within twenty-four (24) hours, after becoming aware of any emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with, the conditions of this environmental authority.
A10	Within ten (10) business days following the notification in accordance with condition A9, or receipt of monitoring results, whichever is the latter, further written advice must be provided to the administering authority, including the following: (a) results and interpretation of any samples taken and analysed; (b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and (c) proposed actions to prevent a recurrence of the emergency or incident.

A11	Complaints The holder of this environmental authority must record all environmental complaints received about the mining activities including: (a) name, address and contact number of the complainant; (b) time and date of complaint; (c) reasons for the complaint; (d) investigations undertaken; (e) conclusions formed; (f) actions taken to resolve the complaint; (g) any abatement measures implemented; and (h) person responsible for resolving the complaint.
A12	The holder of this environmental authority must, when requested by the administering authority and within a reasonable timeframe nominated or agreed to by the administering authority: (a) investigate any complaint of environmental harm; (b) undertake the relevant specified monitoring; and (c) within ten (10) business days of completion of the investigation, or no later than ten (10) business days after the end of the timeframe nominated by the administering authority to undertake the investigation, provide to the administering authority the results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures, where implemented.
A13	Where a condition of this environmental authority requires compliance with a standard, policy or guideline published externally to this environmental authority and the standard is amended or changed subsequent to the issue of this environmental authority, the holder of this environmental authority must: (a) comply with the amended or changed standard, policy or guideline within two (2) years of the amendment or change being made, unless a different period is specified in the amended standard or relevant legislation, or where the amendment or change relates specifically to regulated structures referred to in condition G33, the time specified in that condition; and (b) until compliance with the amended or changed standard, policy or guideline is achieved, continue to remain in compliance with the corresponding provision that was current immediately prior to the relevant amendment or change.
A14	Risk management The holder of this environmental authority must develop and implement a risk management system for mining activities which mirrors the content requirement of the Standard for Risk Management (ISO31000:2018), or the latest edition of an Australian standard for risk management, to the extent relevant to environmental management.

A15	Third-party reporting The holder of this environmental authority must: (a) within one (1) year of the commencement of this environmental authority, obtain from an appropriately qualified person a report on compliance with the conditions of this environmental authority; (b) obtain further such reports at regular intervals, not exceeding three-yearly intervals, from the completion of the report referred to above; and (c) provide each report to the administering authority within ninety (90) days of its completion.
A16	Storage and handling of flammable and combustible liquids All flammable and combustible liquids must be stored and handled in accordance with the most recent version of AS1940 – The Storage and Handling of Flammable and Combustible Liquids.
A17	All hazardous chemicals must be stored and handled in accordance with the relevant Australian Standards, including AS4326 – The Storage and Handling of Oxidising Agents.
A18	Any spillage of chemicals or flammable or combustible liquids must be cleaned up in accordance with the AS1940 or the relevant Australian Standard.
A19	The Trap Gully Bulk Storage Facility permitted to be carried out under this environmental authority on ML5662 must not exceed the disturbance footprint in Appendix 2, Figure 4 – Callide Mine - Trap Gully Bulk Storage Facility footprint.

Schedule B – Air	
Condition number	Condition
B1	Dust and particulate matter monitoring The environmental authority holder must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the dust and particulate matter emissions generated by the mining activities do not cause exceedances of the following levels when measured at any sensitive or commercial place: (a) Dust deposition of 120 milligrams per square metre per day, averaged over one (1) month, when monitored in accordance with the most recent version of Australian Standard AS3580.10.1 <i>Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter – Gravimetric method</i>. (b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM₁₀) suspended in the atmosphere of 50 micrograms per cubic metre over a twenty-four (24)-hour averaging time when monitored in accordance with the most recent version of either: (i) Australian Standard AS3580.9.9 <i>Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM₁₀ low volume sampler—Gravimetric method</i>; or (ii) Any alternative method of monitoring PM₁₀ which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority. (c) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a one (1) year averaging time, when monitored in accordance with the most recent version of AS/NZS3580.9.3:2003 <i>Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method</i>.
B2	If the dust deposition monitoring undertaken as per condition B1(a) indicates an exceedance of the relevant limits, and a complaint is received from any sensitive or commercial place within thirty-one (31) days prior to the exceedance being recorded or within thirty-one (31 days) after the exceedance being recorded, the environmental authority holder must within ninety (90) days of receiving the monitoring results indicating the exceedance, complete an investigation into the exceedance, and submit to the administering authority a report detailing the investigation undertaken. The report must: (a) provide details of the investigation; and (b) detail whether the result is directly associated with mining activities and if so; (i) any dust abatement measures implemented; (ii) whether any environmental harm has occurred; and (iii) outline any actions required to mitigate environmental harm.

B3	If the particulate matter monitoring undertaken as per condition B1(b) and B1(c) indicates an exceedance of the relevant limits, the environmental authority holder must within ninety (90) days of receiving the monitoring results indicating the exceedance, complete an investigation into the exceedance, and submit to the administering authority a report detailing the investigation undertaken. The report must: (a) provide details of the investigation; and (b) detail whether the result is directly associated with mining activities and if so; (i) any dust abatement measures implemented; (ii) whether any environmental harm has occurred; and (iii) outline any actions required to mitigate environmental harm.
B4	The results of dust deposition and particulate matter monitoring undertaken as per condition B1 must be made available upon request by the administering authority.

Schedule C – Surface Water	
Condition number	Condition
C1	Contaminant Release Contaminants that will or have the potential to cause environmental harm must not be released directly or indirectly to any waters as a result of the mining activities, except as permitted under the conditions of this environmental authority.
C2	Unless otherwise permitted under the conditions of this environmental authority, the release of mine affected water to waters must only occur from the release points specified in Table C1 - Mine affected water release points, sources and receiving waters .
C3	The release of mine affected water to internal water management infrastructure that is installed and operated in accordance with a water management plan that complies with condition C25 is permitted.

Table C1 - Mine affected water release points, sources and receiving waters

Release Point (RP)	Latitude (GDA94)	Longitude (GDA94)	Mine Affected Water Source and Location	Monitoring Point	Receiving waters description
RP1	-24.3293	150.6269	Dunn Creek Dam spillway overflow	Dam Spillway	Dunn Creek
RP1a	-24.2638	150.6208	Turkey's Nest Storage	Flow: End of pipe flow monitor, Quality: Storage	Oaky Creek
RP1b	-24.2686	150.5528	Trap Gully Pipeline	Flow: End of pipe flow monitor, Quality: Storage (Ghost Ryder's Storage)	Oaky Creek
RP2	-24.3019	150.5628	Ghost Ryders Storage	Flow: End of pipe flow monitor, Quality: Downstream of pipe	Oaky Creek
RP3	-24.2115	150.4793	Lake Gasteen	Flow: End of pipe flow monitor, Quality: Downstream of pipe	Gate Creek

C4	The release of mine affected water to waters in accordance with condition C2 must not exceed the release limits stated in Table - C2 Mine affected water release limits (Dunn Creek Dam) and Table C3 - Mine affected water release limits (other than for Dunn Creek Dam) when measured at the monitoring points specified in Table C1 - Mine affected water release points, sources and receiving waters for each quality characteristic.
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Table C2 - Mine affected water release limits (Dunn Creek Dam)

Quality Characteristic	Release Limits	Monitoring frequency
Electrical conductivity ($\mu\text{S}/\text{cm}$)	1,400	Daily during release (the first sample must be taken within 2 hours of commencement of release)
pH (pH Unit)	6.5 (minimum), 9.0 (maximum)	
Suspended Solids (mg/L)	200	
Sulfate (mg/L)	400	

Table C3 - Mine affected water release limits (other than for Dunn Creek Dam)

Quality Characteristic	Release Limits	Monitoring frequency
Electrical conductivity ($\mu\text{S}/\text{cm}$)	1800 maximum	Daily during release (the first sample must be taken within 2 hours of commencement of release)
pH (pH Unit)	6.5 (minimum), 9.0 (maximum)	
Suspended Solids (mg/L)	1,000	
Sulfate (mg/L)	520	

C5	The release of mine affected water to waters from the release points must be monitored at the locations specified in Table C1 - Mine affected water release points, sources and receiving waters for each quality characteristic and at the frequency specified in Table C2 - Mine affected water release limits (Dunn Creek Dam), Table C3 - Mine affected water release limits (other than for Dunn Creek Dam) and Table C4 - Release contaminant trigger investigation levels – potential contaminants. <i>Note: the administering authority will take into consideration any extenuating circumstances prior to determining an appropriate enforcement response in the event condition C5 is contravened due to a temporary lack of safe or practical access. The administering authority expects the environmental authority holder to take all reasonable and practicable measures to maintain safe and practical access to designated monitoring locations.</i>
C6	All analysis and tests for water quality that are required under this environmental authority must be performed by a laboratory that has National Association of Testing Authorities' certification for such analysis and tests. The only exception to this condition is for the monitoring of pH, electrical conductivity, dissolved oxygen, temperature and turbidity in-situ.

Table C4 - Release contaminant trigger investigation levels – potential contaminants

Quality Characteristic	Trigger Levels (µg/L)	Comment on Trigger Level	Monitoring Frequency
Aluminium	55	<i>For aquatic ecosystem protection, based on SMD guideline</i>	Commencement of release and thereafter weekly during release
Cadmium	0.2	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Chromium	1	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Copper	2	<i>For aquatic ecosystem protection, based on LOR for ICPMS</i>	
Iron	300	<i>For aquatic ecosystem protection, based on low reliability guideline</i>	
Lead	4	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Mercury	0.2	<i>For aquatic ecosystem protection, based on LOR for CV FIMS</i>	
Nickel	11	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Zinc	8	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Boron	370	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Cobalt	1.4	<i>For aquatic ecosystem protection, based on low reliability guideline</i>	
Manganese	1,900	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Molybdenum	34	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Selenium	10	<i>For aquatic ecosystem protection, based on LOR for ICPMS</i>	
Silver	1	<i>For aquatic ecosystem protection, based on LOR for ICPMS</i>	
Uranium	1	<i>For aquatic ecosystem protection, based on LOR for ICPMS</i>	
Vanadium	10	<i>For aquatic ecosystem protection, based on LOR for ICPMS</i>	
Ammonia	900	<i>For aquatic ecosystem protection, based on SMD guideline</i>	
Nitrate	1,100	<i>For aquatic ecosystem protection, based on ambient Qld WQ Guidelines (2006) for TN</i>	
Fluoride (Total)	2,000	<i>Protection of livestock and short-term irrigation guideline</i>	
Sodium	180,000	<i>Australian Drinking Water Guidelines (2004)</i>	

Table C4 – Release contaminant trigger investigation levels, potential contaminants notes:

1. All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger.
2. The quality characteristics required to be monitored as per **Table C4 - Release Contaminant Trigger Investigation Levels – Potential Contaminants** can be reviewed once the results of two years monitoring data is available, or if sufficient data is available to adequately demonstrate negligible environmental risk, and it may be determined that a reduced monitoring frequency is appropriate or that certain quality characteristics can be removed from **Table C4 - Release Contaminant Trigger Investigation Levels – Potential Contaminants** by amendment.
3. SMD – slightly moderately disturbed level of protection; guideline refers ANZECC & ARMCANZ (2000).
4. LOR – typical reporting for method stated. ICPMS/CV FIMS – analytical method required to achieve LOR.

C7	If quality characteristics of the release exceed any of the trigger levels specified in Table C4 - Release contaminant trigger investigation levels – potential contaminants during a release event, the environmental authority holder must compare the downstream results in the receiving waters to the trigger values specified in Table C4 - Release contaminant trigger investigation levels – potential contaminants and: (a) where the trigger values are not exceeded then no action is to be taken; or where the downstream results exceed the trigger values specified for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and: (i) if the result is less than the background monitoring site data, then no action is to be taken; or (ii) if the result is greater than the background monitoring site data, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining: 1. details of the investigations carried out; and 2. actions taken to prevent environmental harm. <i>Note: Where an exceedance of a trigger level has occurred and is being investigated, in accordance with C7(2)(b) of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.</i>
C8	If an exceedance in accordance with condition C7(a)(ii) is identified, the environmental authority holder must notify the administering authority within fourteen (14) days of receiving the result.
C9	Mine affected water release events The environmental authority holder must ensure a stream flow gauging station/s is installed, operated and maintained to determine and record stream flows at the locations and flow recording frequency specified in Table C5 - Mine affected water release during flow events.
C10	Notwithstanding any other condition of this environmental authority, the release of mine affected water to waters in accordance with condition C2 must only take place during periods of natural flow events in accordance with the receiving water flow criteria for discharge specified in Table C5 - Mine affected water release during flow events for the release points specified in Table C1 - Mine affected water release points, sources and receiving waters.
C11	The 80th percentile of electrical conductivity (EC) values recorded at the downstream monitoring points listed in Table C6 - Receiving water upstream background sites and downstream monitoring points (Dunn Creek Dam) and Table C7 - Receiving water upstream background sites and downstream monitoring points (other than Dunn Creek Dam) must not exceed 1600µS/cm over the duration of the release influence period. The 80th percentile must be calculated using all EC values recorded by the monitoring station during the release influence period. <i>Note: The release influence period is the period during which the downstream monitoring points are influenced by mine affected water from Callide Mine and includes both the duration of release and any lag time between release points and downstream monitoring points.</i>

Table C5 - Mine affected water release during flow events

Receiving water/stream	Release Point	Gauging station	Gauging Station Latitude (GDA94)	Gauging Station Longitude (GDA94)	Minimum Flow in Receiving Water Required for a Release Event ^a	Flow recording Frequency
Dunn Creek	Dunn Creek Dam (RP1)	Callide Dam headwaters	-24.32305	150.68501	1.5 m ³ /s	Continuous (minimum daily)
Both: Callide Creek And Oaky Creek	Turkey's Nest Storage (RP1a) and Trap Gully Pipeline (RP1b)	Goovigen Gauging Station (GS4)	- 24.1065	150.2872	Both: ≥ 3 m ³ /s	
		Oaky Creek Downstream (GS1)	- 24.2617	150.5961	And ≥ 0.1 m ³ /s	
Both: Callide Creek And Oaky Creek	Ghost Ryder's Storage (RP2)	Goovigen Gauging Station (GS4)	- 24.1065	150.2872	Both: ≥ 3 m ³ /s	
		Oaky Creek Trap Gully Confluence (GS2)	- 24.2952	150.5326	And ≥ 0.1 m ³ /s	
Callide Creek	Lake Gasteen Dam (RP3)	Goovigen Gauging Station (GS4)	- 24.1065	150.2872	≥ 3 m ³ /s	

Note:

a) In addition, at the tail end of a natural flow event, low flow releases continue to be authorised for a period of **fourteen (14) calendar days** from the moment that natural flow has receded below the threshold in column 6 and the electrical conductivity is limited to 1220 µS/cm. Maximum release rate during this period must not exceed 0.5 m³/s.

C12	The daily quantity of mine affected water released from each release point must be measured and recorded at the monitoring points in Table C1 - Mine affected water release points, sources and receiving waters .
C13	Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters or cause a material build-up of sediment in such waters.

C14	Notification of Release Event The environmental authority holder must notify the administering authority via WaTERS within twenty-four (24) hours after commencing to release mine affected water to the receiving environment. Notification must include the submission of written advice to the administering authority of the following information: (a) release commencement date/time; (b) release point/s; (c) release rate; (d) release volume (estimated); (e) receiving water/s including the natural flow rate in the receiving water(s); and (f) any details (including available data) regarding likely impacts on the receiving water(s).
C15	The environmental authority holder must notify the administering authority via WaTERS within twenty-four (24) hours after the cessation of a release event notified under condition C14. Notification must include the submission of written advice to the administering authority of the following information: (a) release cessation date and time; (b) natural flow volume in receiving water; and (c) volume of water released. <i>Note: Successive or intermittent releases occurring within twenty-four (24) hours of the cessation of any individual release can be considered part of a single release event and do not require individual notification for the purpose of compliance with conditions C14, C15 and C16, provided the relevant details of the release are included within the notification provided in accordance with conditions C14, C15 and C16.</i>
C16	Within twenty-eight (28) days of notification under condition C15, provide the administering authority via WaTERS the following information: (a) confirmation of: (i) the release commencement date and time; (ii) the release cessation date and time; (iii) receiving water(s) including the natural flow rate; and (iv) volume of water released; (b) all in-situ and laboratory water quality monitoring results; (c) details regarding the compliance of the release with the conditions in Schedule C: Surface Water of this environmental authority; (d) whether the release of water resulted in any impacts to the receiving environment; and (e) any other matter(s) pertinent to the water release event.

C17	Notification of release event exceedance If the release limits defined in Table C2 - Contaminant release limits (Dunn Creek Dam) and Table C3 - Mine affected water release limits (other than for Dunn Creek Dam) are exceeded, the holder of the environmental authority must notify the administering authority within twenty-four (24) hours of receiving the results.
C18	The environmental authority holder must, within twenty-eight (28) days of a release that is not compliant with the conditions of this environmental authority, provide a report to the administering authority detailing: (a) the reason for the release; (b) the location of the release; (c) the total volume of the release and which (if any) part of this volume was non-compliant; (d) the total duration of the release and which (if any) part of this period was non-compliant; (e) all water quality monitoring results (including all laboratory analyses); (f) identification of any environmental harm as a result of the non-compliance; (g) all calculations; and (h) any other matters pertinent to the water release event.
C19	Receiving environment monitoring and contaminant trigger levels The quality of the receiving waters must be monitored for each quality characteristic and at the monitoring locations specified in Table C6 - Receiving waters contaminant trigger levels at the locations specified in: (a) Table C7 - Receiving water upstream background sites and downstream monitoring points (Dunn Creek Dam); and (b) Table C8 - Receiving water upstream background sites and downstream monitoring points (other than Dunn Creek Dam).

Table C6 - Receiving waters contaminant trigger levels

Quality Characteristic	Trigger Level	Monitoring Frequency
pH	6.5 - 8.0	Daily during the release
Electrical Conductivity (µS/cm)	80th Percentile: 1,600, Maximum: 1,920	
Suspended solids (mg/L)	1,000	
Sulfate (mg/L)	250 (Protection of drinking water Environmental Value)	
Sodium (mg/L)	180 (Australian Drinking Water Guidelines, 2004)	

Table C7 - Receiving water upstream background sites and downstream monitoring points (Dunn Creek Dam)

Monitoring Points	Receiving Waters Location Description	Latitude (GDA94)	Longitude (GDA94)
Upstream Background Monitoring Point			
Dunn Creek Dam	Callide Dam headwaters	- 24.3224	150.66994
Downstream Background Monitoring Point			
Dunn Creek Dam	Callide Dam	- 24.3693	150.6143

Note: The data from background monitoring points must not be used where they are affected by releases from other mines.

**Table C8 - Receiving water upstream background sites and downstream monitoring points
(other than Dunn Creek Dam)**

Monitoring Points	Receiving Waters Location Description	Latitude (GDA94)	Longitude (GDA94)
Upstream Background Monitoring Points			
Monitoring Point 1	Dingo Gully 3700 metres upstream of RP1a	- 24.2772	150.6447
Monitoring Point 2	Timber Reserve Background 3000 metres Upstream of RP1b	- 24.2487	150.5666
Monitoring Point 3	Trap Gully 5000 metres upstream of RP2 unnamed gully confluence with Oaky Creek	- 24.2826	150.5708
Monitoring Point 4	Gate Creek 1500 metres upstream of RP3 unnamed gully confluence with Gate Creek.	- 24.2287	150.4867
Monitoring Point 5	Callide Creek at Dawson Highway Crossing	- 24.3707	150.5322
Downstream Monitoring Points			
CC1	NRM Goovigen Gauging Station on Callide Creek	- 24.1054	150.2866
CC2	Callide Creek Main Channel –Electrical Conductivity Gauge	- 24.2649	150.4132
CC3	Callide Creek old Channel –Electrical Conductivity Gauge	- 24.2581	150.4263
Monitoring Point 6	Kroombit Creek at McCann's Road Crossing	- 24.2394	150.3872

Notes:

- a) The upstream monitoring point should be within 15km of the release point.
- b) The downstream point should not be greater than 15km from the release point.
- c) The data from background monitoring points must not be used where they are affected by releases from other mines.

C20	If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in Table C6 - Receiving waters contaminant trigger levels during a release event, the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and: (a) where the downstream result is the same or a lower value than the upstream value for the quality characteristic then no action is to be taken; or (b) where the downstream results exceed the upstream results, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining: (i) details of the investigations carried out; and (ii) actions taken to prevent environmental harm. <i>Note: Where an exceedance of a trigger level has occurred and is being investigated, in accordance with condition F20(b)(ii) of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.</i>
C21	Receiving Environment Monitoring Program (REMP) The environmental authority holder must develop and implement a Receiving Environment Monitoring Program (REMP) to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site. For the purposes of the REMP, the receiving environment is the waters as described in Table C7 - Receiving water upstream background sites and downstream monitoring points (Dunn Creek Dam) and Table C8 - Receiving water upstream background sites and downstream monitoring points (other than Dunn Creek Dam) and connected waterways within 8.3km downstream of the Dunn Creek Dam release, and additionally the Callide Creek and Oaky Creek 15km downstream of the respective releases and connected or surrounding waterways within the Callide Catchment (15km) downstream of the release. The REMP should encompass any sensitive receiving waters or environmental values downstream of the authorised mining activity that will potentially be directly affected by an authorised release of mine affected water.
C22	A report outlining the findings of the REMP, including all monitoring results and interpretations must be prepared annually. This must include: (a) an assessment of background reference water quality; (b) the condition of downstream water quality compared against water quality objectives; and (c) the suitability of current discharge limits to protect downstream environmental values.
C23	Water reuse Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as farm dams or tanks, or used directly at properties owned by the environmental authority holder or a third party (with the consent of the third party).

C24	Annual water monitoring reporting The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format with each annual return: (a) the date on which the sample was taken; (b) the time at which the sample was taken; (c) the monitoring point at which the sample was taken; (d) the measured or estimated daily quantity of mine affected water released from all release points; (e) the release flow rate at the time of sampling for each release point; and (f) the results of all monitoring and details of any exceedances of the conditions of this environmental authority.
C25	Water management plan A Water Management Plan must be developed by an appropriately qualified person and implemented.
C26	Stormwater and water sediment controls An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities and must demonstrate how erosion and sediment control measures adequately minimise: (a) erosion; (b) the release of sediment to receiving waters; and (c) contamination of stormwater.
C27	Stormwater, other than mine affected water, is permitted to be released to waters from: (a) erosion and sediment control structures that are installed and operated in accordance with the Erosion and Sediment Control Plan required by condition C26; and (b) water management infrastructure that is installed and operated, in accordance with a Water Management Plan for the purpose of ensuring water does not become mine affected water.

Schedule D - Groundwater	
Condition number	Condition
D1	The holder of this environmental authority must not release contaminants to groundwater.
D2	Monitoring and reporting Groundwater quality must be monitored at the locations and frequencies defined in Table D1 - Groundwater monitoring locations and frequency and shown in Appendix 2, Figure 5 – Groundwater bore monitoring network for the parameters identified in Table D2 - Groundwater quality triggers.
D3	Groundwater levels must be monitored at the locations and frequencies defined in Table D1 - Groundwater monitoring locations and frequency and shown in Appendix 2, Figure 5 – Groundwater bore monitoring network .
D4	Groundwater quality triggers must be amended to replace all TBA values with appropriate values once at least eight (8) representative measurements are available for bores MB06, MB20 and MB25. Appropriate values must be determined in accordance with the latest edition of the administering authority's guideline '<i>Using monitoring data to assess groundwater quality and potential environmental impacts</i>'.
D5	The method of sampling of surface and groundwater must comply with that set out in the latest edition of the administering authority's <i>Monitoring and Sampling Manual</i> .

D6	The holder of this environmental authority must complete an annual groundwater monitoring report by 31 March 2023 and each year thereafter and submit this report to the administering authority upon request. The report must be prepared by an appropriately qualified person and must address the following requirements as a minimum: (a) analyses of groundwater chemistry and hydrogeological data for all groundwater monitoring bores listed in Table D1 - Groundwater monitoring locations and frequency; (b) discuss effectiveness of the groundwater monitoring program described in Table D1 - Groundwater monitoring locations and frequency and any improvements necessary to ensure early detection of unexpected changes in groundwater levels and quality; (c) Ensure that all unexpected changes to groundwater levels and quality due to the mining activity are identified and monitored. Where unexpected changes to groundwater levels and quality are identified, describe any monitoring and management measures necessary to minimise the potential for significant environmental harm due to the approved mining activities (d) Include a conceptual groundwater model that is reviewed, updated and validated once every 2 years in accordance with findings of the groundwater monitoring; (e) changes in groundwater levels plotted as a function of time to identify seasonal patterns and possible draw-down effects; (f) groundwater elevation contours and flow direction; and (g) interpretation and discussion of groundwater monitoring data.
D7	Groundwater quality results when measured at the monitoring locations specified in Table D1 - Groundwater monitoring locations and frequency must not exceed the groundwater quality trigger levels specified in Table D2 - Groundwater quality triggers on any three (3) consecutive sampling occasions in accordance with the sampling frequency specified in Table D1 - Groundwater monitoring locations and frequency.
D8	Groundwater levels when measured at the monitoring locations and frequencies specified in Table D1 – Groundwater monitoring locations and frequency must not exceed the groundwater level trigger thresholds specified in Table D3 – Groundwater level trigger thresholds.
D9	If groundwater quality or levels measured at compliance groundwater monitoring bores identified in Table D1 - Groundwater monitoring locations and frequency exceed any of the groundwater quality trigger levels stated in Table D2 - Groundwater quality triggers or any of the groundwater level trigger thresholds stated in Table D3 - Groundwater level trigger thresholds, an investigation must be undertaken by the holder of the environmental authority within fourteen (14) days of detection to determine if the exceedance is a result of: (a) mining activities authorised under this environmental authority; or (b) natural variation; or (c) neighbouring land use resulting in groundwater impacts.

D10	The holder of this environmental authority must provide a report of the investigation to the administering authority via WaTERS within twenty-eight (28) days of completion of the investigation under condition D9 .
D11	Bore construction and maintenance and decommissioning The construction, maintenance, management and decommissioning of groundwater bores (including groundwater monitoring bores) must be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring.

Table D1 – Groundwater monitoring locations and frequency

Monitoring Site ID	Screened Formation	Bore Location Coordinates ¹		Ground Surface Elevation (m) ²	Monitoring Frequency	
		Latitude (GDA2020)	Longitude (GDA2020)		Groundwater Quality	Groundwater Level
1900	Callide Coal Measures	-24.324250	150.627859	270.32	Quarterly	Quarterly
DC040C	Callide Coal Measures	-24.298603	150.626564	367.25	Quarterly	Quarterly
TG01	Callide Coal Measures	-24.283339	150.552074	240.66	Quarterly	Quarterly
TG02	Callide Coal Measures	-24.294118	150.547101	217.67	Quarterly	Quarterly
HUT01	Callide Coal Measures	-24.287237	150.633994	368.69	Quarterly	Quarterly
HUT03	Callide Coal Measures	-24.272976	150.585851	291.83	Quarterly	Quarterly
MB36	Callide Coal Measures	-24.258934	150.619306	329.18	Quarterly	Quarterly
BH01	Basement Volcanics	-24.207758	150.482171	204.29	Quarterly	Quarterly
BH_MB01	Basement Volcanics	-24.220865	150.483891	202.85	Quarterly	Quarterly
MB15 ⁵	Precipice Sandstone	-24.255793	150.545533	271.40	Not applicable	Quarterly
R3076 ⁵	Precipice Sandstone	-24.247797	150.510650	224.57	Not applicable	Quarterly
R3084 ⁵	Precipice Sandstone	-24.259008	150.522227	244.46	Not applicable	Quarterly
MB29	Precipice Sandstone	-24.240946	150.529477	268.98	Quarterly	Quarterly
MB07	Callide Coal Measures	-24.202560	150.525760	321.90	Quarterly	Quarterly
C0507663	Callide Coal Measures	-24.238984	150.498861	246.96	Quarterly	Quarterly
MB23	Callide Coal Measures	-24.240883	150.529439	269.07	Quarterly	Quarterly
MB27	Callide Coal Measures	-24.221633	150.547528	335.70	Quarterly	Quarterly
BHE_VWP0 ¹⁴	Callide Coal Measures	-24.193001	150.519106	295.29	Not applicable	High frequency ³

Notes:

¹ Coordinates are in GDA2020, Zone 56

² Elevation in metres above reduced/relative level (m RL).

³ 'High frequency' monitoring means automatic recording of groundwater levels at pre-set intervals (nominally 6-hourly) using a datalogger.

⁴ Groundwater level monitoring site for observation purposes only.

⁵ Groundwater level monitoring site for validation of predicted groundwater levels in the Precipice Sandstone aquifer.

Table D2 - Groundwater quality triggers

Mining area	Monitoring bore	pH Triggers ^a (pH units)	EC Triggers ^b (µS/cm)
Dunn Creek	DC01	6.56 – 6.94	7,104
	DC02	6.78 – 7.40	5,662
	DC040C	6.68 – 6.90	2,407
	DC040P	6.67 – 7.19	1,429
Trap Gully	TG01	6.38 – 6.72	1,744
Boundary Hill	C0507663	6.68 – 7.17	1,753
	MB06	TBA	TBA
	MB07	6.27 – 6.90	1,780
	MB15	5.96 – 6.87	1,189
	MB16	5.70 – 6.75	1,701
	MB20	TBA	TBA
	MB23	6.50 – 7.05	1,793
	MB25	TBA	TBA
	MB26	6.02 – 6.41	1,638
	MB27	5.88 – 6.69	2,142
	MB28	5.44 – 6.61	6,843
	MB29	4.46 – 6.06	928
	R3038	6.08 – 6.87	1,689
	R3055	6.65 – 7.09	2,232
	R3070	6.25 – 6.85	1,296
	R3072	6.68 – 7.67	2,012
	R3076	6.49 – 7.06	1,668
	R3079	6.67 – 7.12	3,554
	R3084	6.62 – 7.13	1,305

Notes:

- a) Acceptable pH range. For the purpose of condition D7 an exceedance is 3 consecutive results above the acceptable pH range or 3 consecutive results below the acceptable pH range.
- b) Maximum EC value.

Table D3 - Groundwater level trigger thresholds

Monitoring Site ID	Groundwater Level trigger threshold ¹	Trigger basis
1900	253.00	Nominal elevation 0.2m above base of bore ⁶
DC040C	248.54	2023 Groundwater model ⁵
TG01	214.40	Nominal elevation 0.2m above base of bore ⁶
TG02	197.31	Generic 5m drawdown trigger ³
HUT01	340.60	Generic 5m drawdown trigger ²
HUT03	219.68	2023 Groundwater model ⁴
MB36	312.52	Generic 5m drawdown trigger ³
BH01	197.22	Generic 5m drawdown trigger ²
C0507663	183.16	2023 Groundwater model ⁴
BH_MB01	181.50	Nominal elevation 0.2m above base of bore ⁶
MB07	229.96	2023 Groundwater model ⁴
MB15	211.89	Generic 5m drawdown trigger ²
MB23	195.87	2023 Groundwater model ⁴
MB27	296.35	Generic 5m drawdown trigger ³
R3076	195.00	2023 Groundwater model ⁷
R3084	200.15	2023 Groundwater model ⁵
BHE_VWP01	Not applicable	For observation purposes only
MB29	197.38	2023 Groundwater model ⁵

Notes:

¹ Proposed level trigger thresholds are a minimum value presented in metres above reduced/relative level (m RL).

² Trigger level calculated by the environmental authority holder by applying a generic 5m drawdown trigger threshold to observed groundwater levels.

³ Trigger level calculated by the administering authority by applying a 5m drawdown trigger threshold to average observed groundwater levels.

⁴ Trigger level calculated by the environmental authority holder based on 2023 groundwater model.

⁵ Trigger level calculated by the administering authority based on 2023 groundwater model with no correction factor applied.

⁶ Trigger level calculated by the administering authority to be set above the base of the bore.

⁷ Trigger level calculated by the administering authority via manual adjustment of model prediction hydrograph/extrapolation of observed groundwater levels.

Schedule E – Acoustic	
Condition number	Condition
E1	Noise Nuisance Noise from the mining activity must not cause an environmental nuisance at any sensitive place.
E2	When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive place, and the results must be notified within ten (10) business days to the administering authority following completion of monitoring.
E3	The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's '<i>Noise Measurement Manual</i>'.
E4	Airblast overpressure and ground vibration from the mining activity must not cause an environmental nuisance at any sensitive place.
E5	When requested by the administering authority, airblast overpressure and ground vibration monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive place, and the results must be notified within ten (10) business days to the administering authority following completion of monitoring.
E6	Monitoring required by condition E5 must include: (a) location of the blast/s within the mining area (including which bench level); (b) atmospheric conditions including temperature, relative humidity and wind speed and direction; and (c) location, date and time of recording.

Table E1 – Blasting noise limits

	Blasting noise limits at any sensitive place or commercial place		
	Monday to Saturday 9.00am – 5.00pm	Sundays and Public Holidays 9.00am-5.00pm	All days 5.00pm-9.00am
Airblast overpressure	All mining areas: Maximum air blast overpressure level (linear peak) all blasts in any given 12-month period: (a) less than 115 dBL for 90% of blasts; and (b) 115 to 120 dBL for 9% of blasts; and (c) 120 to 125 dBL for 1% of blasts.	At The Hut mining area only: All blasts permitted. All other mining areas: (a) interburden and coal blasts only and no overburden blasts permitted. (b) Maximum air blast overpressure level (linear peak) all blasts in any given 12-month period: (i) Less than 115 dBL for 90% of blasts; (ii) 115 to 120 dBL for 9% of blasts; and (iii) 120 to 125 dBL for 1% of blasts.	No blasting
Ground vibration peak particle velocity	5mm/s peak particle velocity for any four (4) out of five (5) consecutive blasts and a maximum of 10 mm/s.	The Hut Mining Area: (a) All blasts permitted. (b) Vibration limits: 10mm/s peak particle velocity for any 4 out of 5 consecutive blasts and a maximum of 10 mm/s. Other Mining Areas: (a) Interburden and coal blasts only. No overburden blasts permitted.	No blasting

Note: The method of measurement and reporting of vibration levels must comply with the latest edition of the administering authority's vibration and air blast overpressure monitoring guideline.

E7	If it can be demonstrated to the administering authority that an exceedance of the limits defined in Table E1 - Blasting noise limits is caused by activities other than mining activities the administering authority may determine that the holder is not in breach of condition E4 .
E8	If monitoring indicates an exceedance of the relevant limits in Table E1 - Blasting noise limits, then the environmental authority holder must: (a) address any noise complaint received, including the use of appropriate dispute resolution if required; or (b) immediately implement air blast overpressure and/or vibration abatement measures so that air blast overpressure and/or vibration from the activity does not result in further environmental nuisance.

Schedule F – Land	
Condition number	Condition
F1	All land disturbed by mining activities must be rehabilitated in a manner that ensures it is: (a) safe for humans and wildlife; (b) stable; (c) able to sustain vegetation; and (d) non-polluting.
F2	Rehabilitation Management Plan A Rehabilitation Management Plan must be developed by a suitably qualified person and implemented for all areas disturbed by mining activities by 30 November 2020. The Rehabilitation Management Plan must: (a) be reviewed every three (3) years; and (b) identify milestones for mine closure.
F3	At a minimum the Rehabilitation Management plan must include: (a) map existing areas of rehabilitation including classification of stage (i.e. time since establishment) and quality; (b) a strategy for progressive rehabilitation; (c) detail the design objectives for rehabilitation of each domain to achieve rehabilitation success criteria and the identified post mining land uses; (d) specify spoil characteristics, soil analysis, soil separation for use on rehabilitation; (e) specify the topsoil requirements for the site and provide details of how topsoil will be managed for use in rehabilitation; (f) detail any topsoil deficit and how any deficit will be managed for successful rehabilitation, including, if applicable, the proposal of surrogate growth media; (g) detail rehabilitation methods applied to areas; (h) detail landform design including end of mine design; (i) detail how landform design will be consistent with surrounding topography; (j) identify and detail planned native vegetation rehabilitation areas and corridors; (k) identify at least a minimum of three (3) reference sites for use in rehabilitation monitoring; (l) describe rehabilitation indicators and how these will be monitored; (m) describe management actions to address unsuccessful rehabilitation or redesign; (n) describe end of mine landform design planning and post mining land uses across the mine; and include a triple bottom line assessment (or a comparative alternative assessment method) of the proposed final landform design criteria and alternatives.

F5	Rehabilitation requirements – All mining areas (Boundary Hill, Dunn Creek, Trap Gully, The Hut, The Bluff and Boundary Hill South) Rehabilitation must commence progressively as soon as areas become available.
F6	Rehabilitation requirements – All mining areas (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas) All areas significantly disturbed by the Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas must be rehabilitated to the final land description as defined in: (a) Table F1 - Final land use capability and projective area (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas); (b) Table F2 - Final landform design criteria (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas); and (c) The acceptance criteria stated in “Callide Mine Report on Rehabilitation Acceptance (Completion) Criteria”, Barcode C1554627, December 2003.

**Table F1 - Final land use capability and projective area schedule
(Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas)**

Southern Pits		Boundary Hill	
Tenure ID: Mining leases 5632, 5641, 5662, 5653, 5654, 80093, 6993, 80030, 80092, 80118, 80117, 80122		Tenure ID: Mining leases 5655, 6994, 80115, 80107, 80151, 80186	
Post Mine land capability classification	Projective surface area (ha)	Post mine land capability classification	Projective surface area (ha)
4	100	4	64
5	6.9	5	0
6	239.4	6	360
7	2,203.70	7	567
8	2,028.70	8	173

**Table F2 - Final landform design criteria
(Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas)**

Disturbance type	Slope	Drainage
Dragline and pre-strip soil (except Dunn Creek A and S Cut spoil) – outer slopes	Overall slope angle of 15% on outer slopes.	Graded banks at 10m vertical intervals (approx. every 60m along the slope).
Dunn Creek A & S Cut spoil – outer slopes	Overall slope angle of 25%, 120m slope length, basalt mulch cladding.	Berms or graded banks at 120m spacing along the slope.
Internal slopes	Generally, 15% or flatter.	Graded banks at 10m vertical intervals
Trial slopes	From 15% to 25% with topsoil or basalt mulch cladding.	Graded banks at 10m vertical intervals.
	Up to 37% (angle of repose).	Cut off drain/diversion bund across top of slope

F7	Areas which are to be progressively rehabilitated to native ecosystem must comply with the following outcomes: (a) all areas disturbed by mining activities must be rehabilitated to the landform design criteria defined in Table F2 - Final landform design criteria (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas); and (b) landforms are stable with erosion comparable and similar to analogue sites.
F8	Residual voids must comply with the following outcomes: (a) residual voids must not cause any serious environmental harm to land, surface waters or any recognised ground water aquifer, other than the environmental harm constituted by the existence of the residual void itself, and subject to any other condition within this environmental authority; and (b) residual voids must comply with Table F3 - Residual void design outcomes (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas); and (c) notwithstanding condition F1, residual void areas – including high walls, low walls, end walls, ramps and ramp slopes and void water bodies – for the Boundary Hill (excluding Boundary Hill South), Dunn Creek, Trap Gully, The Hut and The Bluff must meet the acceptance criteria stated in the “Callide Mine Report on Completion Criteria for Residual Voids”, December 2005 (with the exception of the criterion relating to submerged low walls and ramps); and as such are considered to be non-use management areas (NUMAs).
F9	Rehabilitation requirements - Boundary Hill South Mining Area (a) Land disturbed within the Boundary Hill South Mining Area must be rehabilitated in accordance with Appendix 1 - Rehabilitation requirements (Boundary Hill South Mining Area) and Appendix 2, Figure 2 – Boundary Hill South Mining Area conceptual final landform; and (b) The Boundary Hill South residual void NUMA must not exceed a maximum residual void NUMA area of 147.4ha; and (c) The Boundary Hill South residual void NUMA is authorised at the location and to the extent shown in Appendix 2, Figure 2 – Boundary Hill South Mining Area conceptual final landform.

**Table F3 - Residual void design outcomes
(Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas)**

Void Identification	Configuration
High wall	75° slope angle. Safety bunds will be constructed along the top of the high walls and along the crest of the pre-strip benches. The pre-strip benches will be shaped to shed runoff over the high wall at several locations to limit erosion.
Low wall	Generally at angle of repose.
Ramp Spoil	Generally at angle of repose.

F10	Contaminated land Before applying for surrender of a mining lease, the holder must (if applicable) provide to the administering authority a site investigation report under the <i>Environmental Protection Act 1994</i> in relation to any part of the mining lease which has been used for notifiable activities or which the holder is aware is likely to be contaminated land, and also carry out any further work that is required as a result of that report to ensure that the land is suitable for its final land use.
F11	Before applying for progressive rehabilitation certification for an area, the holder must (if applicable) provide to the administering authority a site investigation report under the <i>Environmental Protection Act 1994</i>, in relation to any part of the area the subject of the application which has been used for notifiable activities or which the holder is aware is likely to be contaminated land, and also carry out any further work that is required as a result of that report to ensure that the land is suitable for its final land use under conditions of this schedule relating to final land use.
F12	Minimise the potential for contamination of land by hazardous contaminants.

Schedule G – Regulated Structures	
Condition number	Condition
G1	Assessment of consequence category The consequence category of any structure must be assessed by a suitably qualified and experienced person in accordance with the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> at the following times: (a) prior to the design and construction of the structure, if it is not an existing structure; or (b) prior to any change in its purpose or the nature of its stored contents.
G2	A consequence assessment report and certification must be prepared for each structure assessed and the report may include a consequence assessment for more than one structure.
G3	Certification must be provided by the suitably qualified and experienced person who undertook the assessment, in the form set out in the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> .
G4	Design and construction of a regulated structure Conditions G5 to G9 inclusive do not apply to existing structures.
G5	All regulated structures must be designed by, and constructed under the supervision of, a suitably qualified and experienced person in accordance with the requirements of the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> .
G6	Construction of a regulated structure is prohibited unless the environmental authority holder has submitted a consequence category assessment report and certification to the administering authority has been certified by a suitably qualified and experienced person for the design and design plan and the associated operating procedures in compliance with the relevant condition of this environmental authority.
G7	Certification must be provided by the suitably qualified and experienced person who oversees the preparation of the design plan in the form set out in the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> and must be recorded in the Register of Regulated Structures.

G8	Regulated structures must: (a) be designed and constructed in accordance with and conform to the requirements of the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i>; (b) be designed and constructed with due consideration given to ensuring that the design integrity would not be compromised on account of: (i) floodwaters from entering the regulated dam from any watercourse or drainage line; and (ii) wall failure due to erosion by floodwaters arising from any watercourse or drainage line; (c) have the floor and sides of the dam designed and constructed to prevent or minimise the passage of the wetting front and any entrained contaminants through either the floor or sides of the dam during the operational life of the dam and for any period of decommissioning and rehabilitation of the dam.
G9	Certification by the suitably qualified and experienced person who supervises the construction must be submitted to the administering authority on the completion of construction of the regulated structure, and state that: (a) the 'as constructed' drawings and specifications meet the original intent of the design plan for that regulated structure; and (b) construction of the regulated structure is in accordance with the design plan.
G10	Operation of a regulated structure Operation of a regulated structure, except for an existing structure, is prohibited unless the environmental authority holder has submitted to the administering authority: (a) one paper copy and one electronic copy of the design plan and certification of the 'design plan' in accordance with condition G7; and (b) a set of 'as constructed' drawings and specifications; and (c) certification of those 'as constructed drawings and specifications' in accordance with condition G9; and (d) where the regulated structure is to be managed as part of an integrated containment system for the purpose of sharing the Design Storage Allowance (DSA) volume across the system, a copy of the certified system design plan; and (e) the requirements of this environmental authority relating to the construction of the regulated structure have been met; and (f) the environmental authority holder has entered the details required under this environmental authority, into a Register of Regulated Structures; and (g) there is a current operational plan for the regulated structures.

G11	For existing structures that are regulated structures: (a) where the existing structure that is a regulated structure is to be managed as part of an integrated containment system for the purpose of sharing the DSA volume across the system, the holder must submit to the administering authority a copy of the certified design plan including that structure; and (b) there must be a current operational plan for the existing structure.
G12	Each regulated structure must be maintained and operated, for the duration of its operational life until decommissioned and rehabilitated, in a manner that is consistent with the current operational plan and, if applicable, the current design plan and associated certified 'as constructed' drawings.
G13	Mandatory reporting level Conditions G14 to G17 inclusive only apply to regulated structures which have not been certified as low consequence category for 'failure to contain – overtopping'.
G14	The Mandatory Reporting Level (MRL) must be marked on a regulated dam in such a way that during routine inspections of that dam, it is clearly observable.
G15	The environmental authority holder must, as soon as practical and within forty-eight (48) hours of becoming aware, notify the administering authority when the level of the contents of a regulated dam reaches the MRL.
G16	The environmental authority holder must, immediately on becoming aware that the MRL has been reached, act to prevent the occurrence of any unauthorised discharge from the regulated dam.
G17	The environmental authority holder must record any changes to the MRL in the Register of Regulated Structures.
G18	Design storage allowance The environmental authority holder must assess the performance of each regulated dam or linked containment system over the preceding November to May period based on actual observations of the available storage in each regulated dam or linked containment system taken prior to 1 July of each year.
G19	By 1 November of each year, storage capacity must be available in each regulated dam (or network of linked containment systems with a shared DSA volume), to meet the DSA volume for the dam (or network of linked containment systems).
G20	The environmental authority holder must, as soon as possible and within forty-eight (48) hours of becoming aware that the regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, notify the administering authority.

G21	The environmental authority holder must, immediately on becoming aware that a regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, act to prevent the occurrence of any unauthorised discharge from the regulated dam or linked containment systems.
G22	Annual inspection report Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person.
G23	At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed and a suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and include recommended actions to ensure the integrity of the regulated structure.
G24	The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> .
G25	The environmental authority holder must within twenty (20) business days of receipt of the annual inspection report, provide to the administering authority: (i) the recommendations section of the annual inspection report; (ii) if applicable, any actions being taken in response to those recommendations.
G26	Transfer arrangements The environmental authority holder must provide a copy of any reports, documentation and certifications prepared under this environmental authority, including but not limited to any Register of Regulated Structures, consequence assessment, design plan and other supporting documentation, to a new holder on transfer of this environmental authority.
G27	Register of Regulated Structures A Register of Regulated Structures must be established and maintained by the environmental authority holder for each regulated structure.
G28	The environmental authority holder must provisionally enter the required information in the Register of Regulated Structures when a design plan for a regulated dam is submitted to the administering authority.
G29	The environmental authority holder must make a final entry of the required information in the Register of Regulated Structures once compliance with condition G10 and G12 has been achieved.
G30	The environmental authority holder must ensure that the information contained in the Register of Regulated Structures is current and complete on any given day.
G31	All entries in the Register of Regulated Structures must be approved by the chief executive officer for the environmental authority holder, or their delegate, as being accurate and correct.

G32	The holder must, at the same time as providing the annual return, supply to the administering authority a copy of the records contained in the Register of Regulated Structures, in the electronic format required by the administering authority.
G33	Transitional arrangements All existing structures that have not been assessed in accordance with either the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> or the former <i>Manual for Assessing Hazard Categories and Hydraulic Performance of Dams</i> must be assessed and certified in accordance with the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i>.
G34	All existing structures must subsequently comply with the timetable for any further assessments in accordance with the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i> specified in Table G1 - Transitional requirements for existing structures , depending on the consequence category for each existing structure assessed in the most recent previous certification for that structure.
G35	Table G1 - Transitional requirements for existing structures ceases to apply for a structure once any of the following events has occurred: (a) it has been brought into compliance with the hydraulic performance criteria applicable to the structure under the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)</i>; or (b) it has been decommissioned; or (c) it has been certified as no longer being assessed as a regulated structure.

Table G1 - Transitional hydraulic performance requirements for existing structures

Transition period required for existing structures to achieve the requirements of the <i>Manual for Assessing Consequence Categories and Hydraulic Performance of Dams</i>			
Compliance with criteria	High	Significant	Low
>90% and a history of good compliance performance in last 5 years	No transition required	No transition required	No transitional conditions apply. Review consequence assessment every 7 years.
>70%-≤90%	Within 7 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Within 10 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	No transitional conditions apply. Review consequence assessment every 7 years.
>50-≤70%	Within 5 years unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Within 7 years unless otherwise agreed with the administering authority, based on no history of unauthorised releases.	Review consequence assessment every 7 years.
≤50%	Within 5 years or as per compliance requirements (e.g. TEP timing)	Within 5 years or as per compliance requirements (e.g. TEP timing)	Review consequence assessment every 5 years.
G36	Certification of the transitional assessment required by G33 and G34 (as applicable) must be provided to the administering authority.		

Schedule H – Waste	
Condition number	Condition
H1	Storage of Tyres Tyres stored awaiting disposal or transport for take-back and, recycling, or waste-to-energy options, should be stockpiled in volumes less than 3m in height and 200 square metres in area and at least 10m from any other tyre storage area.
H2	All reasonable and practicable fire prevention measures must be implemented, including removal of grass and other materials within a 10m radius of the scrap tyre storage area.
H3	Disposing of scrap tyres resulting from the mining activities in spoil emplacements is acceptable, provided tyres are placed as deep in the spoil as possible but not directly on the pit floor.
H4	Scrap tyres resulting from the mining activities disposed within the operational land must not impede saturated aquifers and compromise the stability of the consolidated landform.
H5	Unless otherwise permitted by the conditions of this environmental authority or with prior approval from the administering authority and in accordance with a relevant standard operating procedure, waste must not be burnt.
H6	The holder of this environmental authority may burn vegetation provided the activity does not cause environmental harm at any sensitive or commercial place.

Schedule I – Sewage Treatment	
Condition number	Condition
I1	All effluent released from the sewage treatment plants at Dunn Creek and Boundary Hill must be monitored at end of pipe; at the location specified in Table I1 - Sewage effluent quality targets for irrigation; at the frequency specified in Table I1 - Sewage effluent quality targets for irrigation; and for the parameters specified in Table I1 - Sewage effluent quality targets for irrigation.

Table I1 - Sewage effluent quality targets for irrigation

Quality characteristics	Release limit	Units	Limit type	Monitoring frequency
pH	6.0 to 9.0	-	range	Monthly
Free Chlorine Residual	5	mg/L	Max	Monthly
Faecal Coliforms, based on the average of a minimum of five samples collected	<10	Colonies per 100 millilitres	Max	Monthly
Total Nitrogen	60	mg/L	Max	Monthly
Total Phosphorus	20	mg/L	Max	Monthly

I2	Sewage effluent used for dust suppression or irrigation must not exceed sewage effluent release limits defined in Table I1 - Sewage effluent quality targets for irrigation .
I3	Sewage effluent used for dust suppression or irrigation must not cause spray drift or over spray to any sensitive place.
I4	Subject to conditions I1, I2 and I3 , sewage effluent from sewage treatment facilities must be reused or evaporated and must not be directly released from the sewage treatment plant to any water way or drainage line.

Schedule J – Offsets	
Condition number	Condition
J1	Biodiversity offsets Significant residual impacts to prescribed environmental matters in the Boundary Hill South mining area are only authorised to occur under this environmental authority if the impacts: (a) are specified in Table J1 – Significant residual impacts to prescribed environmental matters (Boundary Hill South); (b) are no greater than the maximum extent of impact for each prescribed environmental matter specified in Table J1 – Significant residual impacts to prescribed environmental matters (Boundary Hill South); and (c) offsets are provided if required by the Boundary Hill South EPBC Act 1999 (Commonwealth) approval (EPBC 2012/6324).

Table J1 – Significant residual impacts to prescribed environmental matters (Boundary Hill South)

Prescribed environmental matters	Maximum extent of impact (ha)	Offset requirement under <i>Environmental Offsets Act 2014</i> (Qld)
Habitat for an animal that is vulnerable wildlife – Squatter Pigeon – <i>Geophaps scripta scripta</i> [1]	266	No
Habitat for an animal that is vulnerable wildlife – Koala – <i>Phascolarctos cinereus</i> [1]	257	No
Habitat for an animal that is vulnerable wildlife – South-eastern long-eared bat – <i>Nyctophilus corbeni</i> [1]	224	No

Note:

[1] These matters are addressed in the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) approval for Boundary Hill South (EPBC2012/6324).

END OF CONDITIONS

Definitions

Key terms and/or phrases used in this document are defined in this section. Where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations or environmental protection policies must be used. If a word remains undefined it has its ordinary meaning.

“administering authority” is the agency that administers the environmental authority provisions under the *Environmental Protection Act 1994*.

“airblast overpressure” means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure, is the peak airblast overpressure measured in decibels linear (dBL).

“annual inspection report” means an assessment prepared by a suitably qualified and experienced person containing details of the assessment against the most recent consequence assessment report and design plan (or system design plan);

- a) against recommendations contained in previous annual inspections reports;
- b) against recognised dam safety deficiency indicators;
- c) for changes in circumstances potentially leading to a change in consequence category;
- d) for conformance with the conditions of this environmental authority;
- e) for conformance with the ‘as constructed’ drawings;
- f) for the adequacy of the available storage in each regulated dam, based on an actual observation or observations taken after 31 May each year but prior to 1 November of that year, of accumulated sediment, state of the containment barrier and the level of liquids in the dam (or network of linked containment systems); and
- g) for evidence of conformance with the current operational plan.

“appropriately qualified person” means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature

“assessed” or **“assess”** or **“assessment”** by a suitably qualified and experienced person in relation to a consequence assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

- a) exactly what has been assessed and the precise nature of that assessment;
- b) the relevant legislative, regulatory and technical criteria on which the assessment has been based;
- c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and
- d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

“background” with reference to **Schedule C - Surface Water** means the average of samples taken prior to the commencement of mining from the same waterway that the current sample has been taken.

“blasting” means the use of explosive material to fracture:

- a) rock, coal and other minerals for later recovery; or
- b) structural components or other items to facilitate removal from a site or for reuse.

“Boundary Hill” means mining leases ML5655, ML6994, ML80107, ML80115 and ML80151.

“Boundary Hill South Mining Area” means the mining area within ML80186.

“certification” means assessment and approval must be undertaken by a suitably qualified and experienced person in relation to any assessment or documentation required by this Manual, including design plans, ‘as constructed’ drawings and specifications, construction, operation or an annual report regarding regulated structures, undertaken in accordance with the Board of Professional Engineers of Queensland Policy Certification by RPEQs (ID: 1.4 (2A)).

“certifying, certify or certified” have a corresponding meaning as ‘certification’.

“chemical” means:

- a) an agricultural chemical product or veterinary chemical product within the meaning of the *Agricultural and Veterinary Chemicals Code Act 1994* (Commonwealth); or
- b) a dangerous good under the *Australian Code for the Transport of Dangerous Goods by Road and Rail* approved by the Australian Transport Council; or
- c) a lead hazardous substance within the meaning of the *Workplace Health and Safety Regulation 1997*; or
- d) a drug or poison in the *Standard for the Uniform Scheduling of Drugs and Poisons* prepared by the Australian Health Ministers’ Advisory Council and published by the Commonwealth; or
- e) any substance used as, or intended for use as:
 - i) a pesticide, insecticide, fungicide, herbicide, rodenticide, nematocide, miticide, fumigant or related product; or
 - ii) a surface active agent, including, for example, soap or related detergent; or
 - iii) a paint solvent, pigment, dye, printing ink, industrial polish, adhesive, sealant, food additive, bleach, sanitiser, disinfectant, or biocide; or
 - iv) a fertiliser for agricultural, horticultural or garden use; or
 - v) a substance used for, or intended for use for mineral processing or treatment of metal, pulp and paper, textile, timber, water or waste water; or
 - vi) manufacture of plastic or synthetic rubber.

“commercial place” means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employee accommodation or public roads. While the Non-residency Agreement between the environmental authority holder and the owner of Kilburnie Homestead is in effect, Kilburnie Homestead is not a commercial place for the purpose of this environmental authority.

“construction” or **“constructed”** in relation to a regulated structure includes building a new regulated structure and lifting or otherwise modifying of an existing regulated structure, but does not include investigations and testing necessary for the purpose of preparing a design plan.

“consequence” in relation to a structure as defined, means the potential for environmental harm resulting from the collapse or failure of the structure to perform its primary purpose of containing, diverting or controlling flowable substances.

“consequence category” means a category, either low, significant or high, into which a dam is assessed as a result of the application of tables and other criteria in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)*.

“dam” means a land-based structure or a void that contains, diverts or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works.

“dam crest volume” means the volume of material (liquids and/or solids) that could be within the walls of a dam at any time when the upper level of that material is at the crest level of that dam. That is, the instantaneous maximum volume within the walls, without regard to flows entering or leaving (for example, via spillway).

“design plan” is a document setting out how all identified consequence scenarios are addressed in the planned design and operation of a regulated structure.

“design storage allowance” or **“DSA”** means an available volume, estimated in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)* published by the administering authority, must be provided in a dam as at 1 November each year in order to prevent a discharge from that dam to an annual exceedance probability (AEP) specified in that Manual.

“disturbance” of land includes:

- a) compacting, removing, covering, exposing or stockpiling of earth;
- b) removal or destruction of vegetation or topsoil or both to an extent where the land has been made susceptible to erosion;
- c) carrying out mining within a watercourse, waterway, wetland or lake;
- d) the submersion of areas by tailings or hazardous contaminant storage and dam/structure walls;
- e) temporary infrastructure, including any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be removed after the mining activity has ceased; or
- f) releasing of contaminants into the soil, or underlying geological strata.

However, the following areas are not included when calculating areas of ‘disturbance’:

- a) areas off lease (e.g. roads or tracks which provide access to the mining lease);
- b) areas previously disturbed which have achieved the rehabilitation outcomes;
- c) by agreement with the administering authority, areas previously disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);
- d) areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dam/structures, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be left by agreement with the landowner.
- e) disturbance that pre-existed the grant of the tenure.

“Dunn Creek” means mining leases ML5632, ML5641, ML80030, ML80092, ML80093, ML80118.

“EC” means electrical conductivity.

“effluent” treated waste water discharged from sewage treatment plants.

“emergency action plan” means documentation forming part of the operational plan held by the holder or a nominated responsible officer, that identifies emergency conditions that sets out procedures and actions that will be followed and taken by the dam owner and operating personnel in the event of an emergency. The actions are to minimise the risk and consequences of failure, and ensure timely warning to downstream communities and the implementation of protection measures. The plan must require dam owners to annually update contact information.

“ERC decision” means a decision made by the administering authority under section 300 of the *Environmental Protection Act 1994* about the estimated rehabilitation cost for a resource activity.

“ERC period for the estimated rehabilitation cost for a resource activity” means:

- a) if a PRCP schedule applies for the activity, the period of between 1 and 5 years stated in the application for an ERC decision under section 298(2)(b); or
- b) if the activity is a petroleum activity that is an ineligible ERA, other than a petroleum activity to which a plan of operations applies, or the activity relates to a 1923 Act petroleum tenure granted under the *Petroleum Act 1923*, the period of between 1 and 5 years stated in the ERC decision about the estimated rehabilitation cost; or
- c) if a plan of operations applies for the activities, the plan period for the plan of operations; or
- d) otherwise, the total period during which the resource activity is likely to be carried out under the environmental authority for the activity.

“Estimated rehabilitation cost or “ERC” for a resource activity, see section 300(2) of the *Environmental Protection Act 1994*.

“existing structure” means a structure that was in existence prior to 21 February 2014.

“flowable substance” means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

“holder”, for a mining tenement, means a holder of the tenement under the *Mineral Resources Act 1989*, and the holder of the associated environmental authority under the *Environmental Protection Act 1994*.

“hydraulic performance” means the capacity of a regulated dam to contain or safely pass flowable substances based on the design criteria specified for the relevant consequence category in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)*.

“infrastructure” means water storage dams, levees, roads and tracks, buildings and other structures built for the purpose of the mining activity.

“Kilburnie Homestead” means the place located on Lot 77 on SP163782 and registered on the Queensland Heritage Register as the Kilburnie Homestead with Place ID 600016.

“land” in Schedule F - Land of this document means land excluding waters and the atmosphere, that is, the term has a different meaning from the term as defined in the *Environmental Protection Act 1994*. For the purposes of the *Acts Interpretation Act 1954*, it is expressly noted that the term ‘land’ in this environmental authority relates to physical land and not to interests in land.

“land use” means the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

“levee” means an embankment that only provides for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from releases from other works, during the progress of those stormwater or flood flows or those releases; and does not store any significant volume of water or flowable substances at any other times.

“m” means metres.

“mandatory reporting level” or “MRL” means a warning and reporting level determined in accordance with the criteria in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)* published by the administering authority.

“Manual” means the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)* published by the administering authority.

“matters of state environmental significance” or “MSES” has the meaning in schedule 2 of the *Environmental Offsets Regulation 2014*.

“maximum extent of impact” means the total, cumulative, residual extent and duration of impact to a prescribed environmental matter that will occur over a project’s life after all reasonable avoidance and reasonable on-site mitigation measures have been, or will be, undertaken.

“measures” includes any measures to prevent or minimise environmental impacts of the mining activity such as bunds, silt fences, diversion drains, capping, and containment systems.

“mine affected water” means the following types of water:

- a) pit water, tailings dam water, processing plant water;
- b) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the *Environmental Protection Regulation 2008* if it had not formed part of the mining activity;
- c) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water;
- d) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated;
- e) groundwater from the mine’s dewatering activities; or
- f) a mix of mine affected water (under any of paragraphs a) – e) and other water.

Does not include surface water runoff which, to the extent that it has been in contact with areas disturbed by mining activities that have not yet been completely rehabilitated, has only been in contact with:

- a) land that has been rehabilitated to a stable landform and either capped or revegetated in accordance with the acceptance criteria set out in the environmental authority but only still awaiting maintenance and monitoring of the rehabilitation over a specified period of time to demonstrate rehabilitation success; or
- b) land that has partially been rehabilitated and monitoring demonstrates the relevant part of the landform with which the water has been in contact does not cause environmental harm to waters or groundwater, for example:
 - i) areas that have been capped and have monitoring data demonstrating hazardous material adequately contained with the site;
 - ii) evidence provided through monitoring that the relevant surface water would have met the water quality parameters for mine affected water release limits in this environmental authority, if those parameters had been applicable to the surface water runoff; or
- c) both a) and b) above.

“Mining activity / mining activities” means the following activities:

- a) authorised as per the definition of section 110 of the *Environmental Protection Act 1994*;
- b) all environmentally relevant activities authorised under this environmental authority;
- c) all mining disturbance including the construction of mining infrastructure, overburden removal and active mining;
- d) all activities carried out while the mine is not operational (i.e. care and maintenance status);
- e) exploration; and
- f) rehabilitation.

“NATA” means National Association of Testing Authorities, Australia.

“natural flow” means the flow of water through waters caused by nature.

“notice of election” has the meaning in section 18(2) of the *Environmental Offsets Act 2014*.

“operational plan” includes:

- a) normal operating procedures and rules (including clear documentation and definition of process inputs in the DSA allowance);
- b) contingency and emergency action plans including operating procedures designed to avoid and/or minimise environmental impacts including threats to human life resulting from any overtopping or loss of structural integrity of the regulated structure.

“peak particle velocity” or **“ppv”** means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms).

“prescribed environmental matter” has the same meaning as in section 10 of the *Environmental Offsets Act 2014*, limited to the matters of State environmental significance listed in schedule 2 of the *Environmental Offsets Regulation 2014*.

“receiving environment” in relation to an activity that causes or may cause environmental harm, means the part of the environment to which the harm is, or may be, caused. The receiving environment includes (but is not limited to):

- a) a watercourse;
- b) groundwater; and
- c) an area of land that is not specified as operational land of this environmental authority.

“receiving waters” means the waters into which this environmental authority authorises releases of mine affected water.

“Register of Regulated Structures” includes:

- a) date of entry in the register;
- b) name of the dam, its purpose and intended/actual contents;
- c) the consequence category of the dam as assessed using the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635);
- d) dates, names, and reference for the design plan plus dates, names, and reference numbers of all document(s) lodged as part of a design plan for the dam;
- e) name and qualifications of the suitably qualified and experienced person who certified the design plan and 'as constructed' drawings;
- f) for the regulated dam, other than in relation to any levees:
 - i) the dimensions (metres) and surface area (hectares) of the dam measured at the footprint of the dam;
 - ii) coordinates (latitude and longitude in GDA94) within five metres at any point from the outside of the dam including its storage area
 - iii) dam crest volume (megalitres);
 - iv) spillway crest level (metres AHD).
 - v) maximum operating level (metres AHD);
 - vi) storage rating table of stored volume versus level (metres AHD);
 - vii) design storage allowance (megalitres) and associated level of the dam (metres AHD);

- viii) mandatory reporting level (metres AHD);
- g) the design plan title and reference relevant to the dam;
- h) the date construction was certified as compliant with the design plan;
- i) the name and details of the suitably qualified and experienced person who certified that the constructed dam was compliant with the design plan;
- j) details of the composition and construction of any liner;
- k) the system for the detection of any leakage through the floor and sides of the dam;
- l) dates when the regulated dam underwent an annual inspection for structural and operational adequacy, and to ascertain the available storage volume for 1 November of any year;
- m) dates when recommendations and actions arising from the annual inspection were provided to the administering authority; and
- n) dam water quality as obtained from any monitoring required under this environmental authority as at 1 November of each year.

“regulated dam” means any dam in the significant or high consequence category as assessed using the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (EM635)* published by the administering authority.

“regulated structure” includes land-based containment structures, levees, bunds and voids, but not a tank or container designed and constructed to an Australian Standard that deals with strength and structural integrity.

“rehabilitation” means the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

“release event” means a surface water discharge from mine affected water storages or contaminated areas on the licensed place.

“RL” means reduced level, relative to mean sea level as distinct from depths to water.

“secondary containment system” means a system designed, installed and operated to prevent any release of contaminants from the system, or containers within the system, to land, groundwater, or surface waters.

“sensitive place” means:

- a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- b) a motel, hotel or hostel; or
- c) an educational institution; or
- d) a medical centre or hospital; or
- e) a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 2004* or a World Heritage Area; or
- f) a public park or gardens.

Note: The definition of ‘sensitive place’ and ‘commercial place’ is based on Schedule 1 of EPP Noise. That is, a sensitive place is inside or outside of a dwelling, library & educational institution, childcare or kindergarten, school or playground, hospital, surgery or other medical institution, commercial & retail activity, protected area or an area identified under a conservation plan under Nature conservation Act 1992 as a critical habitat or an area of major interest, marine park under Marine Parks Act 2004, park or garden that is outside of the mining

lease and open to the public for use other than for sport or organised entertainment. A commercial place is inside or outside a commercial or retail activity.

A mining camp (i.e., accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority) is not a sensitive place for that mine or mining project, whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the holders of the environmental authority for the mining project, or a related company. Accommodation for mine employees or contractors is not a sensitive place if the land is held by a mining company or related company, and if occupation is restricted to the employees, contractors and their families for the particular mine or mines which are held by the same company or a related company.

For example, a township (occupied by the mine employees, contractors and their families for multiple mines that are held by different companies) would be a sensitive place, even if part or all of the township is constructed on land owned by one or more of the companies.

"significant residual impacts" has the same meaning given in the *Environmental Offsets Act 2014*.

"spillway" means a weir, channel, conduit, tunnel, gate or other structure designed to permit discharges from the dam, normally under flood conditions or in anticipation of flood conditions.

"suitably qualified and experienced person" in relation to regulated structures means a person who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act 2002*, and has demonstrated competency and relevant experience:

- a) for regulated dams, an RPEQ who is a civil engineer with the required qualifications in dam safety and dam design; and
- b) for regulated levees, an RPEQ who is a civil engineer with the required qualifications in the design of flood protection embankments.

Note: It is permissible that a suitably qualified and experienced person obtain subsidiary certification from an RPEQ who has demonstrated competence and relevant experience in either geomechanics, hydraulic design or engineering hydrology.

"The Bluff" means mining lease ML6993.

"The Hut" means mining lease ML5654.

"Trap Gully" means mining leases ML80122, ML80117, ML5653, ML5662 and ML700059.

"void" means any constructed, open excavation in the ground.

"µS/cm" means microsiemens per centimetre.

"watercourse" has the same meaning given in the *Water Act 2000*.

"water quality" means the chemical, physical and biological condition of water.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), storm water channel, storm water drain, and groundwater and any part thereof.

END OF DEFINITIONS

Appendices

Appendix 1 - Rehabilitation requirements (Boundary Hill South Mining Area)

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Residual void area (Non-use management area shown in Appendix 2, Figure 2 – Boundary Hill South conceptual final landform)	Long term safety	The site is structurally safe and the environment is not exposed to contamination by heavy metals or other toxic materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.
				Landform design meets the requirements of Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.
			Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
			Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
			Evidence of stream bank erosion.	Evidence in the Rehabilitation Report that creek diversions are stable at closure and exhibit characteristics for long term stability.
		Site is safe for humans and animals now and in the foreseeable future.	Safety assessment of landform stability (geotechnical studies).	An appropriately qualified person certifies the long-term geotechnical stability of the residual slopes and faces in the voids and evidence of this is documented in the Rehabilitation Report.
			Adequacy and predicted long-term performance of safety barriers.	Evidence in the Rehabilitation Report that a safety risk assessment of the residual void areas has been completed and proposed mitigation measures are documented in a Safety Plan.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Installation of safety barriers and human/wildlife exclusion fencing of residual void.	If required, mitigation measures documented in a Safety Plan, e.g. fencing or other suitable barrier around the residual void areas are installed to restrict access.
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures are decommissioned appropriately.	The number and condition of non-permanent regulated structures.	Regulated structures are decommissioned in accordance with the administering authority requirements.
		Residual voids protected from flooding.	Flood protection measures constructed around residual voids.	Certification by a suitably qualified and experienced person in the Rehabilitation Report that the residual voids have an adequate protection system to prevent inundation from a 1: 1,000 year annual exceedance probability flood event.
		Diversion design and maintenance.	Whether or not a water licence under the <i>Water Act 2000</i> (QLD) is required.	Confirmation in writing from the administering authority that the water licence under the <i>Water Act 2000</i> (QLD) is no longer required.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Stable landform	Very low probability of rock falls with serious environmental consequences.	The number of rock falls during the life of the mine.	Evidence in the Rehabilitation Report that the number of rock falls has been acceptably low, and that appropriate control measures are in place to prevent rock falls with serious environmental consequences in the future.
	Stable landform (cont.)	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.
			Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report how drainage diversions have changed over the life of mine and that they are stable at closure and are likely to remain that way into the foreseeable future.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				To be designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).
	Stable landform (cont.)	Very low probability of rock falls with serious environmental consequences.	Geotechnical studies.	Evidence in the Rehabilitation Report that a risk assessment has been done and mitigation measures (if any) have been documented and implemented.
Mining infrastructure area	Long term safety	Rehabilitation or conversion of exploration drill holes and groundwater monitoring bored.	Number of non-artesian exploration drill holes on the mining lease that have been, or have not been, rehabilitated or converted to water bores.	Certification by an appropriately qualified person that all non-artesian exploration drill holes that are not converted to either a water bore or a groundwater monitoring bore have been rehabilitated.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification by an appropriately qualified person, that all sub-artesian aquifers have been isolated where non-artesian exploration drill holes have intersected more than one sub-artesian water bearing strata, in accordance with <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition
				Certification by an appropriately qualified person that all non-artesian exploration drill holes converted to a water bore have been converted in accordance with the <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition.
				Certification by an appropriately qualified person that all non-artesian exploration drill holes converted to water bores are compliant with the <i>Water Act 2000</i> (QLD).

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Number of monitoring bores on the mining lease that have been, or have not been, rehabilitated.	Certification by an appropriately qualified person that all monitoring bores have been rehabilitated in accordance with the <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition.
		Structurally safe with no hazardous materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
		Site is safe for humans and animals now and in the foreseeable future.	The presence on site of infrastructure that requires decommissioning.	Certification by an appropriately qualified person in the site Rehabilitation Report that the infrastructure has been decommissioned and rehabilitated. Buildings, water storage(s), roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Access to the area is conducive of the intended purpose of the post-mining land use including pastoral farming.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated. (cont.)	All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures	Regulated structures are decommissioned in accordance with the administering authority requirements.
	Containment or removal of any potential sources of contamination.	Hazardous materials are adequately managed, and the environment is not exposed to contamination by heavy metals or other toxic materials.	Encapsulation depth, and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
		The site is free of material other than waste rock that could contaminate the land.	Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	The final landform is stable	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Vegetation cover is sufficient to form a self-sustaining community and minimise erosion.	Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
			Vegetation type and density.	Vegetation types and densities are comparable with the relevant reference site.
			Foliage cover.	Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces >20m ² in area or >10m in length down slope.
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report will show whether, and if so how, drainage diversions have changed over the life of mine; that they are stable at closure; and are likely to remain stable into the foreseeable future.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Demonstration that drainage diversions have been designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).
		Very low probability of rock falls with serious environmental consequences.	Geotechnical studies.	Evidence in the Rehabilitation Report that appropriate geotechnical risk assessment has been done and control measures put in place.
			The number of rock falls during the life of the mine.	Evidence in the Rehabilitation Report that the number of rock falls has been acceptably low, and that appropriate control measures are in place to prevent rock falls with serious environmental consequences in the future.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties of the soil, including pH, salinity, nutrient content, exchangeable sodium percentage.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; - soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro- and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
			Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
		Establish self-sustaining natural vegetation or habitat.	Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Self-sustaining natural vegetation or habitat.	Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Livestock stocking rates.	An appropriately qualified person has predicted and defined the expected stocking rates of the rehabilitated land, and these have been agreed with relevant stakeholders.
			Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.
			Number and volume of water sources suitable for stock.	Stock has adequate access to water that meet accepted livestock drinking water guidelines.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Overburden Emplacement Area	Long term safety	The site is structurally safe, and the environment is not exposed to contamination by heavy metals and other toxic materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
			Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
			Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
			Evidence of stream bank erosion.	Evidence in the Rehabilitation Report that creek diversions are stable at closure and exhibit characteristics for long term stability.
		Site is safe for humans and animals now and in the foreseeable future.	Safety assessment of landform stability (geotechnical studies).	An appropriately qualified person certifies the long-term geotechnical stability of the residual slopes and faces and evidence of this is documented in the Rehabilitation Report.
		Site is safe for humans and animals now and in the foreseeable future.	Adequacy and predicted long-term performance of safety barriers.	Evidence in the Rehabilitation Report that a safety risk assessment of the slopes has been completed and proposed mitigation measures are documented in a Safety Plan.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Installation of safety barriers and human/wildlife exclusion fencing.	If required, mitigation measures documented in a Safety Plan, e.g. fencing or other suitable barrier around the slopes are installed to restrict access.
	No receiving waters are contaminated.	Mine affected water contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Final landform water storages are contained on-site, with no overflows into external surface water systems.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures.	All regulated structures are decommissioned in accordance with the administering authority requirements.
		Acid mine drainage will not cause serious environmental harm.	Encapsulation depth and containment of potentially contaminating material.	Certification by suitably qualified person in the Rehabilitation Report that the emplacement cells for any potentially acid forming material have been constructed in accordance with recommendations in the Acid Mine Drainage Assessment report.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Stable landform	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning as intended.
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Vegetation cover sufficient for a self-sustaining community and to minimise erosion.	Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
			Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
				Vegetation types and densities are comparable with the relevant reference site.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report how drainage diversions have changed over the life of mine and that they are stable at closure and are likely to remain that way into the foreseeable future.
				To be designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties of the soil, including pH, salinity, nutrient content and exchangeable sodium percentage.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; - soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
		Soil properties support the desired land-use.	Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
			Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Self-sustaining natural vegetation or habitat.	Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Abundance of declared plants (weeds) identified through surveys.	Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Livestock stocking rates.	An appropriately qualified person has predicted and defined the expected stocking rates of the rehabilitated land, and these have been agreed with relevant stakeholders.
			Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.
			Number and volume of water sources suitable for stock.	Stock has adequate access to water that meet accepted livestock drinking water guidelines.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Water storage areas	Long term safety	Structurally safe with no hazardous materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.
		Site is safe for humans and animals now and in the foreseeable future.	The presence on site of regulated dams that need decommissioning.	Certification by a suitably qualified and experienced person in the site Rehabilitation Report that regulated dams and structures have been decommissioned and rehabilitated.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures.	Regulated structures are decommissioned in accordance with the administering authority requirements.
			Voids protected from flooding.	Certification by a suitably qualified and experienced person in the Rehabilitation Report that the voids have an adequate protection system to prevent inundation from a 1: 1,000 year annual exceedance probability flood event.
		Hazardous materials are adequately managed, and the environment is not exposed to contamination by heavy metals or other toxic material.	Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		The site is free of material other than waste rock that could contaminate the land.	Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
		Diversion design and maintenance.	The administering authority of the water licence under the <i>Water Act 2000</i> (QLD) has determined that the water licence is no longer required.	Confirmation in writing from the administering authority that the water licence under the <i>Water Act 2000</i> (QLD) is no longer required.
		Landform design achieves appropriate erosion rates.	Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
		Vegetation cover sufficient for a self-sustaining community and to minimise erosion.	Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
				Vegetation types and densities are comparable with the relevant reference site.
			Foliage cover.	Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces >20 m ² in area or > 10 m in length down slope.
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report will show whether, and if so how, drainage diversions have changed over the life of mine; that they are stable at closure; and are likely to remain stable into the foreseeable future.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	The final landform is stable.	The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Demonstration that drainage diversions have been designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties, e.g. pH, salinity, nutrient content, sodium content of topsoil to support the proposed vegetation and land-use.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

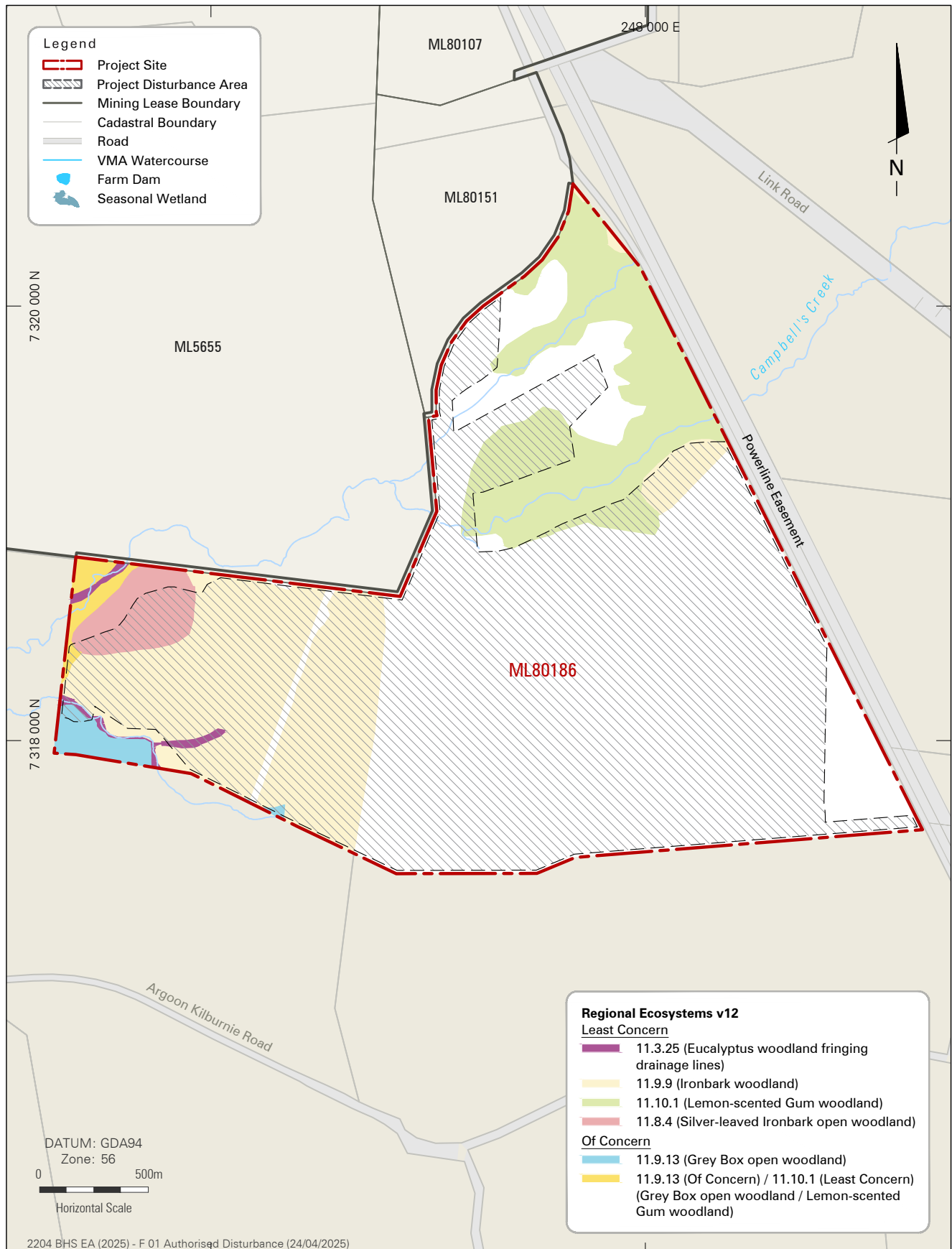
Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
			Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

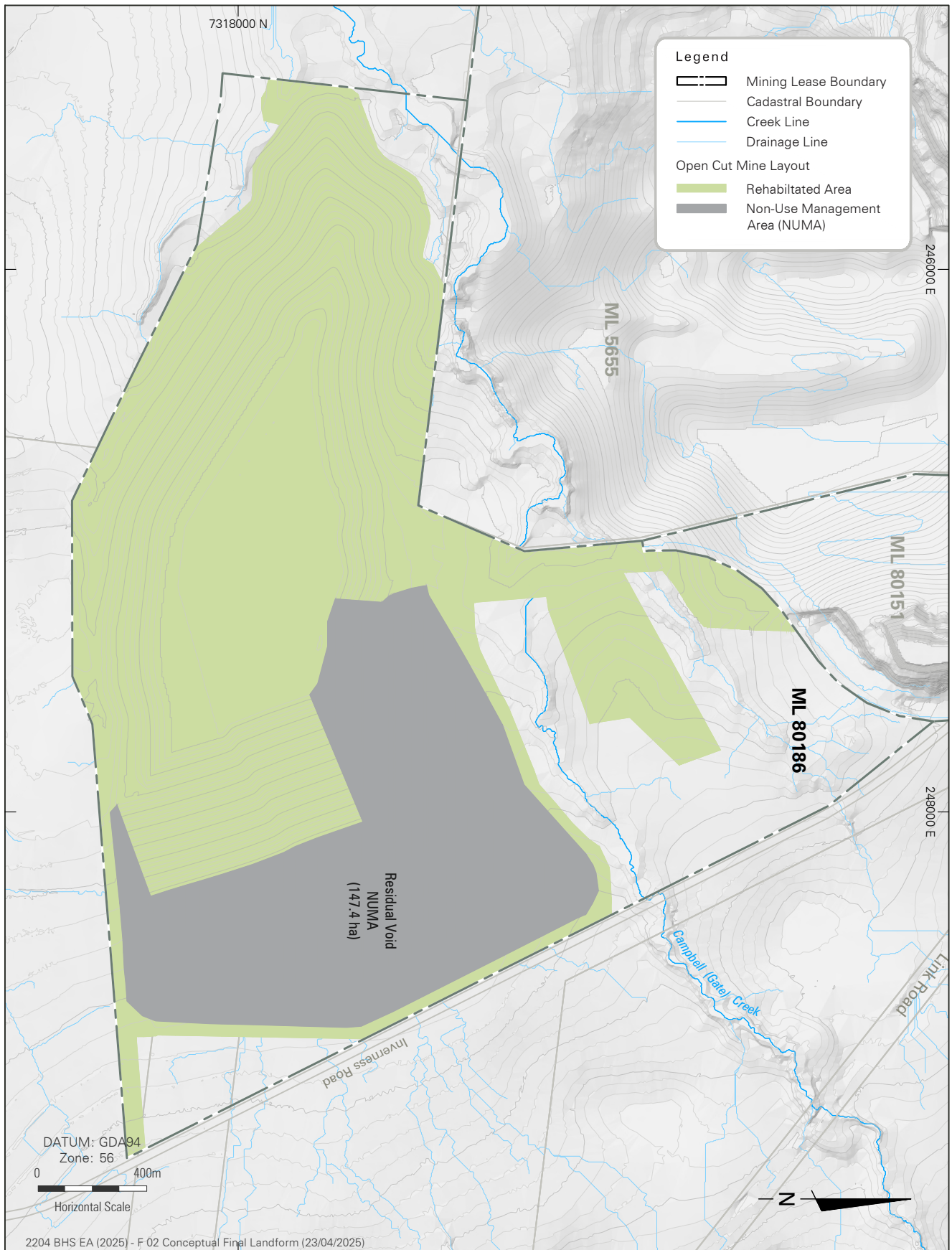
Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
			Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.
		Self-sustaining natural vegetation or habitat.	Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.

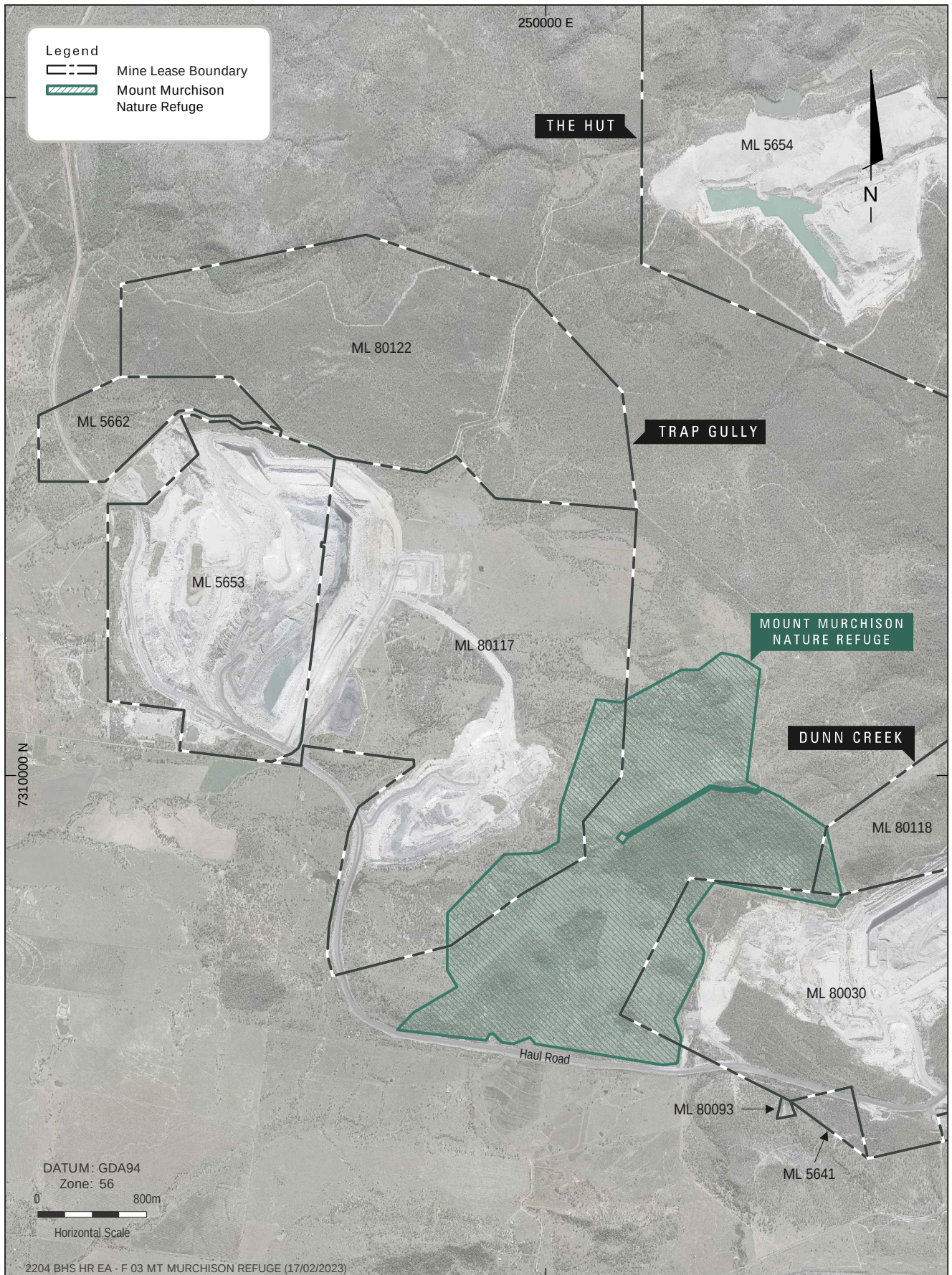
Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.
		Self-sustaining natural vegetation or habitat.	Abundance of declared plants (weeds) identified through surveys.	Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is not greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.
			Stock access to water sources.	Stock has adequate access to water that meets accepted livestock drinking water guidelines.

APPENDIX 2







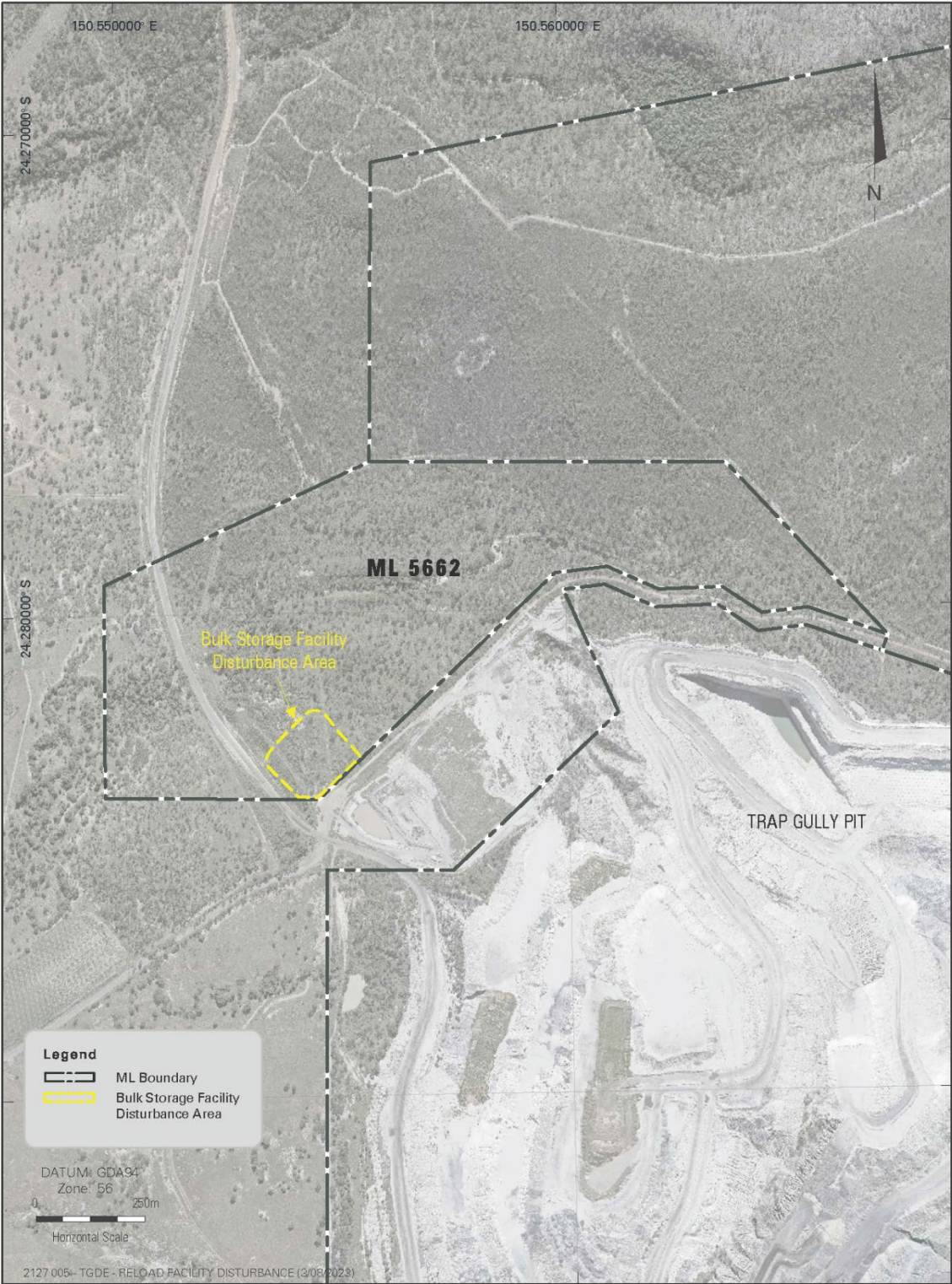
CALLIDE MINE

BATCHFIRE  GALLIDE

 **HANSEN**
ENVIRONMENTAL
CONSULTING

Mount Murchison Nature Refuge

FIGURE 3

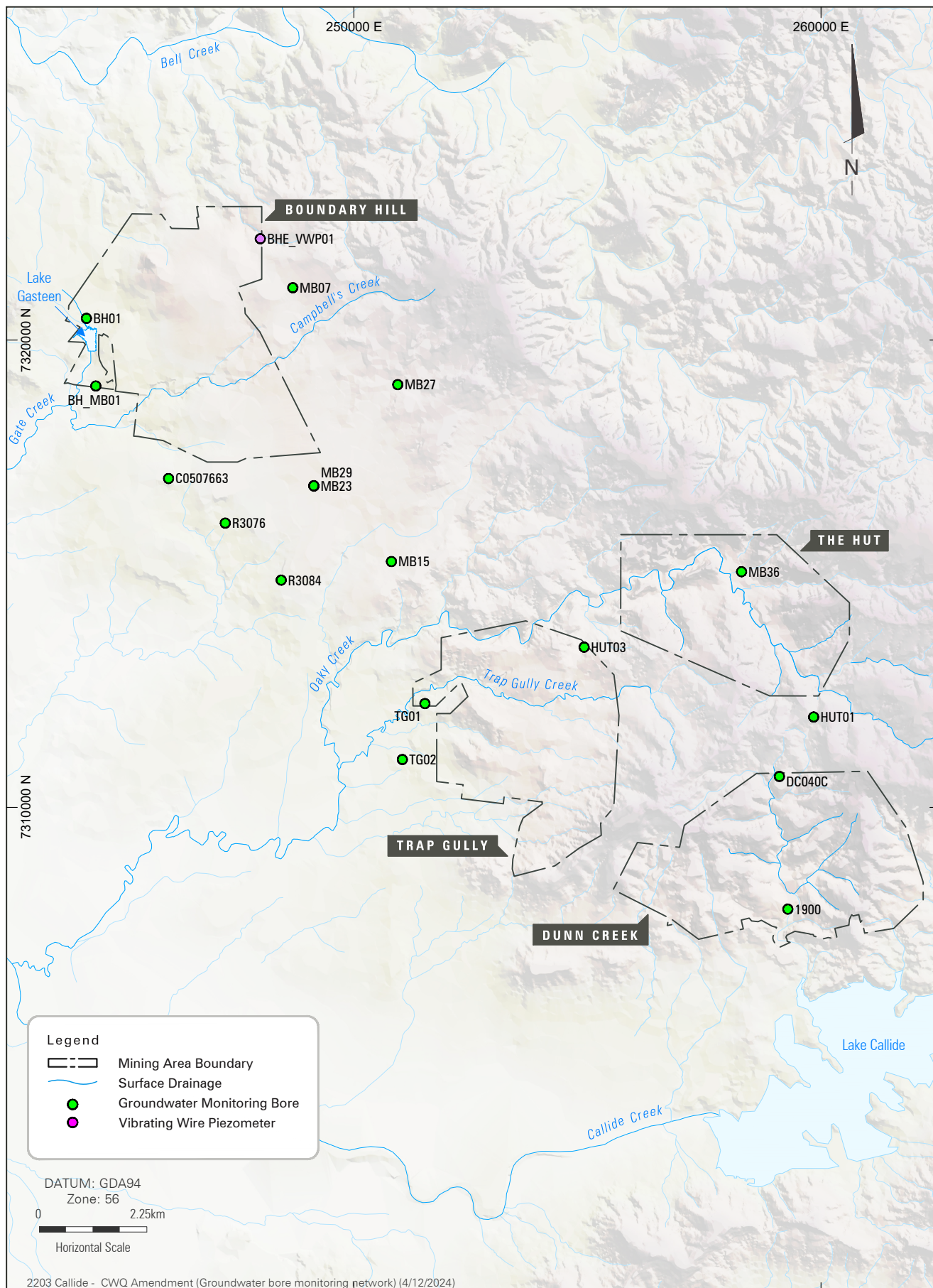


TRAP GULLY BULK STORAGE FACILITY

Bulk Storage Facility Disturbance Area

FIGURE 4





CALLIDE MINE

BATCHFIRE  CALLIDE



Groundwater Bore Monitoring Network

FIGURE 5

END OF ENVIRONMENTAL AUTHORITY

Appendix C2:

Callide Mine Rehabilitation Management Plan 2026



EMS_07

Rehabilitation Management Plan

Document Owner – Environment & Community Superintendent	Date	Signature
Rebecca Hyde	05 May 2026	
General Manager – ESG & Development	Date	Signature
Stuart Schmidt	05 May 2026	

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1 Purpose and Scope

This RMP addresses the specific requirements of Callide Mine EA conditions F2 and F3.

Table 1 presents the EA conditions and provides a reference to where each specific requirement is addressed in this RMP document

Table 1
Environmental Authority Rehabilitation Management Plan Requirements Checklist

EA (ref. EPML00720413) Condition	RMP Section Reference
<u>Condition F2 Rehabilitation Management Plan</u> A Rehabilitation Management Plan must be developed by a suitably qualified person and implemented for all areas disturbed by mining activities by 30 November 2020. The Rehabilitation Management Plan must: (a) be reviewed every three (3) years; and (b) identify milestones for mine closure.	This plan Section 4.5 & 6
<u>Condition F3</u> At a minimum the Rehabilitation Management plan must include: (a) map of existing areas of rehabilitation including classification of stage (i.e. time since establishment) and quality; (b) a strategy for progressive rehabilitation; (c) detail the design objectives for rehabilitation of each domain to achieve rehabilitation success criteria and the identified post mining land uses; (d) specify spoil characteristics, soil analysis, soil separation for use on rehabilitation; (e) specify the topsoil requirements for the site and provide details of how topsoil will be managed for use in rehabilitation; (f) detail any topsoil deficit and how any deficit will be managed for successful rehabilitation, including, if applicable, the proposal of surrogate growth media; (g) detail rehabilitation methods applied to areas; (h) detail landform design including end of mine design; (i) detail how landform design will be consistent with surrounding topography; (j) identify and detail planned native vegetation rehabilitation areas and corridors; (k) identify at least a minimum of three (3) reference sites for use in rehabilitation monitoring; (l) describe rehabilitation indicators and how these will be monitored; (m) describe management actions to address unsuccessful rehabilitation or redesign; (n) Describe end of mine landform design planning and post mining land uses across the mine; and include a triple bottom line assessment (or a comparative alternative assessment method) of the proposed final landform design criteria and alternatives.	Figure 2 & Section 3.1 Section 4.6.1 Section 4 Section 4.6.1 Section 4.6.4 Section 4.6.4 Section 4.6 Section 4.3 Section 4.3 Section 4.4 Section 5.2 Section 4.5 Section 7 Section 4.3

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2 Definitions

Term	Definition
Condition	Condition within the EA
DETSI	Department of the Environment, Science, Tourism and Innovation
EA	Callide Mine Environmental Authority EPML007201413
LOD	Land Outcome Documents
LOM	Life of Mine
MIA	Mine Industrial Area
ML	Mining Lease
PMLU	Post Mining Land Use
PRCP	Progressive Rehabilitation and Closure Plan
PTD	Permit to Disturb
Rehabilitation	The process of treating mine affected land and returning to safe, stable and non-polluting landform
RMP	Rehabilitation Management Plan
Should	Indicates a direction is a recommendation
Shall	Indicates a direction is mandatory
Topsoil	The uppermost horizon (or A Horizon) of the soil profile which usually contains the organic matter, biota, and a concentration of nutrients
WRAC	Workplace Risk Assessment and Control

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3 Overview of mining activities

Callide Mine is located approximately 20 km north of Biloela in Central Queensland. Callide Mine is an open cut coal mine with an annual production rate of approximately 10.5 million tonnes per annum of product coal. Mining commenced at Callide Mine in 1944. The mine produces low-sulphur, sub-bituminous thermal coal that is used to supply the adjacent Callide Power Station and for export to overseas customers.

Callide Mine involves open cut mining in four discrete mining areas. An overview of each mining area is as follows:

- **Dunn Creek mining area.** Dunn Creek was the original mining area at Callide Mine with mining operations commencing in 1944. There are currently two operating pits within the Dunn Creek mining area, known as the Dunn Creek Pit (the western pit) and The Bluff Pit (the eastern pit). Mining operations involve a dragline and truck and shovel pre-stripping. The primary infrastructure area for Callide Mine is located at the Dunn Creek mining area and includes a CHP, coal stockpiles, conveyor and train loading facilities, administration buildings and offices, and workshops and maintenance facilities. ROM coal is hauled to the Dunn Creek CHP. Once crushed in the CHP, coal is either conveyed to the nearby Callide Power Station or loaded onto trains and transported to Gladstone.
- **Trap Gully mining area.** Open cut mining commenced in 1981 at the Trap Gully mining area. Mining occurs in a single open cut pit using truck and shovel mining methods. ROM coal from Trap Gully is hauled to the Dunn Creek CHP for crushing and transport from site.
- **The Hut mining area.** Mining in The Hut mining area commenced in 2001 and has been undertaken in three pits using truck and shovel mining methods. ROM coal is hauled to the Dunn Creek CHP for crushing and transport from site. Recently, the western pit in The Hut mining area has been used as a water storage for mine affected water generated at the Trap Gully and Dunn Creek mining areas.
- **Boundary Hill mining area.** Open cut mining at the Boundary Hill mining area commenced in 1983. Boundary Hill operates independently of the other Callide Mine mining areas. Coal is currently mined in two pits using a dragline and truck and shovel fleet. Coal mining at the Boundary Hill South pit commenced in August 2018. Run-of-mine (ROM) coal is hauled from the pits to an in-pit Coal Handling Plant (CHP) for crushing. Crushed coal is then conveyed to the Boundary Hill train load out facility and transported to Gladstone. A mine infrastructure area is located at Boundary Hill including a crib room, administration building and workshops.

Current planning indicates that Callide Mine has a remaining mine life in excess of 20 years. The mine operates 24 hours a day, 7 days a week.

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4 Rehabilitation Strategy

4.1 Rehabilitation Domains

The Callide Mine is comprised of four (4) separate open cut mining areas:

1. Dunn Creek;
2. The Hut;
3. Trap Gully; and
4. Boundary Hill (including Boundary Hill South).

Note that the Dunn Creek, The Hut and Trap Gully mining areas are also collectively referred to as the Southern mining areas.

For the purposes of rehabilitation and closure planning, each mining area is divided into the following domains:

- Overburden emplacement areas;
- Final open cut voids; and
- Mine infrastructure areas.

The rehabilitation strategies for the Callide mining areas and domains are described in the following sections.

4.2 Rehabilitation Objectives

The overall objectives for rehabilitation at Callide Mine are specified in EA condition F1.

All land disturbed by mining activities must be rehabilitated in a manner that ensures it is:

- Safe for humans and wildlife;
- Stable;
- Able to sustain vegetation; and
- Non-polluting.

4.3 Final Landform

The final landform design criteria for overburden emplacement areas and final voids are specified in EA Tables F2 and F3, are presented below.

Table 2
Final landform design criteria (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas) (EA Table F2)

Disturbance type	Slope	Drainage
Dragline and pre-strip soil (except Dunn Creek A and S Cut spoil) - outer slopes	Overall slope angle of 15 percent on outer slopes.	Graded banks at 10m vertical intervals (approx. every 60m along the slope).
Dunn Creek A and S Cut spoil - outer slopes	Overall slope angle of 25 percent, 120m slope length, basalt mulch cladding.	Berms or graded banks at 120m spacing along the slope.
Internal slopes	Generally, 15 percent or flatter.	Graded banks at 10m vertical intervals.
Trial slopes	From 15 percent to 25 percent with topsoil or basalt mulch cladding.	Graded banks at 10m vertical intervals.
	Up to 37 percent (angle of repose).	Cut off drain/diversion bund across top of slope.

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Table 3
Residual void design outcomes (Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas) (EA Table F3)

Void Identification	Configuration
High wall	• 75 degree slope angle. • Safety bunds will be constructed along the top of the high walls and along the crest of the pre-strip benches. The pre-strip benches will be shaped to shed runoff over the high wall at several locations to limit erosion.
Low wall	• Generally at angle of repose.
Ramp Spoil	• Generally at angle of repose.

The conceptual final landform design for Boundary Hill South is shown in Environmental Authority Figure 2.

The natural topography within and surrounding the Callide mining areas ranges from steeply sloping areas within the Callide Timber Reserve, to gently undulating grazing land in the western areas. The approved final landforms for the overburden emplacement areas and final voids will blend with the surrounding topography, as far as practicable.

Following the decommissioning of infrastructure at mine closure, areas disturbed by mine infrastructure will be rehabilitated so that the land will closely match the pre-mining landform.

Detailed end of mine landform designs have not been prepared to date. As part of the Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act) Batchfire will transition into the Progressive Rehabilitation and Closure Plan (PRCP) framework. This will include end of mine landform designs and the consideration and assessment of any feasible alternative final landforms. Land Outcome Documents (LODs) are presented in Section 6 that could be relied upon when developing final landform criteria.

4.4 Final Land Use

The agricultural land capability classifications and project areas for the final land use at Callide mining areas are listed in EA Table F1.

Table 4
Final Land Use Capability (EA Table F1)

Southern Pits (Dunn Creek, Trap Gully, The Hut, The Bluff Mining Areas)		Boundary Hill*	
Post Mine Land Capability Classification	Projective Surface Area (ha)	Post Mine Land Capability Classification	Projective Surface Area (ha)
4	100	4	64
5	6.9	5	0
6	239.4	6	360
7	2,203.70	7	567
8	2,028.70	8	173

*Excludes Boundary Hill South

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The proposed final land uses (post-mining land use (PMLU)) at Callide Mine are grazing and bushland using native seed mix. However, community consultation has been undertaken to provide opportunity to those potentially affected by the proposed rehabilitation to provide input into the planning process. This information was used to help develop the PRCP schedule to identify to regulators and the community, what the final use of all land within the resource tenures will be and how these outcomes will be achieved progressively throughout the Life of Mine.

4.5 Completion Criteria

Completion criteria for the Boundary Hill South area are listed in Appendix 1 of the Callide Mine EA (Appendix 3 of this RMP). Completion criteria for the other mining areas are listed in EA Tables F1, F2 and F3. The completion criteria include measurable indicators and milestones to confirm achievement of the specific rehabilitation objectives and goals for each domain.

Batchfire submitted a Progressive Rehabilitation and Closure Plan (PRCP) to the administering authority on 28/04/23 for approval. The PRCP included revised completion criteria for mine closure. Once approved, the Callide Mine PRCP will supersede this Rehabilitation Management plan.

4.6 Rehabilitation Methods

The following sections detail the rehabilitation methods for the rehabilitation domains.

4.6.1 Overburden Emplacement Areas

Rehabilitation of overburden emplacement areas is undertaken progressively at Callide Mine (Figure 2), as mining progresses and areas become available for rehabilitation. The planning of progressive rehabilitation of the overburden emplacement areas was undertaken under the Plans of Operations and the associated calculations of Financial Assurance. On 14 November 2018, the *Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act)* was passed by Parliament. The MERFP Act replaced the financial assurance arrangements for resource activities with a new financial provisioning scheme and modified how the estimated rehabilitation cost for an environmental authority is calculated. The MERFP Act also introduced new requirements for the progressive rehabilitation and closure of mined land.

Batchfire uses conventional rehabilitation methods for the rehabilitation of overburden emplacements at Callide Mine. Overburden emplacement rehabilitation typically includes 15% maximum slopes, contour drainage, topsoiling, ripping and reseeding.

EA Table F2 (Table 2) allows for steeper rehabilitation slopes in specific areas and trial slope areas. These steeper areas require additional slope treatments, including rock mulching and additional drainage control, to ensure stability. Contour drainage on the standard 15% rehabilitation slopes is required at a vertical interval of 10 m, or approximately 60 m along the slope.

The topsoiling depth is typically an average of 0.15 m, subject to detailed rehabilitation planning. The seeding mix varies depending on the post mining land use for the rehabilitation area, but typically includes a mixture of pasture grasses and native trees and shrubs. The final land use for overburden emplacement areas will bushland or grazing.

Based on 70 years of operational experience, the overburden materials at Callide Mine are not known to be saline or acidic. Site water quality monitoring includes regular monitoring of pit water quality and runoff from overburden emplacement areas. Water quality results are consistent with operational experience and indicate good quality water (low salinity and neutral pH) within the pits and mine water management system. The absence of any problems with the establishment of vegetation in rehabilitated areas to date is consistent with the lack of any acid or saline overburden materials on the site.

Rehabilitation monitoring identifies any areas requiring maintenance or additional works due to a lack of revegetation or erosion. Erosion and sediment controls are put in place in establishing rehabilitation areas as per the existing Callide Mine Erosion and Sediment Control Plan.

4.6.2 Final Open Cut Voids

Rehabilitation of final open cut voids will be undertaken progressively over the life of the mine, as mining progresses and areas become available for rehabilitation.

The open cut mine final voids will be left in a safe, geotechnically stable form and at slopes that comply with the relevant Callide Mine EA landform criteria (Table 3). Low walls and ramps will generally be left at angle of repose.

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Any final highwall benches will have contour drains installed to limit the drainage points over the highwall. Access to highwalls will be prevented by the installation of bunds along the final highwall and along the crest of the highwall benches. Warning signs will also be installed along the final highwall.

The catchment area of the final voids will be limited by diversion drains and the externally draining overburden emplacement areas. Site experience and groundwater modelling for the Boundary Hill South Project indicates that lakes will form in the final voids below the level of the pre-mining water table. Overflow from the final voids is very unlikely given the limited catchment of the final voids, significant storage capacity above the level of the pit lakes and the average annual net evaporation. Pit water quality at Callide Mine has low salinity and final void water is considered unlikely to be a potential source of groundwater contamination.

Final land use for open cut voids will be a combination of permanent water bodies and bushland in areas that are revegetated.

4.6.3 Mine Infrastructure Areas

The decommissioning and rehabilitation of mine infrastructure areas will typically be undertaken at the end of mine life as part of the mine closure and decommissioning, unless agreed by the post-mining landholder.

Site decommissioning is described in detail in the Callide Mine Estimated Rehabilitation Cost submitted annually to the regulator for approval. This includes the CHPs, buildings, tanks, haul roads and site services. All services (including water, electricity, and gas) will be disconnected and terminated. All powerlines, substations, and pipelines will be dismantled and removed from site. Infrastructure hardstand areas will be inspected for any hydrocarbon contamination and remediated, as necessary. All infrastructure and hardstand areas will then be topsoiled, ripped and seeded with the aim of restoring the site to the required PMLU. Topsoil will be placed at a minimum depth of 0.15 m. Revegetation species will include a mixture of pasture grasses and native trees and shrubs.

Haul roads will be rehabilitated by removing coal residue and dumping in the open cut voids (where necessary), regrading (where necessary), topsoiling, ripping and seeding.

A number of farm dams and sediment dams will remain on site, as per existing landowner agreements. All sediment dams will be decommissioned by removing 0.5m thick of sediment removed from the bottom of the dams to ensure they are clean water structures and safe to leave post mining. The removed sediment will be disposed of in the overburden dumps. Mine water dams will also be inspected for any contamination and remediated, as necessary. The watercourse diversions will be maintained until proven to be stable, in accordance with their respective diversion Water Licence conditions.

The final land use for mine infrastructure areas will be typically be grazing, or bushland in any areas with slope restrictions.

Disturbance from exploration activities including boreholes, sumps and exploration tracks, will be rehabilitated progressively over the life of the mine in accordance with the Eligibility criteria and standard conditions for exploration and mineral development projects.

4.6.4 Topsoil Management

Topsoil resources at Callide Mine are managed in accordance with EMS_06 Topsoil Management Plan. The Callide Mine topsoil inventory records the location and quantity of stockpiled topsoil on the site. Where possible, topsoil is placed directly onto areas ready for rehabilitation. If this is not possible, topsoil is stockpiled during the topsoil stripping activities. The topsoil balance indicates that the Callide Mine has sufficient topsoil inventory to provide an average depth of approximately 0.15m on rehabilitation areas. Topsoil placement of a minimum of 0.15 m is similar to the natural topsoil depth in the area and is consistent with the minimum topsoil thickness typically used for rehabilitation of Central Queensland coal mines.

Rehabilitation trials previously undertaken on site (e.g. use of basalt cladding) may continue to be undertaken in accordance with the EA, if there is sufficient, suitable material available.

5 Rehabilitation Monitoring Program

Rehabilitation monitoring in both rehabilitation and reference sites has been undertaken at Callide Mine since 1980. Permanent vegetation monitoring sites were established in 1994. As such, there is significant and detailed baseline data.

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5.1 Existing Rehabilitation Areas

Rehabilitation areas as of December 2025 are detailed in Figure 2.

The existing rehabilitation areas at Callide Mine and their age and quality are summarised as follows:

- Boundary Hill mining area – located on the northern and western overburden emplacement areas. These areas generally consist of older rehabilitation areas with good vegetation establishment, as shown in Photo 1. Boundary Hill East mining area has finished mining of coal. This area has been shaped to final landform and requires topsoil and seeding.
- Dunn Creek mining area – older rehabilitation areas are located on the south and south-western overburden emplacement areas. Active rehabilitation areas are located on the far western overburden emplacement areas. Active rehabilitation trials are currently being undertaken on sections of the eastern overburden emplacement areas, in accordance with the Callide Mine EA, and contain good grass establishment as shown in Photo 2.
- Trap Gully mining area – located on the northern waste rock placement area and associated with a licensed watercourse diversion. This area generally consists of older rehabilitation with good vegetation establishment.
- The Hut mining area – older rehabilitation areas are located on the central overburden emplacement areas, rehabilitated temporary infrastructure and ROM coal stockpile areas, and the rehabilitated creek diversion area. This older rehabilitation generally contains good vegetation establishment, as shown in Photo 3. Active rehabilitation is currently being undertaken over a large area adjacent to the Western Pit (Central Valley North). This area has been shaped to final landform and requires topsoil and seeding.

5.2 Reference Sites

Extensive reference site monitoring has been undertaken at Callide Mine and surrounding areas since the early 1980s with permanent vegetation monitoring sites established in 1994 (33 sites in total). This extensive monitoring database provides a comprehensive understanding of the native ecosystems within the area. Relevant aspects of this existing information will be used to validate the success of site rehabilitation. Future reference sites will be established, as necessary, to monitor aspects of undisturbed areas that are relevant to the post mining land uses.

5.3 Rehabilitation Sites

Rehabilitation monitoring sites were chosen as being representative of some of the range of conditions occurring in the rehabilitation areas on the mine. Rehabilitation monitoring includes a description of vegetation in general terms, a record and count of all species, record of ground and canopy cover, description of tree health and soil characterisation. As part of the development of the Callide PRCP the monitoring program will be reviewed to ensure that the methodology demonstrates that rehabilitation milestones and criteria have been achieved using modern methods.

6 Appointments, Authorisations and Competencies

The following table identifies the parties responsible for ensuring management actions are carried out in accordance with this Rehabilitation Management Plan:

Roles requiring appointments	Roles requiring authorisation
All Coal Mine Workers	• Follow the protocols outlined in this Rehabilitation Management Plan
Environment and Community Superintendent	• Ensure adequate resources are allocated to enable the training of staff • Document owner • Development of Callide PRCP
Environment Team	• Identification of areas where additional management measures are necessary and undertaking additional management measures as required • Assist with the development of the Callide PRCP

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7 Risks and Contingency Measures

Based on operational experience, the key risks to successful rehabilitation at Callide Mine are as follows:

- Erosion instability due to inappropriate landform design and/or drainage design, failure of revegetation or extreme rainfall; and
- Failure of revegetation due to inadequate soil preparation, weather conditions, erosion, or inappropriate species selection.

Rehabilitation monitoring is designed to detect any areas requiring maintenance. Maintenance is conducted, as necessary, based on monitoring results, and typically includes:

- Earthworks to repair erosion areas and replanting;
- Application of additional drainage and/or erosion and sediment control measures in unstable areas;
- Replanting or reseeding in areas of revegetation failure;
- Weed control in infested areas;
- Exclusion of stock to enable establishment of revegetation; and
- Regrading areas where instability is due to steep slopes or inappropriate landform design.

8 Land Outcome Documents

Appendix 4 details Land Outcomes Documents (LODs) that can be relied upon in the development of the Progressive Rehabilitation and Closure Plan (PRCP). The rehabilitation outcomes and milestones described in these documents can be used to assist the development of the PRCP schedule.

9 References

- *Environment Protection Act 1994*
- Callide Mine Environmental Authority EPML00720413
- *Mineral and Energy Resources (Financial Provisioning) Act 2018*
- EMS_06 Topsoil Management Plan
- EMS_02 Erosion and Sediment Control Plan
- EMS_07.2 Permit to Disturb

10 Document Control

V#	Date	Nature of change	Approved Superintendent	Date	Authorised GM ESG&D	Date
1	November 2023	Periodic review, no change	Joseph Hughes	23 Nov 2023	Stuart Schmidt	23 Nov 2023
2	May 2026	Review Update template	Rebecca Hyde	05 May 2026	Stuart Schmidt	

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Appendix 1 – Figures

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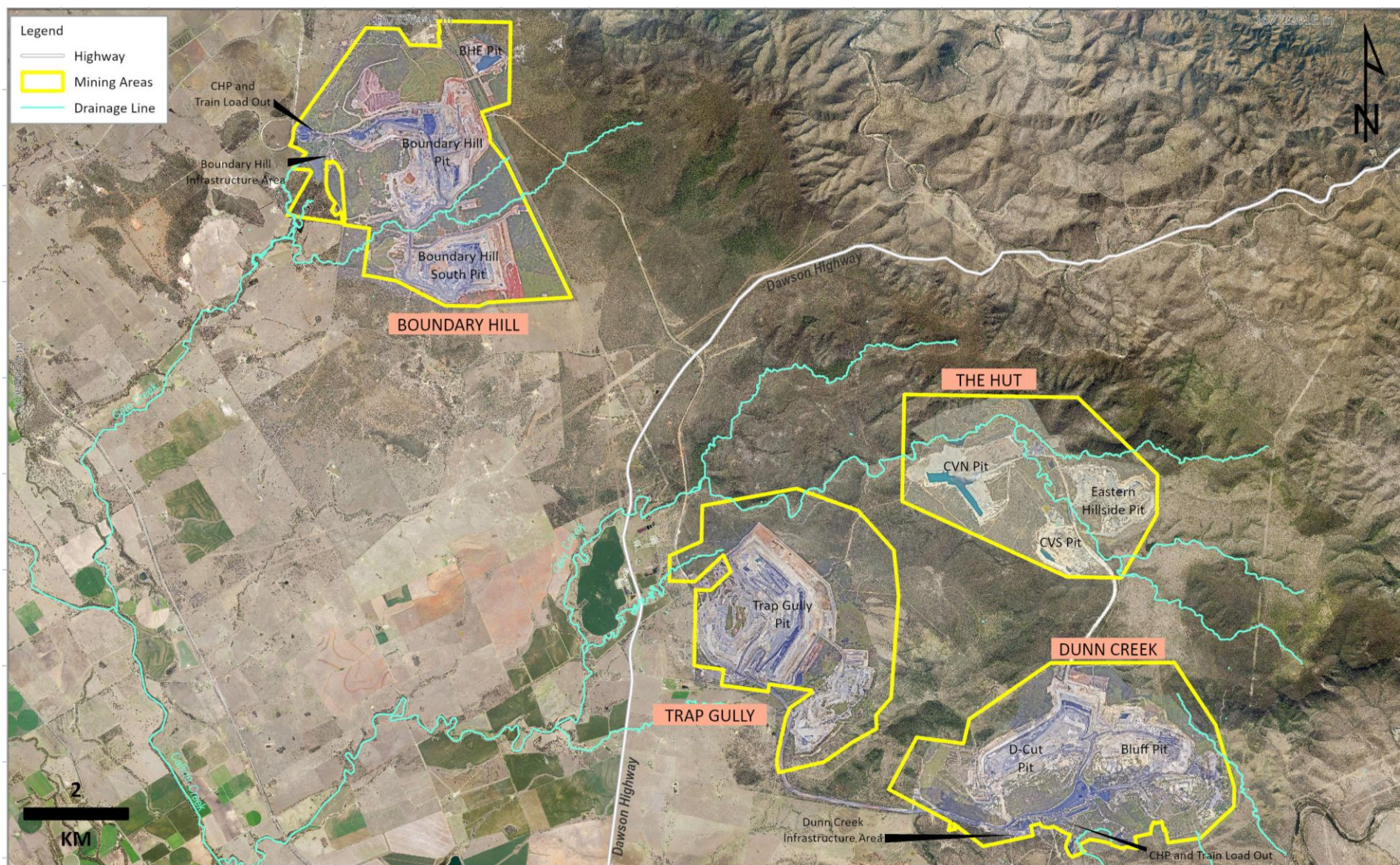


Figure 1: Mine Layout – Overview

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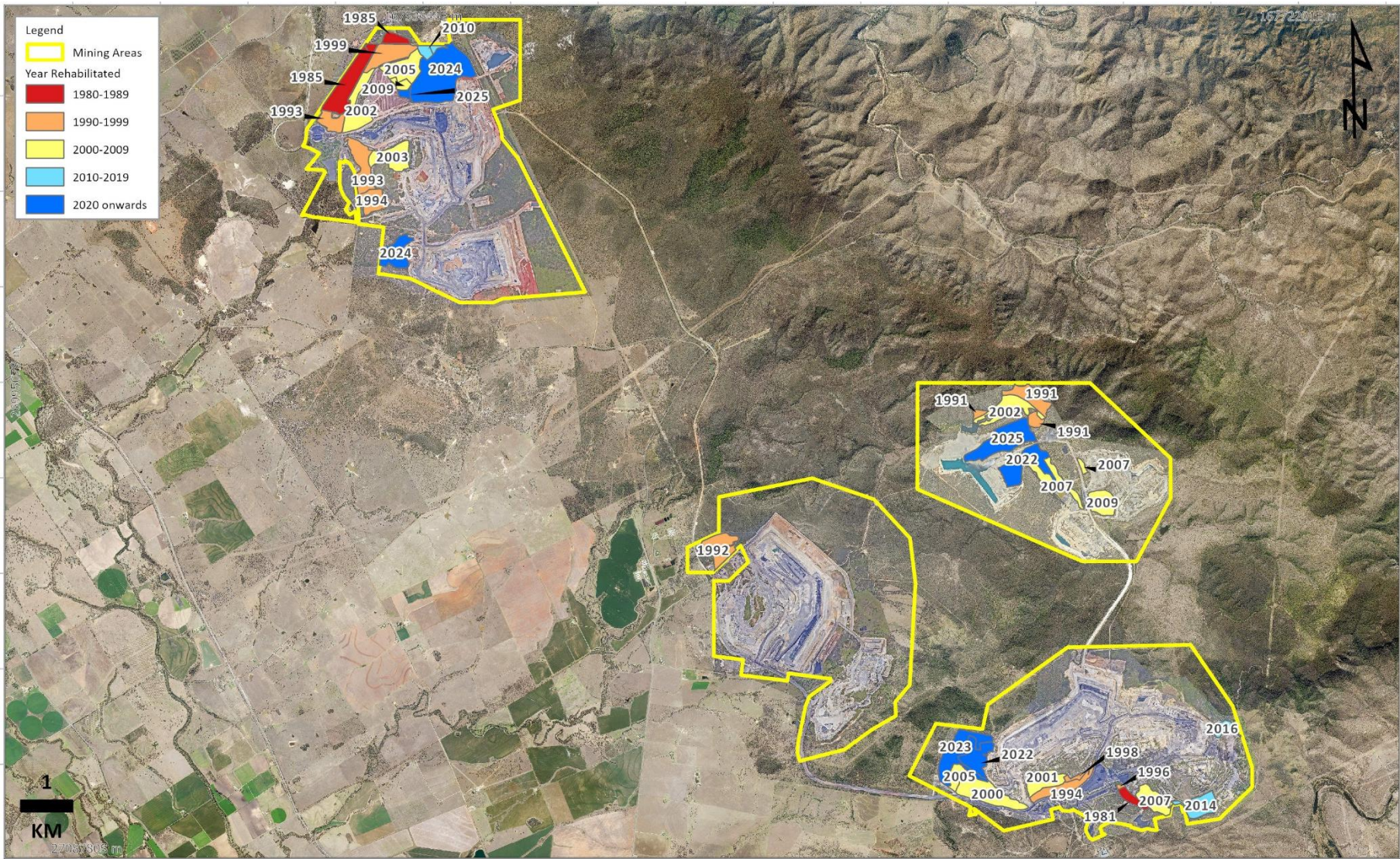


Figure 2: Existing Rehabilitation Areas

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Appendix 2 – Photos



Photo 1: Boundary Hill Mining Area - Established Rehabilitation Example



Photo 2: Dunn Creek Mining Area – Trial Slope Rehabilitation Example

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Photo 3: The Hut Mining Area - Established Rehabilitation Example

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Appendix 3 – Rehabilitation Criteria

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Rehabilitation requirements - (Boundary Hill South Mining Area – Appendix 1 of EA)

Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Residual void area (Non-use management area shown in Appendix 2, Figure 2 – Boundary Hill South conceptual final landform)	Long term safety	The site is structurally safe and the environment is not exposed to contamination by heavy metals or other toxic materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.
				Landform design meets the requirements of Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.
			Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
			Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
			Evidence of stream bank erosion.	Evidence in the Rehabilitation Report that creek diversions are stable at closure and exhibit characteristics for long term stability.
		Site is safe for humans and animals now and in the foreseeable future.	Safety assessment of landform stability (geotechnical studies).	An appropriately qualified person certifies the long-term geotechnical stability of the residual slopes and faces in the voids and evidence of this is documented in the Rehabilitation Report.
			Adequacy and predicted long-term performance of safety barriers.	Evidence in the Rehabilitation Report that a safety risk assessment of the residual void areas has been completed and proposed mitigation measures are documented in a Safety Plan.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Installation of safety barriers and human/wildlife exclusion fencing of residual void.	If required, mitigation measures documented in a Safety Plan, e.g. fencing or other suitable barrier around the residual void areas are installed to restrict access.
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures are decommissioned appropriately.	The number and condition of non-permanent regulated structures.	Regulated structures are decommissioned in accordance with the administering authority requirements.
		Residual voids protected from flooding.	Flood protection measures constructed around residual voids.	Certification by a suitably qualified and experienced person in the Rehabilitation Report that the residual voids have an adequate protection system to prevent inundation from a 1: 1,000 year annual exceedance probability flood event.
		Diversion design and maintenance.	Whether or not a water licence under the <i>Water Act 2000</i> (QLD) is required.	Confirmation in writing from the administering authority that the water licence under the <i>Water Act 2000</i> (QLD) is no longer required.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Stable landform	Very low probability of rock falls with serious environmental consequences.	The number of rock falls during the life of the mine.	Evidence in the Rehabilitation Report that the number of rock falls has been acceptably low, and that appropriate control measures are in place to prevent rock falls with serious environmental consequences in the future.
	Stable landform (cont.)	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.
			Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report how drainage diversions have changed over the life of mine and that they are stable at closure and are likely to remain that way into the foreseeable future.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				To be designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).
	Stable landform (cont.)	Very low probability of rock falls with serious environmental consequences.	Geotechnical studies.	Evidence in the Rehabilitation Report that a risk assessment has been done and mitigation measures (if any) have been documented and implemented.
Mining infrastructure area	Long term safety	Rehabilitation or conversion of exploration drill holes and groundwater monitoring bored.	Number of non-artesian exploration drill holes on the mining lease that have been, or have not been, rehabilitated or converted to water bores.	Certification by an appropriately qualified person that all non-artesian exploration drill holes that are not converted to either a water bore or a groundwater monitoring bore have been rehabilitated.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification by an appropriately qualified person, that all sub-artesian aquifers have been isolated where non-artesian exploration drill holes have intersected more than one sub-artesian water bearing strata, in accordance with <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition
				Certification by an appropriately qualified person that all non-artesian exploration drill holes converted to a water bore have been converted in accordance with the <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition.
				Certification by an appropriately qualified person that all non-artesian exploration drill holes converted to water bores are compliant with the <i>Water Act 2000</i> (QLD).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Number of monitoring bores on the mining lease that have been, or have not been, rehabilitated.	Certification by an appropriately qualified person that all monitoring bores have been rehabilitated in accordance with the <i>Minimum Construction Requirements for Water Bores in Australia</i> (Australian Government February 2012) or latest edition.
		Structurally safe with no hazardous materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
		Site is safe for humans and animals now and in the foreseeable future.	The presence on site of infrastructure that requires decommissioning.	Certification by an appropriately qualified person in the site Rehabilitation Report that the infrastructure has been decommissioned and rehabilitated. Buildings, water storage(s), roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Access to the area is conducive of the intended purpose of the post-mining land use including pastoral farming.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated. (cont.)	All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures	Regulated structures are decommissioned in accordance with the administering authority requirements.
	Containment or removal of any potential sources of contamination.	Hazardous materials are adequately managed, and the environment is not exposed to contamination by heavy metals or other toxic materials.	Encapsulation depth, and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
		The site is free of material other than waste rock that could contaminate the land.	Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	The final landform is stable	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.

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			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Vegetation cover is sufficient to form a self-sustaining community and minimise erosion.	Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
			Vegetation type and density.	Vegetation types and densities are comparable with the relevant reference site.
			Foliage cover.	Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces >20m ² in area or >10m in length down slope.
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report will show whether, and if so how, drainage diversions have changed over the life of mine; that they are stable at closure; and are likely to remain stable into the foreseeable future.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Demonstration that drainage diversions have been designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).
		Very low probability of rock falls with serious environmental consequences.	Geotechnical studies.	Evidence in the Rehabilitation Report that appropriate geotechnical risk assessment has been done and control measures put in place.

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			The number of rock falls during the life of the mine.	Evidence in the Rehabilitation Report that the number of rock falls has been acceptably low, and that appropriate control measures are in place to prevent rock falls with serious environmental consequences in the future.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties of the soil, including pH, salinity, nutrient content, exchangeable sodium percentage.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; - soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro- and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
			Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
		Establish self-sustaining natural vegetation or habitat.	Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Self-sustaining natural vegetation or habitat.	Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Livestock stocking rates.	An appropriately qualified person has predicted and defined the expected stocking rates of the rehabilitated land, and these have been agreed with relevant stakeholders.
			Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.

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			Number and volume of water sources suitable for stock.	Stock has adequate access to water that meet accepted livestock drinking water guidelines.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Overburden Emplacement Area	Long term safety	The site is structurally safe, and the environment is not exposed to contamination by heavy metals and other toxic materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.

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			Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.
			Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
			Evidence of stream bank erosion.	Evidence in the Rehabilitation Report that creek diversions are stable at closure and exhibit characteristics for long term stability.
		Site is safe for humans and animals now and in the foreseeable future.	Safety assessment of landform stability (geotechnical studies).	An appropriately qualified person certifies the long-term geotechnical stability of the residual slopes and faces and evidence of this is documented in the Rehabilitation Report.
		Site is safe for humans and animals now and in the foreseeable future.	Adequacy and predicted long-term performance of safety barriers.	Evidence in the Rehabilitation Report that a safety risk assessment of the slopes has been completed and proposed mitigation measures are documented in a Safety Plan.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Installation of safety barriers and human/wildlife exclusion fencing.	If required, mitigation measures documented in a Safety Plan, e.g. fencing or other suitable barrier around the slopes are installed to restrict access.
	No receiving waters are contaminated.	Mine affected water contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Final landform water storages are contained on-site, with no overflows into external surface water systems.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform. Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures.	All regulated structures are decommissioned in accordance with the administering authority requirements.
		Acid mine drainage will not cause serious environmental harm.	Encapsulation depth and containment of potentially contaminating material.	Certification by suitably qualified person in the Rehabilitation Report that the emplacement cells for any potentially acid forming material have been constructed in accordance with recommendations in the Acid Mine Drainage Assessment report.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Stable landform	Landform design achieves appropriate erosion rates.	Slope angle and length.	Evidence in the Rehabilitation Report that the rehabilitated slopes have been designed to the specifications outlined in Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South final landform of this environmental authority.
			Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning as intended.

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			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Vegetation cover sufficient for a self-sustaining community and to minimise erosion.	Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
			Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
				Vegetation types and densities are comparable with the relevant reference site.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report how drainage diversions have changed over the life of mine and that they are stable at closure and are likely to remain that way into the foreseeable future.
				To be designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties of the soil, including pH, salinity, nutrient content and exchangeable sodium percentage.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; - soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
		Soil properties support the desired land-use.	Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
			Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Self-sustaining natural vegetation or habitat.	Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.

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			Abundance of declared plants (weeds) identified through surveys.	Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Livestock stocking rates.	An appropriately qualified person has predicted and defined the expected stocking rates of the rehabilitated land, and these have been agreed with relevant stakeholders.
			Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.

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			Number and volume of water sources suitable for stock.	Stock has adequate access to water that meet accepted livestock drinking water guidelines.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
Water storage areas	Long term safety	Structurally safe with no hazardous materials.	Safety assessment of landform stability (geotechnical studies).	Certification by an appropriately qualified person in the Rehabilitation Report that slopes are now safe and exhibit characteristics for long term stability.
				A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.
				Landform design meets the requirements of Section 4.5 Land and rehabilitation in the Boundary Hill South Environmental Management Plan (December 2016) and Appendix 2, Figure 2 – Boundary Hill South conceptual final landform of this environmental authority.

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		Site is safe for humans and animals now and in the foreseeable future.	The presence on site of regulated dams that need decommissioning.	Certification by a suitably qualified and experienced person in the site Rehabilitation Report that regulated dams and structures have been decommissioned and rehabilitated.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	No receiving waters are contaminated.	Mine affected water is contained on site.	Downstream surface water quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
			Groundwater quality parameters stated in the project's environmental authority.	Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.
				Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.
		All permanent stream diversion will meet approved design criteria.	Approved design criteria.	Certification by an appropriately qualified person that all stream diversions have been constructed and are operating in accordance with approved design criteria.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		All permanent regulated structures will meet approved design criteria.	Approved design criteria.	The regulated structures are certified by a suitably qualified and experienced person.
		All non-permanent regulated structures decommissioned appropriately.	The number and condition of non-permanent regulated structures.	Regulated structures are decommissioned in accordance with the administering authority requirements.
			Voids protected from flooding.	Certification by a suitably qualified and experienced person in the Rehabilitation Report that the voids have an adequate protection system to prevent inundation from a 1: 1,000 year annual exceedance probability flood event.
		Hazardous materials are adequately managed, and the environment is not exposed to contamination by heavy metals or other toxic material.	Encapsulation depth and containment of potentially contaminating material.	Certification by an appropriately qualified person that the Rehabilitation Report includes predictions about future changes and that the specified cover thickness is in place.
				Evidence in the Rehabilitation Report that monitoring results for dust and particulate matter indicates compliance with the limits in the environmental authority.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		The site is free of material other than waste rock that could contaminate the land.	Results of site contaminated land investigation report.	Evidence in the Rehabilitation Report that measures required in site contaminated land investigation report have been implemented.
		Diversion design and maintenance.	The administering authority of the water licence under the <i>Water Act 2000</i> (QLD) has determined that the water licence is no longer required.	Confirmation in writing from the administering authority that the water licence under the <i>Water Act 2000</i> (QLD) is no longer required.
		Landform design achieves appropriate erosion rates.	Engineered structures to control water flow.	Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning.
			Rates of soil loss.	Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Dimensions and frequency of occurrence of erosion of rills and gullies.	Evidence in the Rehabilitation Report that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).
		Vegetation cover sufficient for a self-sustaining community and to minimise erosion.	Vegetation type and density.	Evidence that the vegetation type and density are of species suited to the site's characteristics including soil type, topography and climate and that soil erosion meets the goals set in this plan.
				Vegetation types and densities are comparable with the relevant reference site.
			Foliage cover.	Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces >20 m ² in area or > 10 m in length down slope.

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		The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Documentation in the Rehabilitation Report will show whether, and if so how, drainage diversions have changed over the life of mine; that they are stable at closure; and are likely to remain stable into the foreseeable future.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	The final landform is stable.	The diversions and run-off drainage lines mirror natural stream functions.	Design and stability of drainage diversions.	Demonstration that drainage diversions have been designed and constructed in accordance with the Queensland Government Natural Resources and Mines, <i>Central West Water Management and Use Regional Guideline: Watercourse Diversions-Central Queensland Mining Industry</i> (2008) and with consideration of contemporary research, i.e. the ACARP report <i>Maintenance of Geomorphic Processes in Bowen Basin River diversions</i> (Project number C8030-C9068).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
	Sustainable land-use	Soil properties support the desired land-use.	Chemical properties, e.g. pH, salinity, nutrient content, sodium content of topsoil to support the proposed vegetation and land-use.	Certification in the Rehabilitation Report that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following: - soil salinity content is <0.6dS/m; - soil pH is between 5.5 and 8.5; soil exchangeable sodium percentage (ESP) is <15%; - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and - adequate macro and micro-nutrients are present.
			Physical properties of topsoil.	Certification in the Rehabilitation Report that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
				Certification in the Rehabilitation Report of suitability for beef cattle grazing land use in accordance with Department of Minerals and Energy (DME) 1995 <i>Land Suitability Assessment Techniques in Technical Guidelines for the Environmental Management of Exploration and Mining</i> .
			Topsoil thickness.	Certification in the Rehabilitation Report that topsoil has been respread according to the depths required in the Topsoil Management Plan.
			Site soil characteristics.	Certification in the Rehabilitation Report that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the <i>Australian Soil and Land Survey Field Handbook</i> (National Committee on Soil and Terrain 2009).

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
		Establish self-sustaining natural vegetation or habitat.	Presence of key plant species.	Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.
			Density of key plant species.	Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.
			Structure of vegetation habitat.	Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.

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		Self-sustaining natural vegetation or habitat.	Abundance and health of desired plant species.	Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.
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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Abundance and diversity of native fauna species.	Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.
			Abundance of declared plants (weeds) identified through surveys.	Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.
		Self-sustaining natural vegetation or habitat.	Abundance of declared plants (weeds) identified through surveys.	Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.

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Domain	Rehabilitation goals	Rehabilitation objectives	Indicators	Completion criteria
			Abundance of declared animals identified through surveys.	Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is not greater than comparable reference sites.
				Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.
		Agricultural grazing.	Landform stability when grazed.	Land maintenance requirements are comparable to comparable reference sites.
			Stock access to water sources.	Stock has adequate access to water that meets accepted livestock drinking water guidelines.

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Appendix 4 – Retrospective Land Outcome Document Review

ML	Residual Void (Y/N)	EA Number	Management Plan Type	Documents
DUNN CREEK				
ML80030	Y	M20602 – 2004-2006	Callide EMOS 2004	Water Studies 1992
ML5641	N	EAMIN1000507307	EM Plan 2008	Water Solutions 2003
ML80093	N			
ML5632	N	EPML00720413	Bluff EIAS 1994	Land Reclamation Services
ML80092	N			
ML6993				
ML 80118	Y		Note: ML6993 – EPBC Approval Variation 2007 and Approval 2006 All other MLs pre EPBC Act.	
THE HUT				
ML5654	Y (CVN, CVS, Eastern Hillside)	M20602 – 2004-2006	Callide EMOS 2004	Water Solutions 2003
		EAMIN1000507307 -2006 – 2017	EM Plan 2008	
		EPML00720413	Bluff EIAS 1994	
			Note: Pre-commencement of the EPBC Act	
TRAP GULLY				
ML5662 (1987 – current) not actively mined currently	N – backfilled void and licenced diversion.	M20602 – 2004-2006	Callide EMOS 2004	Callide Mine Report on acceptance Criteria for Residual Voids 16/12/2005
ML5653 (1982 – current)	N – backfilled void	EAMIN1000507307 -2006 – 2017	EM Plan 2008	
ML80117 (2006-current)	Y – will contain the Trap Gully current advancing pit.	EPML00720413	Bluff EIAS 1994	Water Solutions 2003
ML80122 (current)	Y		Note: Trap Gully Extension (ML80117) non-controlled action	

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ML	Residual Void (Y/N)	EA Number	Management Plan Type	Documents
BOUNDARY HILL				
ML6994 (1993 – 2025) contains infrastructure (dam and rehabilitated surface)	N	M20602 – 2004-2006 EAMIN1000507307 -2006 – 2017 EPML00720413	EM Plan 2006 and 2008	Callide Mine Report on acceptance Criteria for Residual Voids 16/12/2005
ML80115 (Infrastructure lease for Lake Gasteen)	N			PPK Environment & Infrastructure 1997
ML5655 (current)	Y – current ramp and void			Water Solutions 2003
ML80187 (BHE Current)	Y – no studies on residual void			
ML80186 (2017 – current)	Y – to not exceed residual void NUMA area of 147.4 ha		EA EPML007204131 and EIS for Boundary Hill South.	Blain Johnson 1991 Mackie Martin and Associates (1991) Water Solutions (1998a)

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There are two voids that have been rehabilitated at Callide Mine:

- Northern Valley Pit Strip 8 – which is now the Oaky Creek Diversion
- Trap Gully which is now Trap Gully Diversion. Under ML5662.

Summary of LODs

Water Solutions 2003

This report focused on the final void characteristics and the potential for water storage and flow of water into adjoining catchments as well as the quality of the void water. Seven voids were identified at the time.

The voids that the report applied to are:

- Dunn Creek – A and B Cut
- The Hut – Central Valley North, Central Valley South and Eastern Hillside
- Trap Gully – TG Main pit
- Boundary Hill – BH North South Strip

Blain Johnson 1991

This report is specific for Boundary Hill Mining and addresses mine planning in a 5-year context, groundwater impacts and final land use. Under section 4.3 post-mining water management plans are described. The system focuses predominately on open channels to divert runoff and the settlement dams to control suspended sediments and the use of voids primarily as large-scale storages post mining.

Water Studies 1992

This report looks at the water management system as part of the development of the Bluff ML6993.

Land Reclamation Services – Bluff EIAS

Detail on the final treatment of the outer slope at the Bluff Mining Area ML6993.

Development of Pit wall designs and North and south pts box cuts. Kilburnie Deposit for Anglo Callide Coalfield Pty Ltd August 2002

Contains information on how voids are to be managed in terms of factors of safety and design..

The use of the 75° degrees continuous highwall slopes in fresh coal measures strata has operated successfully in pits across the mine site irrespective of age and design and represents a favorable geometry for blasting, dragline stripping and truck shovel operations.

Additional matters noted in the document:

- Aggregate strength of the material sequence in which the slope is developed
- Strength of bedding parallel defects at the base of coal
- Slope angle and high
- Groundwater pressure behind the slope
- Orientation and persistence of rock mass structures.

Factual Report Kilburnie Deposits Geotechnical Investigation, HMLC Boreholes September to October 1998 – M.W. Riley for GeoConsult Pty Ltd

Eight bore holes were established to determine the fractal density within the Kilburnie prospect of which Boundary Hill South occurs in the northern limit of geology.

Revised Geotechnical Assessment and Layout Design for Highwall Mining of Southern Highwall, the Hut, Callide Mine QLD. Leisemann & Follington November 19, 1998

Relates to Central Valley North Pit. Identifies Highwall mining at Central Valley South and Central Valley North and the feasibility of the type of operating activity. The report discusses that there is limited to no groundwater infiltration in the highwalls.

Groundwater Supply Investigations Drill Target Study Dunn Creek – Trap Gully - The Hut Boyd Mining Pty Ltd December 1990

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Describes the groundwater aquifer behavior (Precipice Sandstone) at Trap Gully, Dunn Creek and The Hut. This report assists with understanding the hydrology and what will occur in terms of groundwater infiltration in the residual voids.

Trap Gully Boundary Hill – 1984 Exploration Hole Analytical Results

Provides information on the historical understanding of how the groundwater was behaving.

1998/99 Kilburnie Exploration and Geotechnical Modelling Project – End of Project Report Peter Jorgensen (Jorgensen Geological Services Pty Ltd) November 1999.

This report has extensive information about the ML5655 and Campbells Creek deposit as well as Boundary Hill East:

- Overburden characterization
- Hydrological data and geotechnical study

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Appendix C3

Callide Mine Report on Rehabilitation Acceptance
(Completion) Criteria 2003



CALLIDE MINE

REPORT ON

REHABILITATION ACCEPTANCE (COMPLETION)
CRITERIA

Prepared by:

Mr B Cartwright
Senior Environmental Adviser
Anglo Coal (Callide Management) Pty Ltd

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1 INTRODUCTION

This report has been prepared to comply with Environmental Authority M2602 Condition L4, which states:

“Complete an investigation into rehabilitation of disturbed area and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in Condition L1 and landform criteria in Attachment 1 – Table L1 and Table L2 by 31st December 2003.”

The content of the report are based on a case study prepared on Callide Mine as part of ACARP Project C12045 “Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on Coal Mines in the Bowen Basin.”

2 DESCRIPTION OF THE MINE, EXISTING ENVIRONMENT AND REHABILITATION HISTORY

Callide Mine is an integrated open cut coal mining operation that includes four current open-cut mines located in two general areas, viz. the Southern Pits (Dunn Creek, Trap Gully and The Hut) and the Boundary Hill mining area, plus a future mining area known as The Bluff to the east of Dunn Creek mining area.

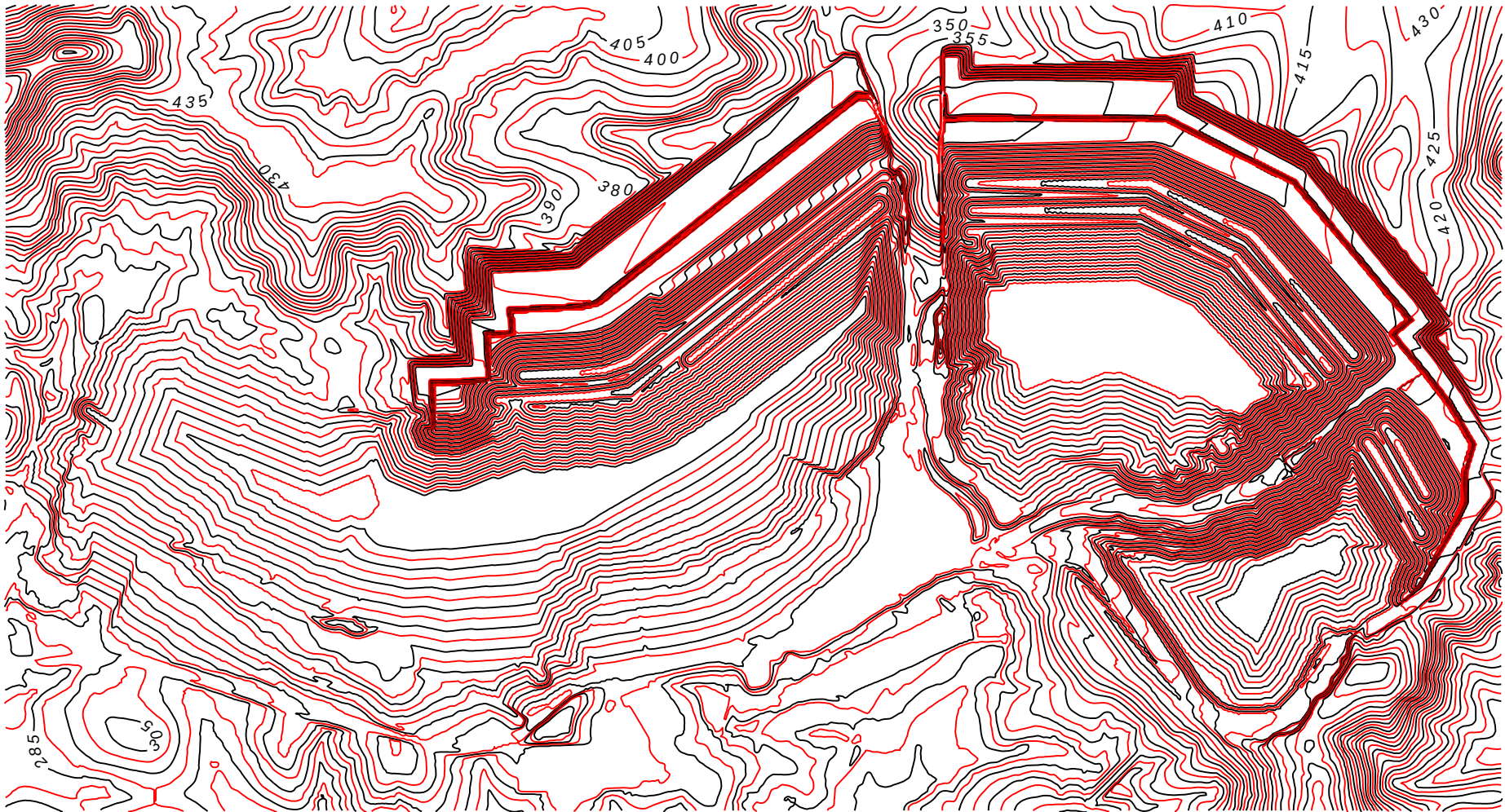
Details of the mining operation are given in the Callide EMOS. Coal is mined from outcrops on the southeastern and northwestern margins of the Callide Basin coal deposit. Mining commenced at Dunn Creek in 1944, at Trap Gully in 1981, Boundary Hill in 1982 and at The Hut in 1990. Total Coal Production is currently approximately 9-10 million tonnes per annum. Based on current known reserves, mining operations are expected to continue until at least 2020.

Mining techniques generally involve the use of draglines, supported by truck and shovel fleets or dozer push for prestrip removal in advance of dragline operations, but in some cases have been carried out only using truck and shovel fleets. Coal is processed through a central Coal Handling Plant at Dunn Creek for the Southern Pits and through a similar Plant at Boundary Hill. No tailings or fines are produced, so no tailings disposal facilities are required.

Spoil is reshaped by strategic placement of prestrip material using trucks, with final trimming using bulldozers. Due to the intrinsic swell factor, the final landform will be higher than that of the surrounding land. Maximum slopes on the rehabilitated spoil, as stipulated in the Callide Environmental Authority EA M2602, are generally 15% (or 8.5 degrees), although up to 25% is permitted on trial areas and for Dunn Creek A and S Cut spoil where adequate basalt cladding material is available. Berms or graded banks, with longitudinal grades of 0.5-1% are constructed at 10m vertical intervals. The internal landform will be gently undulating, incorporating interconnecting ponds. Final low and high walls of the void will be left at angle of repose, although the lower section of the low wall slope will be reduced by placement of semi-compacted fill. A final conceptual landform plan for Dunn Creek is shown in Figure 2.1 as an example.

Detailed studies of soil characteristics have been conducted to develop optimal topsoil management procedures. Results are summarised in the Callide EMOS. Considerable variability exists, ranging from better quality alluvial material, to nutrient poor soil, and deeper materials with high exchangeable sodium percentage that would be highly dispersive if exposed. Measured acid generating potential is low, so separate handling of materials for the purposes of managing AMD is not required.

Figure 2.1 – Conceptual Final Landform Plan for Dunn Creek Mining area



Taking these general factors into consideration, topsoil is respread to an average depth of 150-200mm. Following this, deep ripping on contour and seeding are carried out. The seed mix (see Table 2.1) consists predominantly of locally occurring tree and shrub species, as well as native and/or less competitive naturalised grass species. The seed is applied in alternating strips, with a tree mix being applied in one strip, followed by a grass mix when the bulldozer does the return run. The direct seeding technique has been used since the early 1990s.

Table 2.1 – Callide Mine 2003 Seed Mix – Species List

Type of Plant Species	Species
Trees and Shrubs	<i>Acacia blakei</i> <i>A. podalyriifolia</i> <i>A. polifolia</i> <i>A. salicina</i> <i>A. shirleyi</i> <i>Corymbia citriodora</i> <i>C. intermedia</i> <i>E. cloeziana</i> <i>E. crebra</i> <i>E. decorticans</i> <i>E. exserta</i> <i>E. melanophloia</i> <i>E. moluccana</i> <i>E. tereticornis</i> <i>E. tessallaris</i> <i>E. trachyphloia</i>
Grass and ground cover	Red Natal Curly Mitchell Grass Love Grass Qld Bluegrass Cotton Panic Brigalow Grass Kangaroo Grass Black Spear Grass Barbed Wire Grass Urochloa Wynn cassia

A land management commitment in the EMOS states that, for disturbed areas, the Environmental Protection Objective should be to return disturbed land to stable landforms with a vegetation cover, predominantly consisting of native species, similar in composition to surrounding areas, which is suitable for native fauna.

Approximately 15-30ha are rehabilitated each year. Some changes in methods have occurred, with deep ripping being introduced in 1998, the elimination of pasture grasses from the seed mix from 1999 onwards and the expansion of the native tree seed mix introduced in 1998 to include a wider range of species. As a result of these changes, older rehabilitation would not be expected to meet the same standards as current rehabilitation. For this reason, it is proposed that different objectives and standards for pre- and post-1998 rehabilitation be developed. This is discussed in more detail in Sections 5 and 8.

Non-spoil areas include ramps, final voids, haul roads, and areas of mine infrastructure. Rehabilitation commitments for these are described in the Callide EMOS and EA.

Land use and vegetation prior to mining varied between the different mine areas. Much of the Dunn Creek area, and all of The Hut mining area, fall within State Timber Reserve 170 and were timbered. Some logging was carried out prior to mining, with the main species utilised being *Corymbia citriodora*, and occasionally *Eucalyptus cloeziana*, *E. crebra* and other ironbarks. Parts of the timber reserve were subjected to low intensity cattle grazing, however a large proportion was ungrazed due to the steep slopes and poor grass cover. Erosion due to grazing activity is evident on some slopes in the eastern portion of the area.

An area of 625 ha near The Hut was previously cleared for grazing. Callide has reduced grazing in the area with a view to allowing the vegetation to return to its pre-disturbed state. Although The Hut Reforestation Project is effectively a 'green offset' for other mining disturbance, it is not intended that the effort and responsibilities for rehabilitation of mined areas will in any way be diminished because of it.

Part of The Bluff is used for grazing, and has been cleared and seeded to silk sorghum and buffel grass. Grazing on the lower slopes has caused erosion of sandy soils and silting of drainage lines. Upper slopes are too steep for pasture improvement.

The Trap Gully mining area was also used for low intensity grazing by beef cattle, and also for some cropping, which has since been discontinued, with introduced pasture species sown.

At Boundary Hill, much of the land was held under freehold title and used for grazing by beef cattle prior to mining. Much of the timber had been thinned or cleared, Acacia species had proliferated. Little pasture development had occurred, but small areas have been invaded by species such as buffel grass, Rhodes grass, and green panic.

In terms of pre-mining land capability, the Callide EMOS states that more than 70% of the southern pits area was Class 7 or 8, with only Trap Gully having notable areas of Class 6 (18%) and Class 4 (10%). At Boundary Hill, a 1992 review of land capability on unmined land concluded that most areas fell into Classes 6 and 7.

Native vegetation communities are described in the Callide EMOS. Around the southern pits, remnant vegetation is dominated by eucalypt woodland and open woodland, with small pockets of dry rainforest (semi-evergreen vine thicket). Tree species include *C. citriodora* and *E. crebra*, Acacias include *A. crassa*, *A. blakei* and *A. harpophylla*, while shrubs include *Callitris endlicheri*, *Grevillea banksii* and *Carissa ovata*. The grass/herb layer includes *Cleistochloa subjuncea*, *Ancistrachne uncinulata* and *Aristida spp.* Previously cleared areas have been invaded by native grass species, Acacia regrowth and weed species.

At Boundary Hill, much of the area prior to clearing for agriculture consisted of shrub woodland, consisting mainly of eucalypts including *E. crebra*, *E. polycarpa* and *E. tessellaris*. Much of this had been manually thinned with a resulting proliferation of Acacias.

Nine species listed in the Queensland Nature Conservation Act (1992) as rare, vulnerable or endangered occur on land managed by Callide Mine. This has implications for land management, rehabilitation, monitoring and the development of completion criteria. These are discussed in relevant sections below.

No rare or endangered fauna species have been recorded within the Callide Mining Leases. Faunal communities are considered to have moderate conservation value, with species being common throughout the region.

3 THE CURRENT SITUATION AT CALLIDE REGARDING MINE CLOSURE AND COMPLETION CRITERIA

The current Callide Environmental Authority states that 'Areas which are to be progressively rehabilitated to native ecosystem must comply with the following outcomes:

- Achievement of a self-sustaining ecosystem with a species composition and distribution comparable and similar to native analogue sites; and
- All areas disturbed by mining activities must be rehabilitated to the landform design criteria defined in (EA Attachment 1 Table L2); and
- Landforms are stable with erosion comparable and similar to analogue sites'.

In effect, this implies that rehabilitation will consist of a native ecosystem that is self-sustaining and similar in species composition and erosion rates to native analogue sites. This has several implications:

- The composition of rehabilitation and unmined sites need to be monitored and compared;
- Sustainability of the ecosystem needs to be demonstrated; and
- Erosion rates need to be measured and compared with those of unmined sites.

All of these are recognised as being critical components of the monitoring and research programs described in Sections 6 and 7.

The Callide EA also requires that the company must 'complete an investigation into the rehabilitation of disturbed areas and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in Condition L1 and the landform design criteria in Attachment 1-Table L1 and Table L2 by 31st December 2003' (Condition L1 stipulates requirements pertaining to land capability, while Table L2 presents landform design criteria).

The EMOS also includes relevant environmental protection commitments. In the Land Management section, it states that 'Monitoring criteria for development of success criteria will include:

- Vegetation – average vegetative cover of the ground layer, species diversity, species dominance in the ground layer, tree density and basal area, crown cover of the tree canopy present, and Indices: Species Proportional Similarity, Community Flux and Morphology Index;
- Development of a leaching profile – cores taken to 1m depth, samples taken at 10cm intervals and pH and EC readings taken to determine whether leaching profile or salt rise by capillary action is occurring;
- Erosion – erosion profile frames set across gullies, measures changes in gully profile over time;
- Fauna – annual sampling of ants from plots on a number of rehabilitated areas of different treatments and ages and reference sites.'

As well as these requirements, there are several opportunities and constraints that have been identified in the EMOS and will need to be taken into account when addressing mine closure and completion criteria requirements for Callide. These include:

- Protection of flora and fauna in surrounding lease areas, particularly rare plants. The EMOS states that Callide will search for the presence of Protected Plant Species, prepare and implement a Protected Plant Species Management Plan, monitor rehabilitated areas for their presence, and incorporate them into rehabilitation where feasible;

- Recognising practical opportunities for rehabilitation of surrounding lease areas, e.g. The Hut reforestation project;
- Recognising the limitations of older style rehabilitation, such as some areas at Boundary Hill that were rehabilitated according to different requirements and would not be expected to reach the same standards as current rehabilitation.

In developing the recommended procedures for addressing mine closure and completion criteria issues relating to native ecosystem establishment described in Section 4, all of the above considerations have been taken into account. It should also be noted that the required procedures for mine closure and lease relinquishment in Queensland will also be met as and when appropriate.

4 CURRENT AND PREVIOUS MONITORING AND RESEARCH

4.1 Current Rehabilitation Monitoring

The current rehabilitation monitoring program commenced in 1994. It consists of three components, viz. vegetation, soils and erosion monitoring. Prior to the 2003 monitoring program, a total of sixteen sites had been monitored, including two unmined reference sites. At one intensive monitoring location in each of these areas, the following are measured:

- Cover of live plants (by species), dead plants, litter, logs, rocks and bare ground;
- Species present in nested quadrats (1x10, 10x10 and 20x50)
- Live tree canopy cover
- Density and basal area of trees and acacias >1.6m in height, by species
- Soil depth cores (1m) to measure development of a leaching profile
- Six surface soil samples are collected, bulked, and analysed for those variables shown in Table 9.1
- Erosion monitoring using a fixed 2m long bar and pins to measure depth to the soil surface

The monitoring sites were chosen to reflect a range of ages, mining areas, and rehabilitation procedures. In any one year, a total of 12 sites (including the unmined reference sites) are monitored. In 2003, some new sites were added including two more unmined reference sites. Monitoring at some sites was postponed to maintain the total annual workload of 12 sites.

4.2 Rare Plant Species Monitoring and Research

Callide has developed a Protected Plant Species Management Plan. In this, the company has agreed to undertake research into populations on site, with a view to increasing knowledge, maintaining remnant populations, and investigating the feasibility of incorporating them into rehabilitation programs. Research undertaken to date includes:

- Searches for locations of protected species on Callide Coal managed land;
- Permanent plots established to determine recruitment and survivorship of individuals of the following species: *Acacia pedleyi*, *A. pubicosta*, *Trymalium minutiflorum* and *Quassia bidwilli*.

Callide plan to undertake more detailed searches to upgrade the database on the species distribution, and conduct ongoing research such as that described above.

4.3 The Hut Reforestation Project

The recovery of vegetation in The Hut reforestation project is monitored annually using a permanent transect through the project area. Monitoring of tree planting and direct seeding trials in 1998 has been undertaken.

4.4 Ant Monitoring

Ants are useful bio-indicators of the progress of mine rehabilitation. Ant monitoring at Callide commenced in 2001 following a pilot study in 1999. Pitfall trapping was conducted at eight rehabilitated sites and three reference sites, with a fourth added in 2003. The results have shown that the ant community of the oldest rehabilitation (a 1991 site at The Hut) compares favourably with that of reference sites in terms of species richness, species composition, and functional group composition. Other rehabilitated sites were variable in the extent of convergence. The ant monitoring at Callide will continue, because the results, together with findings from other mining operations (e.g. bauxite and mineral sand mining), suggest that this fauna group can be a useful indicator of rehabilitation success.

4.5 Ecosystem Function and Biological Indicators

Two research projects at the University of Central Queensland are examining some of the above, and other aspects related to sustainability. The first project is being undertaken by Ms Laura McKenna and supervised by Dr Alistair Melzer and Assoc Prof Steve McKillup. It's objective is to assess ecosystem function at a range of rehabilitated sites and compare functionality to unmined sites. Ecological questions being investigated will include whether functionality is correlated with species diversity or age since establishment.

The second project is being conducted by Mr Peter Davies and supervised by Dr. N. Ashwath (CQU) and Dr. D. McKay (University of the Sunshine Coast). The topic of his investigation is 'An Evaluation of the Nitrogen-Fixing Microbial Community as a General Biological Indicator of Rehabilitation Success in Australian Open-Cut Coal Mines'. Concurrently with this, an honours project is looking at LFA so that the links between the two approaches can be investigated. Study sites for the two major research projects include a range of sites at Callide Mine.

4.6 Erosion Processes

An industry wide erosion research program: 'Post-Mining Landscape Parameters For Erosion And Water Quality Control', managed by the Centre for Mined Land Rehabilitation (CMLR) at the University of Queensland, commenced in 1992 (ACARP Project C4011). The program investigates soil erosion processes and water quality issues relating to mine rehabilitation. It is a Queensland coal industry research program aiming to develop erosion prediction models for use in post mining landform design as well as a better understanding of water quality issues. The program was due to be completed by the end of 1997, although further funding allowed it to continue to 2002.

5 RECOMMENDED PROCEDURES FOR ADDRESSING MINE CLOSURE AND COMPLETION CRITERIA ISSUES RELATING TO NATIVE ECOSYSTEM ESTABLISHMENT

The process for developing completion criteria should include the following key aspects:

- Development of clear, achievable rehabilitation objectives
- Development of a rehabilitation monitoring program suitable for determining whether these have been reached
- Linkage to research projects necessary to overcome problems that might prevent rehabilitation meeting the designated objectives
- Development of appropriate completion criteria and target standards, which, if met, confirm that the rehabilitation has fulfilled the stated objectives. Completion criteria need to encompass all stages of the mining operation, including planning, establishment, development, sign-off and post-closure management.

Full details of these aspects are presented in the following sections.

6 RECOMMENDED REHABILITATION OBJECTIVE

As noted above, rehabilitation at Callide includes a range of different-aged sites established using procedures that have evolved over time, and which reflect changing regulatory requirements. Clearly, the standard of older rehabilitation will differ from that of more recent rehabilitation. It is therefore appropriate that overall objectives reflect this. For this reason, it is recommended that there be two rehabilitation objectives; one for rehabilitation established prior to 1998 (older rehabilitation), and one for that established after 1998 (current rehabilitation). The year 1998 was chosen because this is when deep ripping was introduced and the decisions were made to expand the native tree seed mix, eliminate pasture species from the grass seed mix and base the grass seed mix on less competitive native or naturalised grass species. All of these are reflected in the rehabilitation undertaken since 1998. The two objectives are outlined below.

6.1 Objective for Post-1998 Rehabilitation (including Rehabilitation done in 1998):

The objective of rehabilitation following mining at Callide is to establish a stable, self-sustaining native ecosystem that fulfills designated land uses including protection of water resources and nature conservation, and which:

- Represents what can be achieved using cost-effective rehabilitation procedures that reflect mining industry current best practice;
- Is similar in composition and function to that occurring in representative unmined reference sites;
- Provides habitat for a range of native fauna species;
- Is based on the findings of research into the establishment of biodiversity, ecosystem function, and sustainability
- Is compatible with Callide's overall whole-of-lease land management approach, which includes rare plant species conservation, and The Hut Reforestation Project.
- Takes into account the views of the Callide Mine Community Liaison Forum and other relevant stakeholders.

- Results in either no measurable, or acceptable off-site impacts;
- Management requirements (e.g. maintenance of access tracks, fire) are not greater than those of areas prior to mining, or where extra management actions may be required, a mechanism has been put in place for addressing these.

It should be noted that the above objective refers to spoil areas. Rehabilitation objectives and standards for other areas such as roads, ramps and infrastructure will match this to the closest practicable extent.

The rehabilitation objective and associated completion criteria and target standards will be reviewed by Callide and EPA representatives every five years, and if necessary, revised by mutual agreement to reflect advances in cost-effective rehabilitation techniques.

6.2 Objective for Pre-1998 Rehabilitation

The objective of pre-1998 rehabilitation following mining at Callide is to establish a stable, self-sustaining native ecosystem that fulfills designated land uses including protection of water resources and nature conservation, and which:

- Fulfills all regulatory requirements and commitments relevant at the time of rehabilitation;
- Includes a range of native tree, shrub and grass species occurring in representative unmined reference sites;
- Provides habitat for a range of native fauna species;
- Is based on the findings of research into the establishment of biodiversity, ecosystem function, and sustainability
- Is compatible with Callide Mine's overall whole-of-lease land management approach, which includes rare plant species conservation, and The Hut Reforestation Project.
- Takes into account the views of the Callide Mine Community Liaison Forum and other relevant stakeholders.
- Results in either no measurable, or acceptable off-site impacts;

Management requirements (e.g. maintenance of access tracks, fire) are not greater than those of areas prior to mining, or where extra management actions may be required, a mechanism has been put in place for addressing these.

Provided rehabilitation fulfils the above objectives and meets the standards and milestones designated in Section 8, it is not intended that reworking of older sites will be carried out. However, where there is uncertainty, or where a site has clearly failed to meet a particular standard or milestone, a risk based approach such as that described in Section 8 should be applied to determine the appropriate course of action.

7 RECOMMENDED MONITORING PROGRAM

In Section 6, the essential components of a mine closure strategy relevant to native ecosystem rehabilitation and related completion criteria were described. These have been taken into consideration in the recommended Callide monitoring program.

The monitoring program described in this section, in conjunction with previous and current monitoring and research projects, is designed to enable Callide and other stakeholders to assess whether the objectives described in Section 5 have been met, and the completion criteria listed in Section 8 have been fulfilled.

The monitoring and research also form a key part of Callide Mine's continuous improvement program. The level of detail in the monitoring program reflects the amount of previous rehabilitation research conducted at the mine.

The recommended rehabilitation monitoring program consists of two components:

- General rehabilitation assessment monitoring; this is designed to assess the progress of rehabilitated ecosystems.
- Rapid assessment prior to signoff is intended to confirm that all completion criteria listed in Section 8 have been fulfilled prior to closure and relinquishment.

7.1 General Rehabilitation Assessment Monitoring

The current Callide rehabilitation monitoring program has a number of limitations or opportunities for improvement. These include:

- More reference sites are needed to reflect the range of habitats present at the mines, and variation in the extent of disturbance;
- Sites do not need to be monitored every year; this provides the opportunity to monitor a wider range of rehabilitated sites;
- The current approach focuses on a small area and does not measure the variability that is likely to exist across a rehabilitated area;
- No estimate of statistical variance is obtained, precluding the possibility of statistical analyses that could objectively compare different rehabilitation treatments, changes over time, and rehabilitated verses reference sites;
- Current monitoring only assesses the extent of erosion over a very small area;
- More detailed integration of vegetation and soil monitoring analyses is needed;
- Better feedback for continuous improvement e.g. re. seeding success, is required.

In the course of discussions with Callide's B. Cartwright and consultants J. Elsol and B. Emmerton, the monitoring program was reviewed. On the basis of these discussions, it is recommended that the program be revised to address the above issues and provide information that better fulfills the company's needs regarding the assessment of rehabilitation success, and continuous improvement. It is recognised that some fine-tuning of the program will still be required.

The recommended revised monitoring design is shown in Figure 7.1. In a typical section of same-age rehabilitation, four plots should be established; two in the upper section of the slope, and two in the lower section. A smaller number of plots could be established in small rehabilitated areas, but it is important that several be used to give an indication of variability across a pit. The initial location of the plot should be selected at random, located in rehabilitation, which appears to be 'typical' of that particular rehabilitated area. The second plot should be sited at least 100m further along the slope. Where significant variation exists in a rehabilitated area, e.g. where some areas have a good tree cover and others have few trees and mainly grass, it may be necessary to stratify the sampling, to ensure that monitoring is a true reflection of the vegetation community. Thus, if site inspection or aerial photo interpretation reveal that $\frac{3}{4}$ of the rehabilitated area has good tree cover and $\frac{1}{4}$ has only grass, three of the four plots should be located in treed areas.

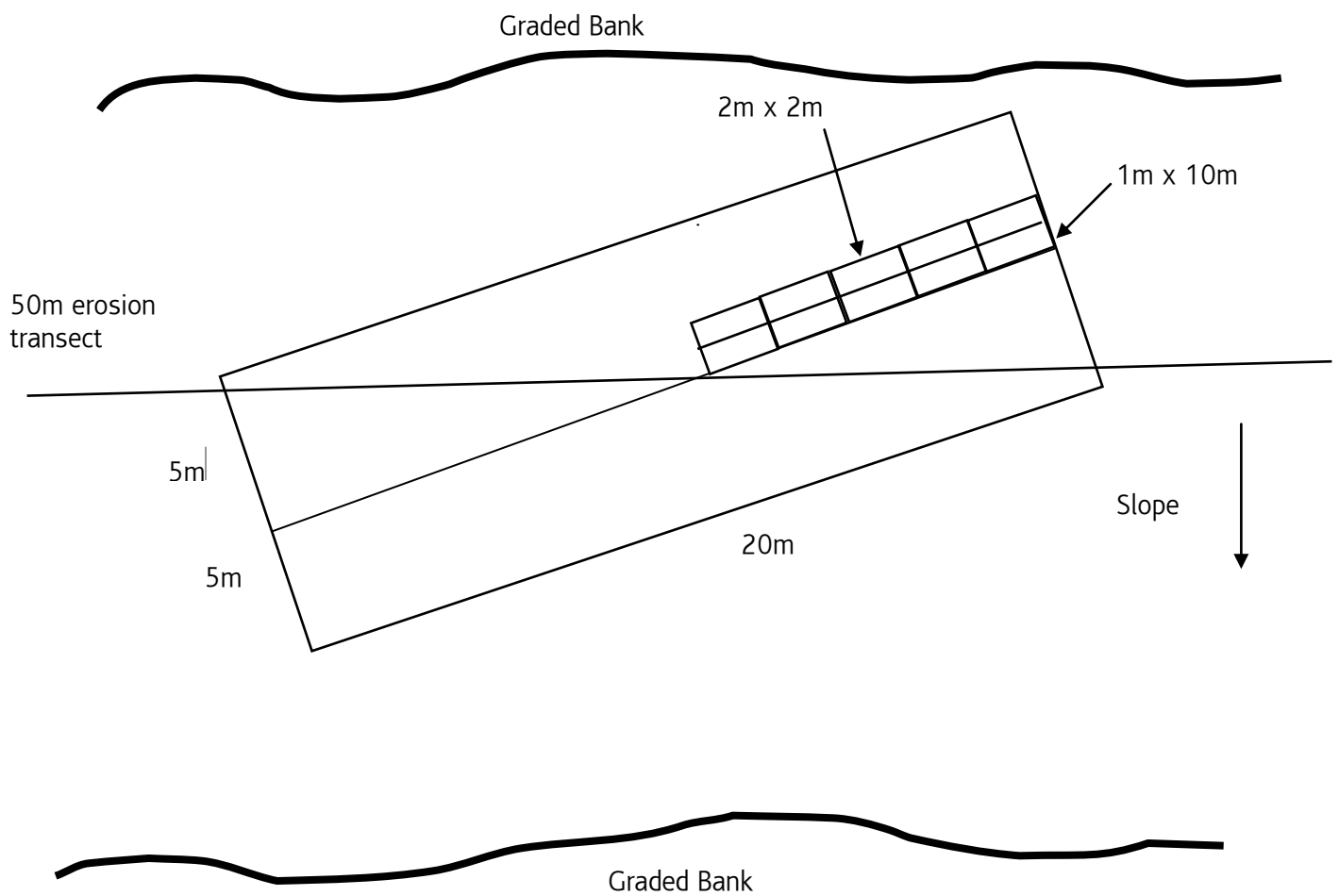


Figure 7.1 - Recommended Monitoring Plot Design for use at Callide Mine

Each plot should be orientated at an angle to the contour to ensure that alternating strips of trees and grass are monitored.

Each plot should consist of the following:

- A 1m x 10m area to retain consistency with previous monitoring (encompass these areas where possible)
- Five, 2m x 2m quadrats overlaying the 1m x 10m area, and located to one side of the centre-line.
- One 20m x 10m plot overlying the 2m quadrats and located 5m either side of the centre-line, for ease of monitoring.
- A 50m erosion monitoring transect on contour and running through the centre-line of the plot.

In each plot, measurements described in Table 7.1 should be recorded. The start and end points of each 20m x 10m plot on the transect line should be marked using a star picket, and its GPS location recorded.

Table 7.1 - Recommended Procedures for Monitoring Representative Rehabilitated and Reference Sites.

Plot Size	Measurement
General Description	Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc.
1m x 10m	- Record all species present - Record ground cover as per the current technique, i.e. at 100 intercept points, record the presence of live plants (by species), dead cover, litter bare, rocks or logs.
2m x 2m quadrats	Count the number of plants of all species, excluding grass
20m x 10m plots	- Count, by species, all trees >1.6m tall - Tag and measure DBH of trees >1.6m tall, to a maximum of 10 for any one species. - Record canopy cover over the whole 20m centreline - Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of healthy trees. - Record any new plant species not present in the smaller plots, including any declared noxious weeds - From two of the four monitoring plots, take five surface soil samples (e.g. at approx. 5m intervals) and bulk these for analyses of: pH, EC, chloride and sulphate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn. - From one monitoring plot, take soil depth cores using the current sampling procedure, to monitor development of the soil profile
50m	- Along the 50m erosion monitoring transect, record the location, number and dimension of all gullies >30cm wide and/or 30cm deep. - Erosion pins should be established to record sheet erosion (ON to discuss details with R. Loch)
Rehabilitation in general	- When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (i.e. bare areas greater than 0.1ha). - Observations such as this can provide useful, broad scale information on rehabilitation success and problems.
Photographic record	For each 20m x 10m plot, a photograph should be taken at each end of the plot, along the centreline looking in.

Prior to 2003, two reference sites were monitored:

- Site 11, reference site BH, consisting of *C. citriodora* – *E. crebra* woodland with sparse ground cover, 2% slope; and
- Site 12, reference site DC, *C. citriodora* woodland with sparse ground cover, 38% slope

In the 2003 monitoring, two more sites were selected to better reflect variation between the mining areas, and also to include some disturbed areas, including a regrowth area near The Hut. It is envisaged that further reference sites will be added.

It is recommended that reference sites be monitored using the same techniques as used for rehabilitated sites.

In any one year, a total of six sites should be monitored. These should consist of four rehabilitated sites ranging in age from 3 years old (the minimum age they should be monitored) up to the oldest sites available (e.g. The Hut 1991), as well as two reference sites. It is not necessary that every site be monitored each year. In alternate years, a second set of rehabilitated and reference sites should be monitored so that, in time, data on key indicator parameters can be plotted against rehabilitation age and compared with values from unmined reference sites. This approach would allow for up to six reference sites and 12 representative rehabilitated sites to be surveyed on a three-year rotation. Some variation in this program may be required according to needs and site availability, however, it is not necessary that all rehabilitated sites in any year are monitored, only those representative of particular ages, locations, and other known variation.

It should be noted that maintenance of good records on rehabilitation techniques used is essential for the interpretation of monitoring results and continuous improvement of rehabilitation procedures. The recording of rehabilitation methods is described in section 8.

7.2 Rapid Assessment prior to Signoff

When it is thought that a rehabilitated area is ready for signoff, the following procedures will need to be undertaken:

- Collation of all relevant records, monitoring and research data, including the 'Initial Post-establishment Monitoring Checklist' (see Section 9 - Table 9.2), to determine whether all completion criteria standards and milestones have been met.
- If the site has been monitored, much of the information required will be available from this, together with rehabilitation records, checklists and research findings.
- If the site has not been monitored, a rapid belt transect procedure should be used to determine whether all measurable standards and milestones have been met.
- Regardless of whether an 'Initial Post-establishment Monitoring Checklist' has been completed or not, a general inspection will be required to confirm that rehabilitation operations have been carried out as required (or as best as can be determined, for older sites).
- During routine long-term monitoring or rapid assessment, a site worksheet should be prepared, which summarises key rehabilitation operations, describes the rehabilitation in general terms, and notes any remedial actions that may be required to meet particular standards and milestones (e.g. repair of waterways or erosion gullies, establishment of trees where initial establishment was poor).

- When all records have been collated and any required remedial work completed, a site inspection with the responsible EPA officer should be conducted to confirm their agreement that requirements have been fulfilled, or if not, determine what further work is needed.

8 RELATED RESEARCH NEEDED ENSURE REHABILITATION MEETS DEFINED OBJECTIVES

Ongoing rehabilitation research projects described in Section 3 should continue.

As well as these, other priority areas where information will be required by Callide Mine include:

- Studies into the effects of fire on ecosystem development and function
- Studies designed to understand the extent and processes of vertebrate fauna colonisation
- Long-term successional trends
- Cost-effective techniques for increasing the diversity of understorey species (as part of a process of continuous improvement).

Components of the latter two projects are already included in the current research and monitoring programs.

9 MINE CLOSURE AND COMPLETION CRITERIA

9.1 Post-1998 Completion Criteria

Recommended post-1998 completion criteria for Callide are shown in Table 9.1. It should be emphasised that these only apply to the establishment of native ecosystems and related rehabilitation aspects, and therefore only constitute part of the overall mine closure plan, which will follow the approach advocated in the ANZMEC/MCA (2000) Strategic Framework for Mine Closure.

The table is designed to address the requirements identified in Section 6, including the indicators described, which are either addressed in the monitoring program or in the research program. It is based on a staged approach, which requires that Callide meet defined standards or milestones at the following stages:

1. Planning – this requires that all objectives, procedures, landform plans, monitoring and research programs have been developed to the satisfaction of regulatory authorities;
2. Establishment – this requires that all rehabilitation has been carried out according to procedures described in the EMOS and EA, and appropriate records kept.
3. Development and sign-off stage – this sets required standards and milestones for the developing rehabilitated ecosystem, focusing on key aspects and indicators relating to vegetation, fauna, landform stability, soils and land use.
4. Monitoring and maintenance – this addresses post-closure and post-relinquishment issues relating to monitoring, management, ownership and liability, funding and risk assessment.

An initial post-establishment monitoring checklist would be completed for each rehabilitation area as detailed in Table 9.2

Table 9.1 - Post-1998 Completion Criteria Assessment Checklist to be used in assessing whether Rehabilitation Objectives have been met.

Rehabilitation Criteria	Standard or Milestone Required	Corrective Action
1. Planning stage		
Rehabilitation objectives	Clear rehabilitation objectives have been developed in consultation with EPA and other stakeholders (see Section 5)	Develop and agree on objectives
Rehabilitation procedures documented	Agreed rehabilitation procedures have been developed and are described in the EMOS and Plan of Operations	Develop agreed rehabilitation procedures
Landform plan	Final conceptual landform plans have been developed	Develop landform plans
Drainage	Contour bank spacing, grades, location of waterways etc in accordance with EMOS and EA requirements	Ensure appropriate graded banks and waterways are constructed
Monitoring and research	Rehabilitation monitoring and research programs designed to assess conformance with requirements and development of rehabilitation, and enable continuous improvement, have been implemented and will continue, where necessary, during the life of the operation	Design and implement rehabilitation monitoring programs
2. Establishment Stage		
Rehabilitation has been carried out to the standards required in EA M2602; specifically in relation to:	An Initial Post-establishment Monitoring Checklist (see Table 9.2) has been completed as a quality control procedure, to confirm that all required rehabilitation works have been carried out	Any operations not carried out to the required standard will be redone if required* (e.g. if significant erosion potential exists)
- landform design	As per Initial Post-establishment Monitoring Checklist	
- erosion control structures inc. waterways and contour banks	As per Initial Post-establishment Monitoring Checklist	
- ripping	As per Initial Post-establishment Monitoring Checklist	
- resspreading of topsoil	As per Initial Post-establishment Monitoring Checklist	
- seeding	As per Initial Post-establishment Monitoring Checklist	

* Where necessary, a Qualitative Risk Assessment procedure should be conducted to determine what corrective actions might be appropriate.

Rehabilitation Criteria	Standard or Milestone Required	Corrective Action
Has topsoil been returned?	Topsoil has been respread uniformly on rehabilitated areas where available to an average depth of 150-200mm.. Where available and practical, topsoil likely to contain viable native seed has been respread directly onto rehabilitated areas.	Respread topsoil if significant problems with vegetation establishment on slopes is apparent, and monitoring shows lack of topsoil to be the cause
Have all areas been ripped?	Ripping has been completed along contour on all areas and to a depth of 0.5-0.7m.	Conduct ripping if significant problems with tree establishment or erosion are demonstrated by monitoring
3. Development and sign-off stages		
3.1 Vegetation establishment and sustainability		
Tree species composition is compatible with that of other vegetation types in the lease, ie. it includes:		
- local eucalypt species	A range of local eucalypt species are present	Plant or seed more species if required
- local tall acacia species	A range of local acacia species are present	Plant or seed more species if required
Tree health	More than 75% of trees are healthy and growing as indicated by long term monitoring	Investigate causes of problem and correct if required
Leaf nutrient analysis	Nutrient analyses conducted on trees in representative areas indicate no deficiencies of key macro- or micro-nutrients	Investigate causes of any problems and address as required
Tree density	Monitoring or visual estimation show the density of trees >1.6m tall to be >100 stems/ha	Plant or seed more trees if required
Presence of treeless areas	No treeless areas greater than 0.5ha are present	Correct using planting or seeding if required
Evidence of tree regeneration	Second generation tree seedlings are present or likely to be, based on monitoring in comparable older sites.	Conduct follow-up assessment later, or add seed if required
Grasses	Native grass species are present	Seed more species if grass cover is poor
Sufficient grass cover, rocks, logs etc. are present on outer boxcut slopes and steeper inner slopes to control erosion in the long term	Monitoring and visual estimation show grass cover to be >50% on these areas, or sites have sufficient rock cover to control erosion	Where necessary, delay closure until grass cover increases, or increase cover by seeding
Presence of bare areas on outer boxcut slopes	No bare areas that have obviously failed and are greater than 0.1ha in total area, or greater than 5m in width extending >10m down the slope, are present	Establish grass cover on bare areas if significant erosion is likely
Shrubs	A range of native shrub species are present	Investigate the feasibility of establishing more shrub species and do so if practicable

Rehabilitation Criteria	Standard or Milestone Required	Corrective Action
Rare plant species	Record the presence of any rare plant species in the area (mention the plan for managing them in unmined areas, and establishing some in rehab where practical/desirable)	
Noxious weeds	A management program for the control of declared plants has been implemented on the site	Control declared plants as per the management program
Fire tolerance	Tree, understorey and grass species are capable of either surviving or regenerating following a fire	Rehabilitation may be too young to determine this; investigate using research and/or literature review of relevant research on other mines
Drought tolerance	Tree, understorey and grass species are capable of surviving drought, as demonstrated by recent monitoring and research results (following a period of severe drought from 2001-2003)	If large-scale deaths have occurred, consider the need for replanting or reseedling, and whether more drought tolerant species should be included in the seed mix
Sustainability	Monitoring and research results indicate that the rehabilitation is likely to be sustainable over the long-term, if managed according to the procedures defined in Criteria 4 below.	If sustainability has not been demonstrated for a site, depending on the circumstances, the response could include corrective actions, or postponing signoff until it has
3.2 Fauna habitat and faunal recolonisation	Fauna habitat matches that in some surrounding woodland areas or will do so in time	Investigate whether further planting or seeding might be required as per Criteria 3.1
Diversity of vegetation	Includes a range of vegetation structural habitats e.g. eucalypts, shrubs, ground cover and a developing litter layer.	“ “ “
Fauna recolonisation – invertebrates	Studies demonstrate that key invertebrate functional groups such as ants and soil faunal communities are becoming established	Investigate the causes where key groups have not recolonised
Fauna recolonisation – vertebrates	Vertebrate surveys demonstrate that bird, mammal, reptile and frog communities are becoming established in rehabilitated sites	Investigate the causes where key vertebrate groups have not recolonised
Management of fauna habitat in unmined areas	Where possible, fauna habitat of adjacent unmined areas will be protected from clearing and grazing as part of Callide's overall lease management program, and disturbed areas will be allowed to regenerate (e.g. The Hut Reforestation Project Area). Such areas constitute sources of recruitment for both fauna and flora to rehabilitation	Protect areas of adjacent native fauna habitat
Management of rare species habitat	Habitat of any rare or vulnerable fauna species recorded is managed to promote the species conservation where not on the mining path.	Manage habitat as required

Rehabilitation Criteria	Standard or Milestone Required	Corrective Action
3.3 Landform stability		
Absence of significant erosion – gullies	No erosion gullies >2m deep and/or 2m wide are present on outer slopes	Gullies which fail to meet the standard should be reshaped and replanted if required*
Absence of significant erosion – sheet	Annual soil loss rates will not exceed 40t/ha for normal spoil rehabilitation areas and in time will approach values recorded for reference sites.	Where erosion rates are measured or likely to exceed this value, procedures will be implemented to reduce erosion rates, such as reseeding, construction of more contour banks etc. as appropriate
Integrity of waterways	If still required, waterways are still in good working condition	Repair waterways if required*
Graded banks have been removed	After establishment of adequate vegetation cover, graded banks will be removed as described in the EMOS at such time as they are not longer required.	Remove when appropriate
Final voids	Residual voids have been constructed and, where relevant, rehabilitated according to the requirements stipulated in the EMOS and EA M2602.	Complete rehabilitation according to stipulated requirements
3.4 Soil suitability		
Conductivity and the development of a leaching profile	Monitoring and research results show that a leaching profile has developed, or is likely to, and EC values are sufficiently low to allow survival and growth of the plant species present	Determine the cause of any problems identified, and what corrective actions may be appropriate (eg. ripping to improve leaching, establishment of salt tolerant species)
pH	Levels of pH are within the range required to allow plant growth (a more specific range may be developed following several years monitoring, as agreed in conjunction with the EPA)	Determine the cause of any problems identified, and what corrective actions may be appropriate
Soil fertility	Monitoring and research results show that levels of soil macro- and micro-nutrients are likely to be sufficient to ensure that trees do not experience nutrient deficiencies (more specific values may be set following several years monitoring, as agreed in conjunction with the EPA)	Determine the cause of any problems identified, and what corrective actions may be appropriate (e.g. seeding of legumes or application of fertiliser)
Nutrient cycling	Studies conducted on representative rehabilitated areas (e.g. litter decomposition and soil microbiology studies) indicate that nutrient cycling processes are becoming established	Determine the cause of any problems identified, and what corrective actions may be appropriate

Rehabilitation Criteria	Standard or Milestone Required	Corrective Action
Soil physical properties	Visual inspections indicates that no crusting or excessive compaction exists that may affect plant growth or recruitment.	Determine whether ripping (for compaction) or addition of a topsoiling material (for crusting) may be required
3.5 Land use suitability		
- suitability for nature conservation	Areas of rehabilitation and unmined sites within the lease, including The Hut Reforestation Area, together possess defined conservation values and could be managed for the purposes of conserving a range of local flora and fauna species and vegetation types, including the rare plant species identified.	Determine whether further revegetation or other management procedures may be required
- protection of water quality	Water quality, landform design, geotechnical stability and vegetation monitoring data all suggest that sites are not likely to pose a threat to downstream water quality	Implement corrective procedures if required
- long term management	Management requirements have been defined (see Criteria 4 below). Long-term management operations (e.g. maintenance of access tracks, fire) will not be greater than those of areas prior to mining, or where extra management actions may be required, a mechanism has been put in place for addressing these.	Develop long-term management plan as in Criteria 4 below.
3.6 Safety		
Presence of hazards: Rehabilitation area in general	Apart from final voids, no safety hazards exist, including:	Correct as required
	- holes, tunnels, steep walls, or unstable areas	
	- old mining infrastructure	
	- hazardous materials	
	- other hazards	

Final Voids	Final voids do not cause any serious environmental harm to land, surface waters or recognised groundwater aquifers. <u>High walls</u> – safety bunds have been constructed along the top of the high wall and the crest of prestrip benches. Prestrip benches shaped to shed runoff over the high wall at several locations to limit erosion. All accessible, exposed coal seams have been covered with inert material. <u>Low walls and Ramps</u> – Where low wall toe likely to be submerged, slope has been lowered to 27 degrees by either backfilling against the toe or the low wall has been dozed down to this angle or flatter.	Submit a report to EPA on acceptance criteria for final voids by 31 December 2005
	Steep walls surrounding final voids have been fenced and danger signs erected and bunded to prevent vehicular access	Install fencing and signage
	Where water quality may pose a safety risk (eg. for drinking or swimming), safety signs have been erected	Install signs
4. Monitoring and maintenance stage		
Monitoring	A monitoring program has been developed that addresses post-closure and post-relinquishment monitoring requirements and defines responsibilities for conducting monitoring	Address monitoring requirements and responsibilities
Ownership and liability	Post-relinquishment ownership and liability issues will be addressed in the Final Rehabilitation Report	
Post-closure and post-relinquishment management requirements	A plan for addressing post-closure and post-relinquishment management requirements has been developed in conjunction with the EPA and relevant stakeholders, and responsibility for implementing tasks has been allocated	Develop long term management plan
Funding	A mechanism for allocating funding required for post-relinquishment management will be developed in conjunction with regulatory authorities and outlined in the Final Rehabilitation Report	Develop mechanism for addressing funding requirements for post-relinquishment management
Risk assessment and addressing failure	A qualitative risk assessment addressing the likelihood of failure has been carried out by agreement with regulatory authorities, and used to minimise the risk of adverse events, and ensure that funding is available to address specified scenarios.	Conduct risk assessment

Table 9.2 - Initial Post-Establishment Monitoring Checklist

Mining Area:		Approx Area (ha):	
Pit/Location:		Checklist complied by:	
Year Rehabilitated:		Date:	

Checklist Point No.	Detail	Response (Yes/No/NA & reasons)
1	Earthworks:	
1.1	- Outer slopes have been constructed to slope angle of 15%	
1.2	- Outer slopes at Dunn Creek A and S Cuts constructed at 25% slope angle and 120m slope length	
1.3	- Internal slopes have been constructed to 15% or flatter	
1.4	- Presence of trial slopes (15-25%) or angle of repose slopes (~37%) on areas outside of Dunn Creek A and S Cuts	
2	Drainage:	
2.1	- Graded banks have been established at approximately 10m vertical spacings	
2.2	- Graded banks have longitudinal grade of 1% (on average) and are trapezoidal in cross-section	
2.3	- Where possible, graded banks are run out onto natural surface or onto level areas within the rehabilitated landform	
2.4	- If 2.3 is not possible, graded banks have been fed into one or more rock lined waterways.	
2.5	- Rock lined waterway(s) has (have) been constructed in accordance with EMOS specifications	
2.6	- On Dunn Creek A & S Cut outer slopes, berms or graded banks have been constructed at 120m spacings up the slope	
3.	Topsoil	
3.1.	- Topsoil or basalt mulch (specify) has been used as the topdressing medium (refer 1.1, 1.3, 1.4)	
3.2	- All 25% slopes have been basalt mulched (refer 1.2)	
3.3	- Topsoil or basalt mulch has been applied evenly over the area (e.g. no bare areas greater than 100m ²)	
3.4	- Topsoil has been placed to a depth of 150-200mm (confirmed by a number of hand excavations over the area)	
3.5	- If topsoil was directly returned, from where was it obtained?	
3.6	- If topsoil was obtained from one or more topsoil stockpiles, note where and approx. age of stockpile(s)	
4	Ripping:	
4.1	- Ripping to a depth of 0.5-0.7m at 1m spacings on the contour has been undertaken	
5	Vegetation Establishment:	
5.1	- Direct seeding was undertaken in conjunction with contour deep ripping. The month of both has been recorded.	
5.2	- Tree seed and grass seed mixes were applied in bands on the contour	
5.3	- Seed has been spread evenly over the area	
5.4	- Seed mixes applied and seeding rates have been recorded (i.e. species lists and rates/ha/species)	

It should be noted that the type of criteria vary in detail. Some require that certain actions be carried out, such as construction of berms or graded banks and ripping, and auditable records be retained to verify they have been done. Others may require detailed research and monitoring focusing on specific areas, for example demonstrating that nutrient cycling processes are proceeding satisfactorily. Some criteria are designed to be verified by the monitoring program described in Section 6. And finally, some criteria require that mechanisms be in place for addressing relevant post-closure and post-relinquishment issues, thereby ensuring that, once all criteria have been met, Callide Mine will have no ongoing liability in relation to rehabilitation establishment.

Section 2 outlines mine closure and completion criteria aspects contained in the Callide EMOS and EA. These have been incorporated in Table 9.1 above. However, it should be noted that the Company will be required to meet the requirements of all three (i.e. Table 9.1, EMOS and EA) in order to fulfill the objectives stated in Section 5, and achieve sign-off.

The rapid assessment procedure discussed in Section 6.2 is designed to confirm, to the satisfaction of regulators, that the particular rehabilitated area has fulfilled the requirements of all relevant completion criteria stipulated in Table 9.1. This process should enable provisional signoff of the rehabilitation, as per the process currently being developed by the QMC in conjunction with the Queensland EPA. It will also form a key part of the overall Final Rehabilitation Report and Audit Statement.

In some cases, there may be uncertainty regarding whether one of the above standards or milestones has been met, or examples where a site has clearly failed to meet the stated target. In these instances, a risk-based approach should be applied to determine the appropriate course of action. This should address the following questions:

- Do significant environmental impacts, legal or safety issues exist, or are they likely to occur? If so, the situation must be corrected.
- Will the rehabilitated area meet defined success criteria if left alone for an agreed period?
- If not, how practical (cost and logistics) would it be to rehabilitate the site to an acceptable standard?
- What environmental damage could result from corrective rehabilitation?

A decision on the appropriate course of action should be made in conjunction with the regulators and any other key stakeholders. This may include carrying out some remedial actions, postponing closure and waiting to observe further developments, or deciding that impacts are acceptable and not likely to worsen, and should therefore not delay signoff.

9.2 Pre-1998 Completion Criteria

Pre-1998 rehabilitation should fulfill the objectives stated in Section 9.5.2. This essentially requires that rehabilitation must be safe, the landforms stable and the vegetation sustainable, with either no measurable off-site impacts, or impacts within acceptable limits.

With pre-existing rehabilitation it is obviously not possible to complete an 'Initial Post-establishment Monitoring Checklist'. However, it would be possible to determine whether many of the particular procedures were carried out, such as construction of graded banks and waterways. It should also be noted that whilst different techniques might have been used in some older rehabilitation, these might still fulfill the overall objectives and many of the key standards and milestones listed in Table 9.1.

Given the variation in rehabilitation techniques that would have been used, and the changes in rehabilitation requirements over time, it is not considered practical to develop a set of criteria, standards and milestones that are totally applicable to all pre-1998 rehabilitated areas.

It is therefore suggested that, in the first instance, Pre-1998 rehabilitation should be assessed against the Post-1998 Completion Criteria Assessment Checklist shown in Table 9.1. In many cases, it is likely that it will meet the defined standards and milestones, and this is clearly preferable. Where it does not, a decision will need to be made regarding the relevance of the condition to older rehabilitation. Obviously, some requirements such as healthy trees, resilience to fire and drought, absence of significant erosion, control of noxious weeds, and protection of water quality will have to be met, no matter what the age of rehabilitation. However, others, such as the provision of fauna habitat and the presence of shrubs, may not. Where there is doubt, a risk-based approach such as that described in Section 8.1 should be used to determine the likely consequences of a site not meeting a particular criteria, and the appropriate course of action.

It is recommended that several older areas be assessed using this procedure. Worksheets should be developed outlining remedial actions required to meet those criteria deemed necessary for signoff. Once this is done, it may be possible to develop a specific set of pre-1998 completion criteria.

10 REVIEW OF COMPLETION CRITERIA AND STANDARDS

The objectives described in Section 5 and the associated completion criteria and target standards presented in Section 8, will be reviewed by Callide and EPA representatives every five years, and if necessary, revised by mutual agreement to reflect advances in cost-effective rehabilitation techniques.

For example, as further monitoring data become available, it may be possible to set more specific criteria and target standards. Figures 10.1 and 10.2 illustrate tree basal area and crown cover development over time. In both cases, there is a clear trend towards the range of values recorded in the reference sites. At some stage, it might be possible to set minimum standards for key indicators such as these which, if reached, would mean that rehabilitation is likely to be sustainable and continue to perform satisfactorily in comparison with the reference sites. However, it should be noted that Figures 10.1 and 10.2 include both Eucalypts and Acacias, which will behave separately over time (e.g. some Acacias will senesce), so separate standards may be required for parameters such as basal area.

Figure 10.1 - Tree Basal Area Development over Time
(reference sites are allocated an age of 25 years)

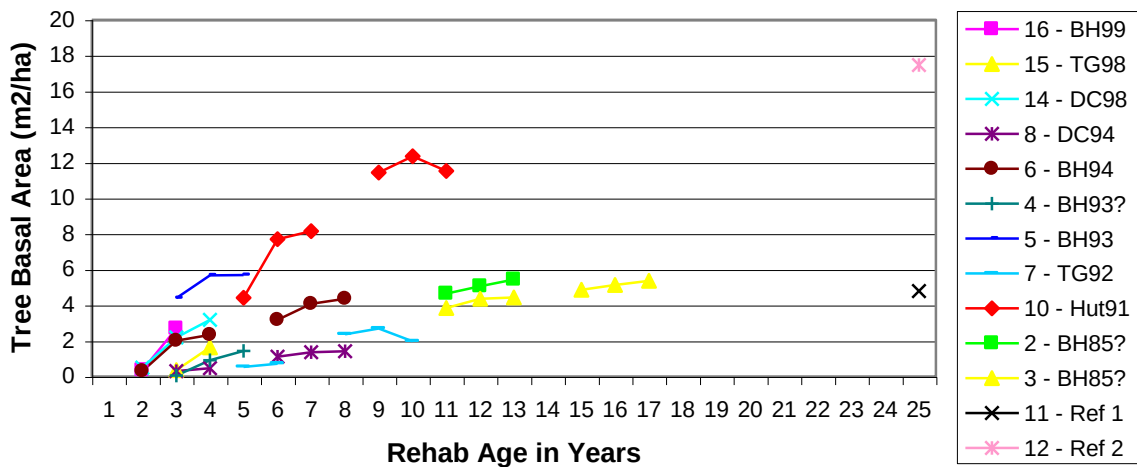
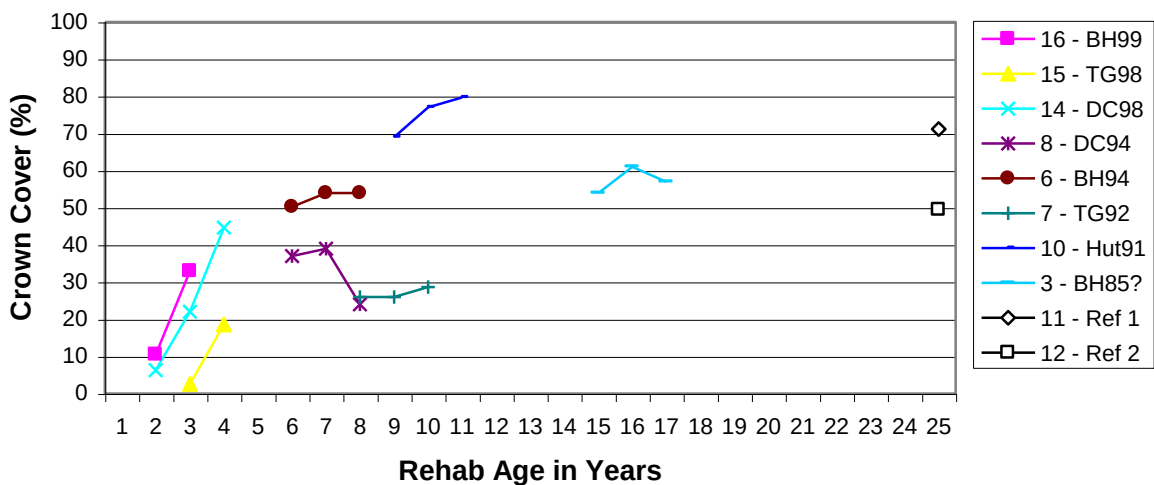


Figure 10.2 - Crown Cover Development over Time
(reference sites are allocated an age of 25 years)



11 DEALING WITH NON-SPOIL AREAS

Non-spoil areas at Callide that will be rehabilitated at some stage include final voids, haul roads, ramps, hardstands and infrastructure. Oaky Creek Diversion at The Hut mining area will also need to be considered. With regards to both rehabilitation and specific completion criteria, each of these will need to be addressed on a case-by-case basis, as the growing conditions are likely to vary considerably.

It is recommended that, as appropriate, non-spoil areas be treated as separate domains. As most of these areas are still operational and there is little knowledge of rehabilitation performance, it is premature to recommend completion criteria, standards or milestones.

These should be developed following the general principles and to the extent practical, as a subset of the completion criteria described above. As a minimum these will require that the vegetation established is sustainable, and fulfils designated functions such as protection from wind and water erosion.

Appendix C4

Callide Mine Report on Completion Criteria for Residual
Voids 2005



Callide Mine

Report on Completion Criteria for Residual Voids

Prepared by:

Mr Brad Cartwright
Senior Environmental Adviser
Anglo Coal (Callide Management) Pty Ltd

16th December 2005

CALLIDE MINE
REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

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CALLIDE MINE
REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

1. INTRODUCTION

This report on proposed acceptance (completion) criteria for residual voids has been prepared in accordance with Environmental Authority M2602 Condition L6.

2. ENVIRONMENTAL AUTHORITY CONDITIONS

Conditions attached to Environmental Authority M2602 regarding residual voids are:

L5 Residual voids must comply with the following outcomes:

- a) residual voids must not cause any serious environmental harm to land, surface waters or any recognised ground water aquifer, other than the environmental harm constituted by the existence of the residual void itself, and subject to any other condition within this environmental authority; and
- b) residual voids must comply with Attachment 1 - Table L3.

L6 Complete an investigation into residual voids and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in Condition L5 and landform design criteria in Attachment 1 -Table L3 by 31 December 2005.

Table in Environmental Authority M2602 – Attachment 1 relating to Residual Voids

Table L3 - Residual Void Design Outcomes

Void Slope	Configuration
High wall	– 75° slope angle. – Safety bunds will be constructed along the top of the highwalls and the crest of prestrip benches. The prestrip benches will be shaped to shed runoff over the highwall at several locations to limit erosion. – All exposed coal seams will be covered with inert material.
Low wall	– Generally at angle of repose. – Where the low wall toe will to be submerged, the slope will be lowered to 27° by backfilling against the toe or dozing the low wall slope down to this angle.
Ramp Spoil	– Generally at angle of repose. – Where the low wall toe will to be submerged, the slope will be lowered to 27° by backfilling against the toe or dozing the low wall slope down to this angle.

3. EM PLAN INFORMATION ON RESIDUAL VOIDS

The Callide Mine EM Plan (i.e. Callide Mine EMOS 2004) has a specific section on post mining water management with respect to residual (final) voids. Information relevant to residual voids has been reproduced/summarised below.

Upon cessation of mining operations, pit dewatering would cease and any remaining mining voids would fill to some extent with water. The number and size of the residual voids will be kept to a minimum by strategic backfilling during the final years of mining at that location.

CALLIDE MINE

REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

During the period of revegetation and stabilisation of the final landform, sedimentation dams will control the suspended sediment in catchment runoff prior to discharge from the lease area. The dams will not be required once the drainage structures and rehabilitation works have been established. These storages will become an integral part of the landscape once mining activities have ceased. They will provide a good quality water supply for native fauna in the area.

3.1. Southern Pits

At Dunn Creek, two (2) final voids will remain at the completion of mining (i.e. one void in the A & S Cut and The Bluff and one in B & D Cuts).

Upon cessation of mining operations, the remaining undisturbed section of the catchment at the head of Dunn Creek would be directed into one of the mining voids. Modelling results confirm that the final voids will not overtop and salinity levels in the ponded water will continually increase since no salts are lost through spill. In the short term, water held in final voids will be suitable for drinking by native animals. The water bodies will provide suitable habitat for local and migratory water birds in both the short and long term. Final void water balance modelling was undertaken by Water Solutions in 2003 (Water Solutions 2003). Overflows from the two Dunn Creek final voids were not expected to occur during the 50 years modelled post-closure and salinity levels over this period were expected to rise to around 1,500ppm.

The major water storages at Dunn Creek (i.e. Dunn Creek Dam, Dunn Creek East Dam, Magazine Dam and Lake McCauley) are expected to remain following cessation of mining, subject to waterworks licensing/referable dam requirements. The sedimentation dams are also expected to remain. It is expected that all storages will provide wetland habitat and a good quality water resource for native wildlife.

At The Bluff, there will not be any significant long-term effect on water quality in Callide Dam due to the extension of Callide Mine into The Bluff Mining Area (Blain Johnson 1991 and Water Studies 1992). Following the completion of mining, the sedimentation dams will be retained for the use of subsequent landholders. Water quality in these dams will be suitable for stock water supply and native fauna.

A single final void will remain in the Trap Gully Mining Area upon cessation of the mining operations in the current mine plan. Modelling indicates that with the diversion of catchment runoff away from the highwall, the void will not overtop. The salinity of the water that collects in the void will gradually increase to around 600ppm over the 50 year period modelled post-closure (Water Solutions 2003) since there will be no overflow and given the high level of evaporation. Water in the final void will be suitable for consumption by native fauna in the short term, and will provide habitat for local and migratory water birds in the long term. It is expected that water will flow into the final void rather than out into the aquifer(s) exposed on the high wall of the final void, since this will be the direction of least resistance to flow. A phreatic line will be established with the unconsolidated low wall sediments. No significant interaction with groundwater resources in the area is expected.

Sedimentation dams will remain on the western and southern boundaries of Mining Lease 5653 (Trap Gully Sediment Dam and Goldings Dam, respectively) at the cessation of mining. These dams will provide a good quality water supply for fauna in the area.

CALLIDE MINE

REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

At The Hut Mining Area, no final void will remain in the Northern Valley, as the mining corridor, including the final void, has been incorporated into the long-term diversion alignment for Oaky Creek. Final voids will remain at the Central Valley (contiguous with the Southern Roadside) and the Eastern Hillside. Modelling indicated that no overflows from these voids would occur over the 50-year period modelled post-closure (Water Solutions 2003). Salinity levels in these voids increase over the time period modelled to between 1,500ppm and 7,000ppm depending on the void modelled.

At this stage, it is expected that The Hut Turkey's Nest Dam would remain following cessation of mining, subject to waterworks licensing/referable dam requirements. The voids and Turkey's Nest Dam would provide water sources and habitat for native fauna.

3.2. Boundary Hill

Two final voids will remain at the completion of mining at Boundary Hill – the mining pit and Block 8 Dam (an internal water storage within the spoil). In the short term, water held in both these final voids will be suitable for drinking by native animals. The water bodies will provide suitable habitat for local and migratory water birds in both the short and long term.

The main mine void will have a capacity of approximately 17,000 ML and a maximum depth of 120 metres. It is proposed that most catchment flows will be directed away from the void to natural drainage lines. This will allow runoff from the undisturbed land east of the void to flow to Gate Creek and Bell Creek. The water body will provide long-term habitat for local and migratory water birds.

A second void is planned within the spoil in part of Boundary Hill Mining Area that is known as Block 8. This void currently exists and is currently utilised as an internal mine water storage and has a storage volume of approximately 500 ML. Water in Block 8 is used preferentially for road watering at Boundary Hill Mine. The void is not considered to be a referable dam under the *Water Act 2000* (previously the *Water Resources Act (1989)* (PPK Environment & Infrastructure, 1997).

Modelling indicated that the water level in the final mining void would stabilise after about 25 years following cessation of mining and would not overflow to the regional drainage system in the long term (Water Solutions 2003). This is due to evaporation and seepage losses. The Block 8 void would not overflow due to the limited catchment area (all rehabilitated at the time of mine closure) reporting to it.

In the short term, water held in the voids will be suitable for drinking by native fauna and introduced animals. The salinity of stored water will continually increase over time due to runoff transporting salts into the void and no loss of salts through overflow. The rate of deterioration is not known, but computer modelling indicates that salinity will increase by around 30 ppm each year once the void lake volume reaches equilibrium between inflows and outflows. Salinity levels would increase to around 2,500ppm over the 50-year period modelled post-closure.

All the sedimentation dams, along with Lake Gasteen (subject to waterworks licensing/referable dam requirements), will remain in place at cessation of mining to control suspended sediment in runoff from disturbed areas under rehabilitation prior to discharge from the Mining Leases. However, once drainage structures and rehabilitation works have been established, these dams will not be needed for sediment collection in the long-term. These dams will become an integral part of the post mining landscape and will provide a good quality water supply for native fauna or grazing animals.

CALLIDE MINE
REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

4. CONTROL MEASURES PROPOSED FOR THE TREATMENT OF RESIDUAL VOIDS

Control measures outline in Section 5 of the Callide Mine EM Plan with respect to the treatment of residual voids is outlined below.

Final voids, including some or all of the ramps, will remain as part of the final landforms at each Mining Area. Final voids will be constructed with highwalls at 75° and low walls at angle of repose, except that they will be lowered to 27° where they are to be submerged either by backfilling against the toe or dozing the low wall slope down to this angle. Ramp spoil slopes will be managed in the same manner as per low walls. All exposed coal seams will be covered with inert material wherever possible.

With the exception of the partially backfilled void, which will remain in the northern valley of The Hut Mining Area as the downstream lake component of the long-term Oaky Creek Diversion, final voids in all mining areas will not overflow to the regional drainage system. The quality of water impounded in the voids will initially be suitable for consumption by stock, but will deteriorate as the concentration of salts increases through evaporation. Water that collects in the final void will provide a suitable habitat for local and migratory water birds in both the short and long term.

The low wall crest will be reshaped to direct runoff away from the low wall to prevent/minimise significant long-term erosion of the low wall slopes. The extent of low wall erosion will be monitored to ensure that the integrity of adjacent rehabilitated areas is not affected.

Safety bunds will also be constructed along the top of the highwalls and the crest of prestrip benches. The prestrip benches will be shaped to shed runoff over the highwall at several locations to limit erosion.

Post closure final void water balance modelling was undertaken by Water Solutions Pty Ltd in 2003 (Water Solutions 2003). Six (6) final voids were identified at the Southern Pits – One (1) at Trap Gully, two (2) at Dunn Creek and three (3) at The Hut. Modelling indicated that no outflows from any of these voids are expected. Given that no outflows are expected, evaporation effects are likely to increase the salt concentrations in the voids over time. Given the volumes of water likely to accumulate in the voids, stratification of these water bodies is likely to occur at least on a seasonal basis.

5. PROPOSED ACCEPTANCE CRITERIA

The following checklist is proposed as acceptable criteria for residual voids:

- Computer modelling undertaken at time of closure indicates that the residual void will not spill to the environment in the long term (i.e. modelled for 50 years)
- Residual void highwalls will be inspected by a suitably qualified geo-technical engineer to determine geotechnical stability at 75° at mine closure. If determined as stable, the highwalls will be left as is. If not deemed stable then alternative treatments will be undertaken to ensure geotechnical stability as determined by the geo-technical engineer.
- Residual void low walls, where they will be submerged will have backfill placed against them or dozed down to create a low wall angle of 27° or less. The required low wall treatment will be specified by a suitably qualified geo-technical engineer.
- Ramps will be treated in a similar manner as for low walls.
- The low wall crest will drain away from the void.
- Where appropriate and practical, diversion drain will be constructed on the crest of the highwall to divert catchment runoff away from the void.

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REPORT ON ACCEPTANCE CRITERIA FOR RESIDUAL VOIDS

- A safety bund will be constructed along the highwall crest to prevent vehicular access.
- All highwall benches where sufficient width for safe access exists, will be topsoiled and shaped such that all drainage is directed off the bench onto natural surface or directed over the high wall face at a number of designated locations.

6. REFERENCES

Callide Mine EMOS (2004). Callide Mine Environmental Management Overview Strategy. Prepared by Anglo Coal (Callide Management) Pty Ltd, dated August 2004.

Water Solutions Pty Ltd (2003). Final Void Water Modelling – Initial Investigations. Unpublished report for Anglo Coal (Callide Management) Pty Ltd dated 5th November 2003.

Appendix D

Groundwater Report



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REPORT ON

CALLIDE MINE

PROGRESSIVE REHABILITATION

AND CLOSURE PLAN

GROUNDWATER REPORT

For: Batchfire Callide Management Pty Ltd

Project number: 4112

Date: 27/04/2023

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Appendix C	Groundwater permeability data used in the groundwater modelling
Appendix D	Groundwater quality data analysis

Callide Mine – Progressive Rehabilitation and Closure Plan Groundwater Report

Prepared for

Batchfire Callide Management Pty Ltd

1. Introduction

Callide Mine is an open cut coal mine located approximately 20 km north of Biloela in Central Queensland. Callide Mine comprises four discrete mining areas, namely the Boundary Hill, Dunn Creek, Trap Gully and The Hut mining areas (Figure 1).

Batchfire Callide Management Pty Ltd (Batchfire) operates Callide Mine in accordance with Callide Mine Environmental Authority (EA) EPML00720413 (effective as of 2 March 2023). Section 754 of the *Environmental Protection Act 1994 (Qld)* (EP Act) requires holders of an existing EA to develop a Progressive Rehabilitation and Closure Plan (PRCP).

hydrogeologist.com.au has been commissioned by Batchfire to undertake a groundwater assessment for the Callide Mine PRCP.

1.1. Scope of work

The Department of Environment and Science (DES) guideline Progressive Rehabilitation and Closure Plans ESR/2019/4964 (the PRCP Guideline) describes the groundwater information that must be provided in a PRCP. Broadly, this includes the following:

- Section 3.1 of the PRCP Guideline requires that information on geology, groundwater levels and properties is provided.
- Section 3.6.1 of the PRCP Guideline requires that hydrogeology information and a conceptual groundwater model is provided.
- Section 3.6.3 of the PRCP Guideline requires that the PRCP include an assessment of the groundwater effects of final voids.

In order to address these requirements, Batchfire has leveraged the existing groundwater information for Callide Mine. Callide Mine has been operating since 1944 and the local groundwater regime is well understood from numerous groundwater investigations and site observations, long-term groundwater monitoring and numerical modelling. The key information sources are as follows:

- In June 2012, the previous mine owner (Anglo American) submitted an EA amendment application to enable mining activities on the Boundary Hill South (BHS) Mining Lease (ML). The EA amendment application was supported by the BHS Environmental Impact Statement (EIS). A technical groundwater study was undertaken by Australian Groundwater and Environmental (AGE) Consultants as part of the BHS EIS. The BHS EIS groundwater study involved a desktop study to obtain background geology and groundwater information, extensive groundwater site investigations, data analysis and development of a conceptual groundwater model and 3D numerical modelling of the local groundwater regime and mining effects on groundwater levels.
- In 2017, Batchfire engaged (AGE) Consultants to update the BHS EIS conceptual and numerical groundwater models to include the full extent of Callide Mine and its approved mining activities.

On this basis, the following scope of work was undertaken to address the PRCP groundwater requirements:

- a review of Batchfire's current (2017) conceptual and numerical groundwater models for Callide Mine to confirm whether they provide a suitable basis for the PRCP groundwater assessment;
- refining the existing conceptual model of the groundwater regime of Callide Mine and its surrounds, as necessary;
- updating the existing Callide Mine numerical flow model to include the predicted final void lake levels prepared as part of the PRCP Final Void Water Balance Report in order to simulate the post closure groundwater conditions; and
- assessing the predicted post-closure groundwater conditions and determining whether the final voids will form groundwater sources or sinks.

1.2. Report structure

This report is structured as follows:

- Section 1 - provides background to the PRCP groundwater assessment, describes the scope of work and outlines the report structure.
- Section 2 - provides an overview of the approved mining operations.
- Section 3 - describes the geology and the existing groundwater regime at Callide Mine and the surrounding area.
- Section 4 - describes the final landform and the final void assessment methodology (including the numerical groundwater modelling approach).
- Section 5 - presents the post-closure groundwater modelling results and key conclusions of the groundwater assessment.
- Sections 6 to 8- comprising references, abbreviations, and a glossary.

Appendix A provides a summary of the groundwater bores used to develop the numerical groundwater model.

Appendix B provides the groundwater level data used to develop the numerical groundwater model.

Appendix C provides the groundwater permeability data used to develop the numerical groundwater model.

Appendix D provides summary statistics of the groundwater quality data.

2. Mine overview

Callide Mine comprises four discrete mining areas as shown in Figure 1 and summarised as follows:

- Dunn Creek mining area:
 - Mining commenced at Dunn Creek mining area in 1944.
 - Coal is currently mined in Dunn Creek Pit (the western pit) and The Bluff Pit (the eastern pit). Mining operations involve a dragline and truck and shovel pre-stripping.
 - The primary infrastructure area for Callide Mine is located at the Dunn Creek mining area and includes a Coal Handling Plant (CHP), coal stockpiles, conveyor and train loading facilities, administration buildings and offices, and workshops and maintenance facilities. Run-of-mine (ROM) coal is hauled to the Dunn Creek CHP. Once crushed in the CHP, coal is either conveyed to the nearby Callide Power Station or loaded onto trains and transported to Gladstone.
- Trap Gully mining area:
 - Mining commenced at Trap Gully mining area in 1981.
 - Coal is mined in a single open cut pit using a dragline and truck and shovel fleet. ROM coal from Trap Gully is hauled to the Dunn Creek CHP for crushing and transport from site.
 - Mining is expected to continue in the Trap Gully mining area until 2047.
- Boundary Hill mining area:
 - Mining commenced at Boundary Hill mining area in 1983.
 - Coal is currently mined in Boundary Hill South (BHS) Pit and the Campbell's Creek Pit using a dragline and truck and shovel fleet. ROM coal is hauled from the pits to an in-pit CHP (also called 'the Stamler') for crushing. Crushed coal is then conveyed to the Boundary Hill train load out facility and transported to Gladstone. A mine infrastructure area (MIA) is located at Boundary Hill including a crib room, administration building and workshops.
 - Open cut mining in the Boundary Hill Pit (also known as 'North South 32 Pit') and the Boundary Hill East Pit has been completed.
 - Mining is expected to continue in the Boundary Hill mining area until 2041.
- The Hut mining area:
 - Mining commenced at The Hut mining area in 1990.
 - Open cut mining in the Central Valley North (CVN), Central Valley South (CVS) and Eastern Hillside open cut pits has been completed.

3. Mine setting

3.1. Topography and drainage

The local topography transitions from the elevated rocky plateaus of the Callide Range in the north-east, to the flatter, low-lying terrain of the Callide Creek floodplain in the south-west. Several plateaus and associated ridgelines extend into the eastern portion of the mine site. These elevated landforms are formed on areas of outcropping basement rock and are abutted by Callide Basin sedimentary strata.

Callide Mine is traversed by several creeks (Figure 2). The creeks exhibit highly ephemeral, short duration, surface water flows that are typically restricted to periods during and immediately following rainfall events during the wet season (i.e., October to March).

3.2. Geology

Callide Mine and its surrounds have a long history of geological exploration and mining. Exploration activities commenced in the 1890s and mining has continued since 1944 until the present day. On this basis, the geology of the mine site and its surrounds is well understood.

Callide Mine and its surrounds overlie an extensive volcanoclastic basement. During the late Triassic period, tectonic activity extensively faulted the basement rock along a northwest-southeast axis. Locally, this faulting created a sunken half-graben structure which was subsequently filled by sediment, forming a sedimentary geological basin (i.e., the Callide Basin).

The Callide Basin is an isolated sedimentary basin that is localised within the graben structure and bounded on all sides by basement rocks (Figure 3). The Callide Basin comprises the Callide Coal Measures and the overlying Precipice Sandstone formations. These formations are undeformed basin-fill strata and do not exhibit any major faulting or folding. The Callide Basin is up to 200 m thick in the centre and thins towards the basin edges.

During the early Tertiary period, the Callide Basin was blanketed by sedimentary deposits of the Biloela Formation and volcanism resulted in localised basalt caps in elevated areas (Figure 3).

The exposed surface of the sedimentary formations and basalt were subsequently modified by extended periods of erosion, weathering and mineralisation which resulted in the development of a deep weathered profile (up to approximately 100 m thick) and localised surface duricrust and thin residual sheetwash and creek deposits (Figure 3).

The stratigraphy at Callide Mine is comprised of (from youngest to oldest):

- Recent residual surface sediments;
- Tertiary basalt;
- Biloela Formation;
- Precipice Sandstone;
- Callide Coal Measures, including the target coal seams; and
- the underlying basement rocks.

The residual surface sediments comprise poorly consolidated, clay-bound sands, silts and gravels. The residual surface sediments are generally localised and present as discrete, thin discontinuous lenses associated with drainage features. The residual surface sediments are located at the ground surface. The residual surface sediments are up to approximately 5 m thick beneath the drainage features and are absent away from the drainage features. The residual surface sediments are geologically distinct from the developed Callide Creek alluvium which forms the Callide Creek floodplain approximately 5 km to 10 km southwest of the mine site. The floodplain alluvium occupies a broad low-lying valley and typically ranges from a few centimetres at the edge of the floodplain up to approximately 20 m on the banks of Callide Creek.

The Tertiary basalt comprises olivine basalt flows. It is localised within elevated areas in the south and east of the Callide Mine. The Tertiary basalt is typically located at the ground surface and, where present, is up to approximately 100 m thick. The Tertiary basalt is up to 80 m thick in the open cut mining areas.

The Biloela Formation is comprised of mudstone, siltstone, oil shale, carbonaceous mudstone and sandstone, minor lignite, coal and limestone. The Biloela Formation is typically located at the ground surface, except where it is overlain by Tertiary basalt or the residual surface sediments. The Biloela Formation ranges in thickness up to 50 m within Callide Mine and thickens to the south-west of Callide Mine to greater than 100 m thickness. The Biloela Formation is up to 30 m thick in the open cut mining areas.

The Precipice Sandstone is comprised of sandstone, siltstone, carbonaceous shale, and conglomerate. The Precipice Sandstone outcrops at the ground surface across the majority of the Callide Basin. It is overlain by the Biloela Formation and Tertiary basalt in the western and eastern parts of the basin. The Precipice Sandstone is generally between 10 m to 70 m thick in the mining areas, with a maximum thickness of 150 m in the centre and northeast of the Callide Basin. The Precipice Sandstone is restricted to the extent of the Callide Basin and thins and 'pinches out' at the margins of the Callide Basin.

The Callide Coal Measures are comprised of conglomerate, sandstone, siltstone, coal and felsic tuff, and include the target coal seams mined at Callide Mine. The Callide Coal Measures unconformably underlie the Precipice Sandstone. The extent of the Callide Coal Measures is restricted to the extent of the Callide Basin. Localised outcrop of the Callide Coal Measures occurs where the Precipice Sandstone is absent along the Callide Range at the eastern margin of the Callide Basin. The target coal seams of the Callide Coal Measures are typically approximately 3 m thick and are found between 20 m to 200 m below surface. There is typically 5 m to 10 m of interburden (sandstone, mudstone and shale) between each target coal seam.

The basement rocks are comprised of a complex sequence of volcanics (basalt, andesite, breccia, tuff, agglomerate, ignimbrite) and interbedded sedimentary rocks (conglomerate, sandstone, siltstone). The basement rocks are regionally extensive. The basement rocks unconformably underlie the Callide Basin, and outcrop to the southeast of the Callide Basin and at the elevated eastern margin of the Callide Basin.

3.3. Hydrogeology

Section 3.3.1 provides an overview of all key aspects of the conceptual groundwater regime. Sections 3.3.2 to 3.3.5 provide additional detail on the hydrogeological properties of each key aquifer and aquitard. Appendices A to C present the available hydrogeological data.

3.3.1. Overview

The local groundwater regime at Callide Mine and its surrounds is illustrated in Figure 4 and includes the following hydro-stratigraphic units:

- Dry and unsaturated residual surface sediments and basalt that do not contribute significantly to the groundwater regime.
- The Biloela Formation aquitard that acts as a confining layer and restricts recharge to the underlying aquifer.
- A productive aquifer that includes the Precipice Sandstone and the uppermost sandstone deposit of the Callide Coal Measures. This is the main groundwater-bearing formation in the Callide Basin.
- Underlying aquitards including the remainder of the Callide Coal Measures and the underlying basement aquitard. The Callide Coal Measures includes water-bearing coal seams that yield limited volumes of groundwater and are not considered productive aquifers.

Widespread, diffuse rainfall recharge occurs over the Callide Basin. Seasonal runoff concentrates on the upper surfaces of the elevated landforms and along drainage lines, enhancing infiltration in these areas. A portion of the surface water infiltration moves through the unsaturated rock profile to recharge the underlying regional groundwater table in the Precipice Sandstone and Callide Coal Measures. Recharge is impeded by the overlying Biloela Formation aquitard where present.

Groundwater flow within the Callide Basin is from the elevated groundwater recharge areas in the east, towards the lower lying areas in the west and south-west.

The groundwater table is hosted within the Precipice Sandstone and in the Callide Coal Measures (where the Precipice Sandstone is not present). Within the western portion of the Callide Basin, the groundwater table can be hosted within the Biloela Formation where present.

The groundwater table is generally deeper in areas of elevated terrain and is shallower beneath drainage features. In the elevated areas at the eastern margin of the basin, the groundwater table is typically located in the Callide Coal Measures at depths of approximately 5 m and up to approximately 100 m below ground level. In the lower lying areas in the south-west of the basin, the groundwater table is typically located in the Precipice Sandstone between approximately 10 m to 60 m below ground level. In general, the Callide Coal Measures are saturated, whilst the Precipice Sandstone is partially saturated.

However, groundwater levels (and flow directions) in the Callide Basin have been extensively modified by approved mining activities. Open cut mining has intersected the groundwater table and pit dewatering has locally depressurised the surrounding aquifers and aquitards. This has created zones of groundwater drawdown surrounding the four mining areas. These effects will continue as part of the approved future mining activities.

The main groundwater discharge mechanism is active dewatering and evaporation from the open cut pits. Groundwater discharge also occurs regionally through evapotranspiration from woodland vegetation, where present.

Groundwater level data indicate that the groundwater table is typically located several metres below the bed of creeks within the vicinity of the mining areas. The separating depth between the creek beds and the groundwater table means that there is no direct interconnection between the groundwater table and surface waters in these areas. Groundwater does not provide baseflow to surface waters within the vicinity of Callide Mine.

Groundwater quality in the Precipice Sandstone and Callide Coal Measures is typically pH neutral and non-saline to brackish, with low concentrations of metals, metalloids, and other solutes. Groundwater in the basement rock and Biloela Formation is distinctly more saline, with maximum EC levels of approximately 40,000 $\mu\text{S}/\text{cm}$.

There are several groundwater supply bores located on four neighbouring properties. Batchfire has a Make Good Agreement (MGA) in place with the owners of all four properties. The MGAs include the requirement for Batchfire to monitor the groundwater level in the landholder's bore(s). In the event that the bores are adversely impacted as a result of the mining activities, the MGAs require Batchfire to make good with an equivalent alternative water supply. To date, the bores have not been adversely impacted.

3.3.2. Biloela Formation

The Biloela Formation is an aquitard that acts as a confining unit for the underlying Precipice Sandstone and Callide Coal Measures. Overall, it exhibits a low porosity that restricts groundwater storage and movement and inhibits infiltration of rainfall and drainage into the underlying formations. There is limited lateral or vertical groundwater movement within the Biloela Formation. Groundwater discharge mainly occurs via seepage to the open cut mining areas and the underlying Precipice Sandstone. On the western margin of the Callide Basin, the Biloela Formation receives recharge from the underlying Callide Coal Measures.

3.3.3. Precipice Sandstone

The Precipice Sandstone hosts the regional groundwater table (except where absent) and is partially saturated where present within Callide Mine. Within the vicinity of the mining areas, the Precipice Sandstone has been desaturated by dewatering and depressurisation, resulting in a lowering of the groundwater table in these areas to below the Precipice Sandstone.

The Precipice Sandstone is recharged by widespread, diffuse rainfall where it outcrops at the surface and via ephemeral surface water flows in the drainage features and creeks. Groundwater flows laterally and discharges via seepage to open cut mining areas and the underlying Callide Coal Measures.

Groundwater flow in the Precipice Sandstone is from east to west, with a south-westerly flow component along the western margin of Callide Basin.

The Precipice Sandstone is a moderate to high permeability formation and aquifer. Permeability within the Precipice Sandstone is higher within coarse-grained sandstone sequences and lower in fine-grained sequences. The hydraulic conductivity of the Precipice Sandstone varies from 5.2×10^{-3} m/day to 2.81 m/day.

Groundwater quality within the Precipice Sandstone ranges from acidic to neutral, with pH ranging from 4.4 to 7.4. Groundwater is generally fresh to slightly saline, with EC ranging from 354 $\mu\text{S}/\text{cm}$ to 7,260 $\mu\text{S}/\text{cm}$.

3.3.4. Callide Coal Measures

Where the Precipice Sandstone is absent, or has been desaturated due to dewatering and depressurisation, the Callide Coal Measures hosts the regional groundwater table. Within the vicinity of the mining areas, the Callide Coal Measures have been desaturated by dewatering and depressurisation. Elsewhere, the Callide Coal Measures are saturated.

The Callide Coal Measures are recharged by widespread, diffuse rainfall where it outcrops at the surface and via ephemeral surface water flows in the drainage features and creeks. Limited recharge of the Callide Coal Measures occurs from downward leakage from the overlying Precipice Sandstone.

Groundwater flow in the Callide Coal Measures is from east to west, with a south-westerly flow component along the western margin of Callide Basin. Groundwater flows laterally within the Callide Coal Measures and discharges via seepage to open cut mining areas. Elsewhere, limited groundwater discharge occurs via vertical seepage to the underlying volcanic basement and/or lateral seepage to the west into the Biloela Formation.

The Callide Coal Measures are a low to moderate permeability formation. The upper coarse-grained sandstone sequence is a moderate permeability aquifer. The overburden and interburden have lower permeability and act as aquitards. The coal seams act as low permeability aquifers, with permeability associated with fractures and cleats in the coal seams.

The hydraulic conductivity of the upper coarse-grained sandstone sequence ranges from 1.6×10^{-3} m/day to 3.3×10^{-1} m/day. The hydraulic conductivity of the overburden and interburden ranges from 4.0×10^{-4} m/day to 1.4×10^{-2} m/day. The hydraulic conductivity of the target coal seams ranges from 3.5×10^{-3} m/day to 7.8×10^{-1} m/day.

Groundwater quality within the Callide Coal Measures ranges from acidic to alkaline, with pH ranging from 5.9 to 8.5. Groundwater is generally fresh to brackish, with EC ranging from 342 $\mu\text{S}/\text{cm}$ to 4,900 $\mu\text{S}/\text{cm}$.

3.3.5. Basement rocks

The basement rocks are characteristically hard, with essentially no primary porosity. Groundwater occurrence is limited to joints and fractures where these occur and therefore, hydraulic conductivity is typically low. As such, the basement rocks are a regional hydrogeological basement.

The basement rocks are recharged by diffuse rainfall where they outcrop at the margins of the Callide Basin to east, north and south of the Callide Basin. The basement rocks are also recharged by the overlying Callide Coal Measures in the eastern portion of the Callide Basin.

Regionally, groundwater flows from the Callide Range in the east towards the lower lying landscapes along the Callide Creek floodplain in the west. Rates of recharge are very low and therefore discharge volumes are also consequently low. Discharge likely occurs into overlying units, mainly the Biloela Formation, to the west of the Callide Basin.

Groundwater quality in the basement rocks is slightly acidic to circum-neutral, with pH ranging from 6.2 to 7.4. Groundwater is brackish to highly saline, with EC values observed in excess of 40,000 $\mu\text{S}/\text{cm}$.

4. Mine closure overview and assessment methodology

Figure 5 to Figure 8 show the conceptual final landform for each of mining area.

The final landform will contain the following open cut pit voids:

- Boundary Hill East Pit void (BH1 void) with a base elevation of approximately 230 mAHD.
- Boundary Hill Pit void (BH2, 4 and 5 voids) with a base elevation ranging from approximately 169 mAHD to 200 mAHD.
- Boundary Hill South Pit void (BH3 void) with a base elevation of approximately 80 mAHD.
- the Dunn Creek Pit void (DC1 and DC2 voids) with a base elevation of approximately 209 mAHD.
- the Trap Gully Pit void (TG1 void) with a base elevation of approximately 153 mAHD.
- the CVN Pit void (TH1 void) with a base elevation of approximately 283 mAHD
- the CVS Pit void (TH3 void) with a base elevation of approximately 320 mAHD.
- the Eastern Hillside Pit void (TH2) with a base elevation of approximately 361 mAHD.

Final void water balance modelling was undertaken as part of the PRCP Final Void Water Balance Report. It is predicted that permanent pit lakes will form in all the final voids at Callide Mine. Table 1 summarises the predicted pit lake elevations.

Table 1 Summary of predicted pit lake elevations

Final void	Predicted pit lake elevation
Boundary Hill East Pit void (BH1 void)	233.6 mAHD
Boundary Hill Pit void (BH2, 4 and 5 voids).	192 mAHD
Boundary Hill South Pit void (BH3 void)	162.7 mAHD
Trap Gully Pit void (TG1 void)	210.8 mAHD
Dunn Creek Pit void (DC1 and DC2 voids)	287 mAHD
CVN Pit void (TH1 void)	286.8 mAHD
CVS Pit void (TH3 void)	334.5 mAHD
Eastern Hillside Pit void (TH2)	367.9 mAHD

In summary, it is predicted that permanent void lakes will form in all final voids. Evaporation from the lake surfaces will concentrate salts in the lakes slowly over time. Lake salinity (as electrical conductivity, [EC]) will typically range from 2,300 $\mu\text{S}/\text{cm}$ to 11,000 $\mu\text{S}/\text{cm}$. However, the void lakes that will form in BH1, TH1 and TH2 are relatively variable and shallow water bodies less than 10 m in depth. These shallow void lakes will be subject to greater variability in water level and will experience significant evaporative drawdown and evapo-concentration. This will result in high EC levels that reach the theoretical limit of salt saturation.

Conceptually, the final void lakes can be:

- A 'groundwater source'. This occurs if the void lake elevation stabilises above the surrounding groundwater levels. Under these conditions, void lake water may be able to move into the surrounding groundwater regime and away from the void lake.
- A 'groundwater sink'. This occurs if the void lake elevation stabilises below the surrounding groundwater levels. Under these conditions, groundwater and any associated solutes will flow towards the void lake.
- A combination of groundwater source and sink. This can occur under conditions when final voids may be located in an area with a steeply-sloping groundwater table. Under these conditions, the upgradient end of the void lake may be below the groundwater table (i.e., forming a groundwater sink) while the downgradient end of the void lake may be above the groundwater table (i.e., forming a groundwater source). Conceptually, groundwater would seep into the upgradient end of the final void lake and void lake water will seep out of the downgradient end of the final void to the surrounding groundwater regime. This scenario is illustrated in Figure 9.

In order to assess the potential for the groundwater sources and sinks following mine closure, the existing 3D numerical groundwater flow model of Callide Mine was updated for the PRCP groundwater assessment.

The numerical groundwater model uses MODFLOW-USG to represent the conceptual hydrogeological model and hydrogeological regime discussed in Section 3.3. The Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012) were considered throughout the modelling process.

The numerical model includes 13 layers representing the key geological units using and extends approximately 23 km east-west and 16 km north-south. The model domain includes the four mining areas at Callide Mine and the surrounding areas.

The physical structure of the groundwater model was based on the detailed geological model developed by Batchfire. Model development was supplemented by published geological maps, bore logs and data from the Queensland Groundwater Database.

The groundwater flow model was calibrated to groundwater levels from the Callide Mine groundwater monitoring network. The calibration achieved a scaled root mean squared (SRMS) error within acceptable limits (i.e., 10%) as recommended by Barnett *et al.* (2012). Furthermore, the calibrated groundwater levels, vertical gradients, flow patterns and mine inflows are comparable to measured data and groundwater trends. The model calibration is therefore considered robust. The calibration hydrographs for the numerical model are presented in Appendix B.

The model was refined to reflect the current mine schedule for the approved life-of-mine operations in order to best represent groundwater conditions at closure. A post-closure scenario was then modelled to predict the behaviour of the groundwater levels in response to the development of final void lakes (as discussed in Section 5). The void lake elevations were simulated using general head boundaries, with the post-closure predictions occurring over a nominal 500 year modelling timeframe.

The numerical modelling approach is consistent with the Office of the Queensland Mine Rehabilitation Commissioner's recent technical guidance paper *Approaches for leading practice modelling of residual mine voids for rehabilitation planning*, which outlines the leading practice methodology for modelling of residual mine voids.

5. Groundwater modelling results and key conclusions

Figure 10 shows the predicted post closure groundwater elevations across Callide Mine and its surrounds. Figure 11 to Figure 19 show cross sections of the predicted post closure voids and their interaction with the groundwater regime.

The model predictions show that:

- Trap Gully Pit and Boundary Hill South Pit voids will function as groundwater sinks.
- There are no uniformly elevated voids that could function as pure groundwater sources.
- The Boundary Hill East Pit, Eastern Hillside Pit, CVN Pit, CVS Pit, Dunn Creek Pit and Boundary Hill North Pit voids may function as a combination of groundwater source and sink (per the scenario described in Section 4 and shown in Figure 9).

The modelling predictions that some final void lakes may form groundwater sources are unexpected and contrary to the previous final void groundwater assessments undertaken at Callide Mine, which have concluded that all final voids would function as groundwater sinks following mine closure.

The current Callide Mine groundwater model is known to have significant data gaps, including a lack of groundwater monitoring data and geological information at key locations around the final voids. These data gaps are likely to have a significant bearing on the predicted groundwater elevations and, by extension, the functioning of the final voids as groundwater sources and/or sinks.

In order to improve the accuracy of the Callide Mine groundwater model and confirm the validity of the current post mining predictions, Batchfire has commenced an extensive PRCP groundwater field investigation program. The PRCP groundwater field investigation includes:

- drilling and constructing total of 12 groundwater monitoring bores and vibrating wire piezometer arrays that target key areas in and around the final voids; and
- undertaking detailed surveys of the existing final voids and the associated geology.

This PRCP groundwater field investigation will form part of the broader groundwater field investigation program and groundwater model upgrade that are currently being undertaken in consultation with DES to address a range of approvals and operational compliance issues. Data collected from the PRCP groundwater field investigation program will improve the accuracy of the groundwater characterisation (particularly groundwater levels) and geological information (particularly final void geometry and coal seam levels) in the vicinity of the final void lakes that are predicted to seep to groundwater. It will be used to update the existing PRCP groundwater model and reassess the likelihood of seepage to groundwater from the final void lakes.

If the field investigation and upgraded groundwater model results indicate that seepage from any final void lakes to groundwater is likely, Batchfire will conduct further work as part of the PRCP approval process to assess the potential groundwater quality effects and consider feasible mitigation and/or management measures.

Feasible measures that may be considered include dewatering of final void water for beneficial reuse. Dewatering the final void would enable Batchfire to maintain the void lake surface at a lower elevation than the surrounding groundwater table, thereby establishing a groundwater sink in the dewatered final voids. The beneficial reuse of pit/void water is a well-established site water management practice at Callide Mine and is specifically authorised by the Callide Mine EA. Batchfire holds numerous existing beneficial reuse agreements with neighbouring land owners.

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7. Abbreviations

BHS:	Boundary Hill South
CHP:	coal handling plant
CVN:	Central Valley North
CVS:	Central Valley South
DES:	Department of Environment and Science
EA:	Environmental Authority
EC:	Electrical Conductivity
EIS:	Environmental Impact Statement
EP Act:	<i>Environmental Protection Act 1994</i>
mAHD:	metres (above) Australian Height Datum
MGA:	Make Good Agreement
MIA:	mine infrastructure area
ML:	mining lease
PRCP:	Progressive Rehabilitation and Closure Plan
ROM:	run-of-mine
SRMS:	scaled root mean squared error
VWP:	vibrating wire piezometer

8. Glossary

Alluvium: Unconsolidated sediments (gravel/sand/silt/clay) transported by water (i.e., deposits within a stream channel or floodplain).

Aquifer: Permeable earth material such as porous sediments or fractured hard rock, saturated with groundwater. The permeability should be such that it is capable of conducting and yielding usable quantities of groundwater to a borehole(s) and / or springs. An aquifer is 'a geological formation which has structures or textures that hold water or permit appreciable water movement through them'.

Aquitard: A confining bed that retards but does not completely stop the flow of water to or from an adjacent aquifer. Although it does not readily release water to boreholes or springs, it may function as a storage chamber for groundwater.

Calibration: The process by which independent variables (e.g., hydraulic conductivity) within a model are varied in order to match a dependent variable (e.g., measured groundwater level within a monitoring bore).

Confined aquifer: An aquifer which is overlain by a confining layer of low permeability. The groundwater is confined under pressure greater than atmospheric pressure such that if the aquifer is penetrated the water level may rise above the top of the aquifer.

Confining layer/unit: Geologic material with little permeability or hydraulic conductivity.

Dewatering: The process of removing water from an underground mine or open cut pit, or from the surrounding rock or non-lithified materials.

Drawdown: Lowering of the water table within an unconfined aquifer, or the potentiometric surface within a confined aquifer caused by an induced stress on the groundwater system (e.g., pumping).

Final void: an area of mine excavation that remains after mining is complete.

Geology: The study of the earth, its history and the changes that have occurred or are occurring and the rocks and non-lithified materials of which it is composed and their mode of formation and transformation.

Groundwater: The water in the saturated zone below the water table.

Hydraulic conductivity: Describes the ease with which water can move through pore spaces or fractures. It depends on the intrinsic permeability of the material and on the degree of saturation. Saturated hydraulic conductivity, K_{sat} , describes water movement through saturated media.

Hydraulic gradient: The change in hydraulic head or water level over a distance.

Hydraulic head: The height above a datum (such as sea level) of the column of water that can be supported by the hydraulic pressure at a given point in a groundwater system.

Lithology: The systematic description of sediment and rocks, in terms of composition, texture and internal structure.

Model: A formalised expression of a theory, event, object, process, or system used for prediction or control; an experimental design based on a casual situation that generates observed data. A model can be viewed as a selective approximation which by the elimination of incidental detail, allows some fundamental, relevant, or interesting aspect of the real world to appear in a generalised form.

pH: The negative logarithm to the base 10 of the hydrogen ion activity $[H^+]$ in solution.

Pit lake: water that accumulates within a final void.

Recharge: The addition of water to the saturated zone, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers.

Saturated zone: That part of the geological stratum in which all the voids are filled with water under pressure greater than that of the atmosphere.

Specific Storage: Volume of water released from storage from a unit volume of aquifer, per unit decline in hydraulic head.

Specific yield: The ratio of the volume of water a rock or spoil will yield by gravity drainage to the volume of the rock or soil. The upper bound of a specific yield value for a given material is equal to its porosity.

Storativity: The storage coefficient or storativity is a measure of the volume of water per volume of aquifer released as a result of a change in head. For confined aquifers, the storage coefficient is equal to the product of the specific storage and aquifer thickness.

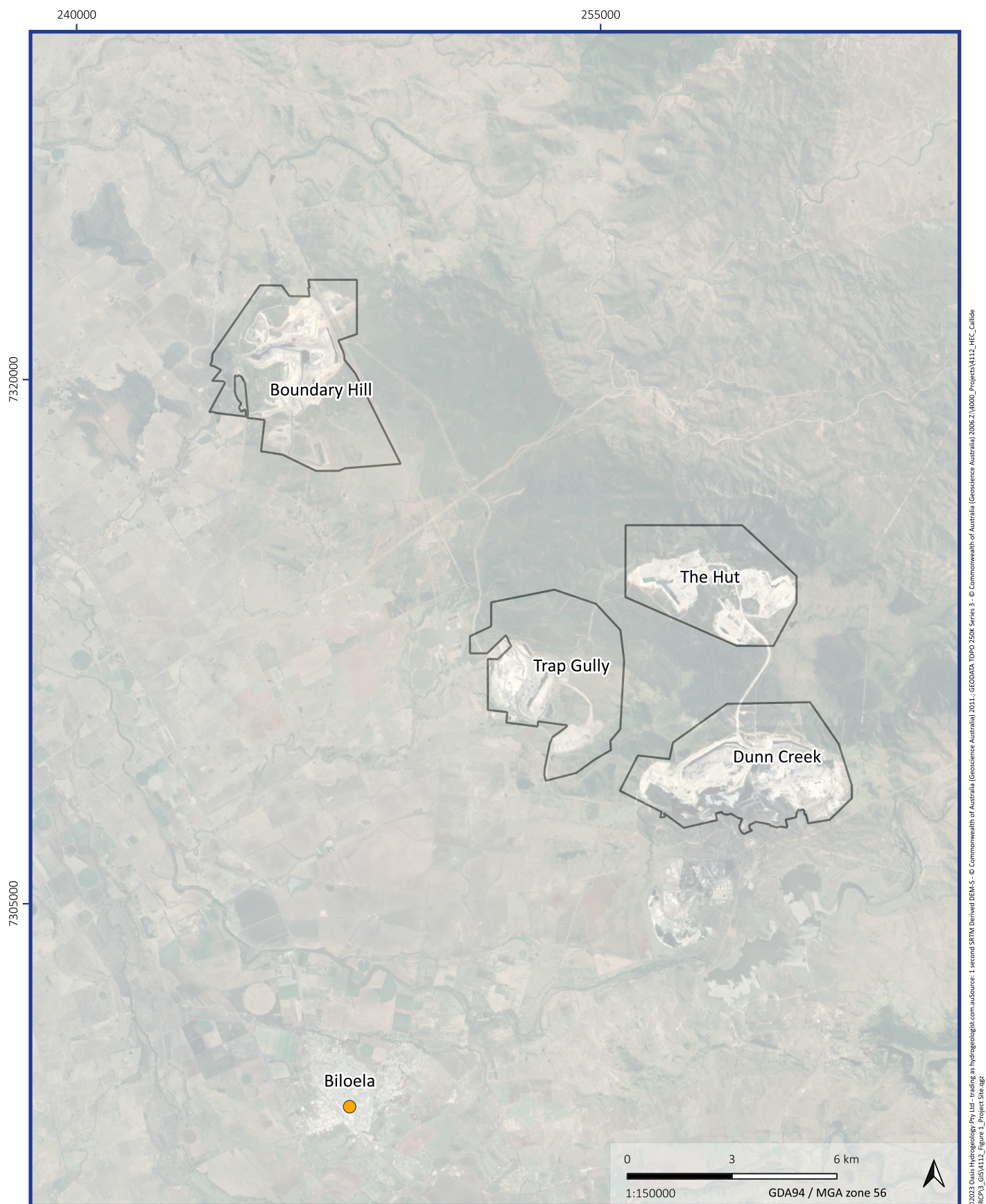
Transmissivity: Transmissivity is the rate at which water is transmitted through a unit thickness of aquifer under a unit hydraulic gradient (Driscoll, 1986). It is the product of the hydraulic conductivity and the contributing thickness of the aquifer to flow.

Unconfined aquifer: An aquifer whose upper surface (water table) is free to fluctuate.

Unsaturated zone: That part of the geological stratum above the saturated zone in which the voids contain both air and water.

Water table: The top of an unconfined aquifer, where the aquifer is fully saturated, and the water pressure is equal to atmospheric pressure. Usually measured in metres below ground level or below top of casing.

Weathering: The processes by which particles, rocks and minerals are altered on exposure to surface temperature and pressure and atmospheric agents such as air, water, and biological activity.



Callide Mine layout

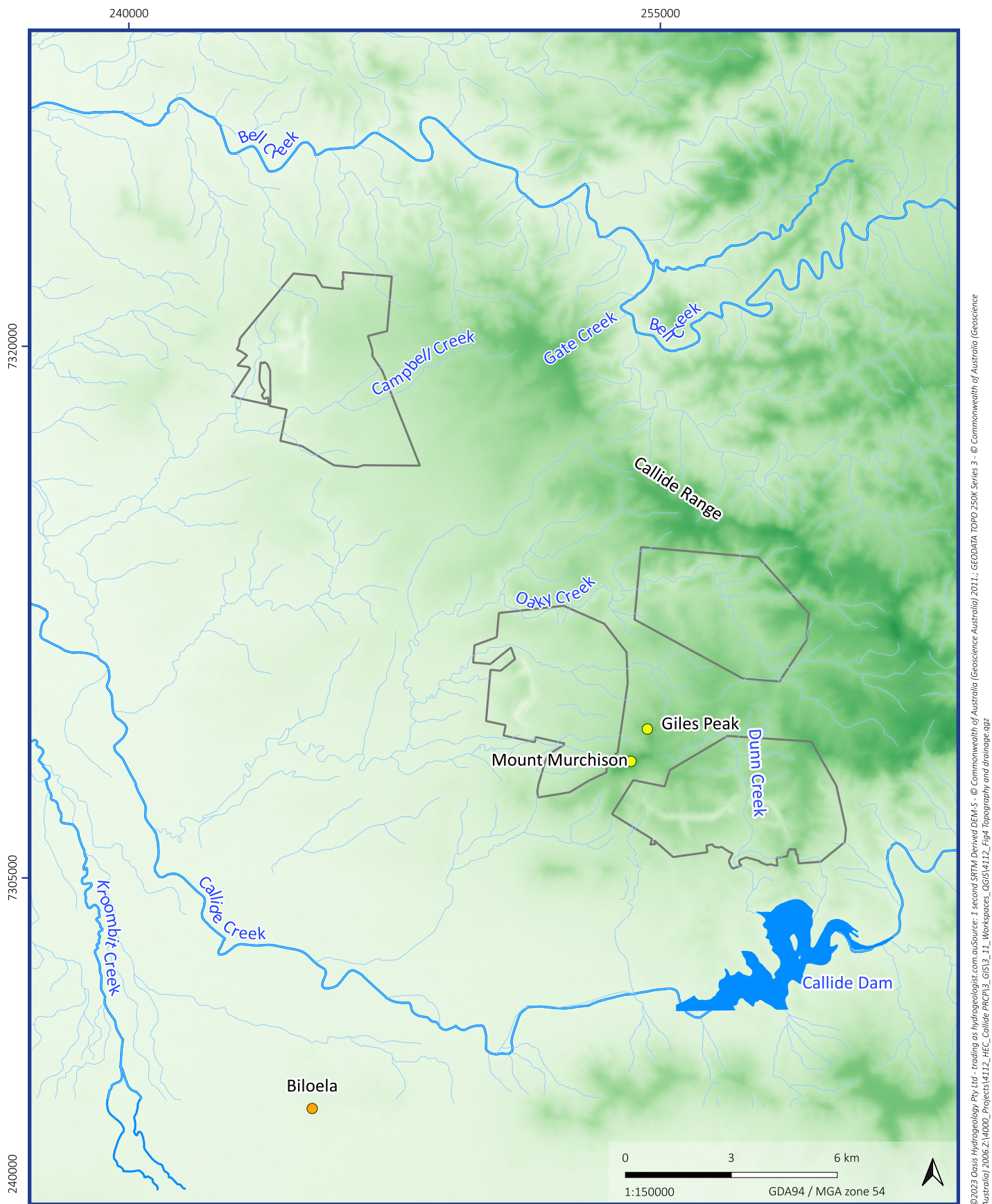
Callide Mine PRCP Groundwater Assessment (4112)

Figure 1

21/03/2023

Legend

Mining area boundary



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Topography and drainage

Callide Mine PRCP Groundwater Assessment (4112)

Figure 2

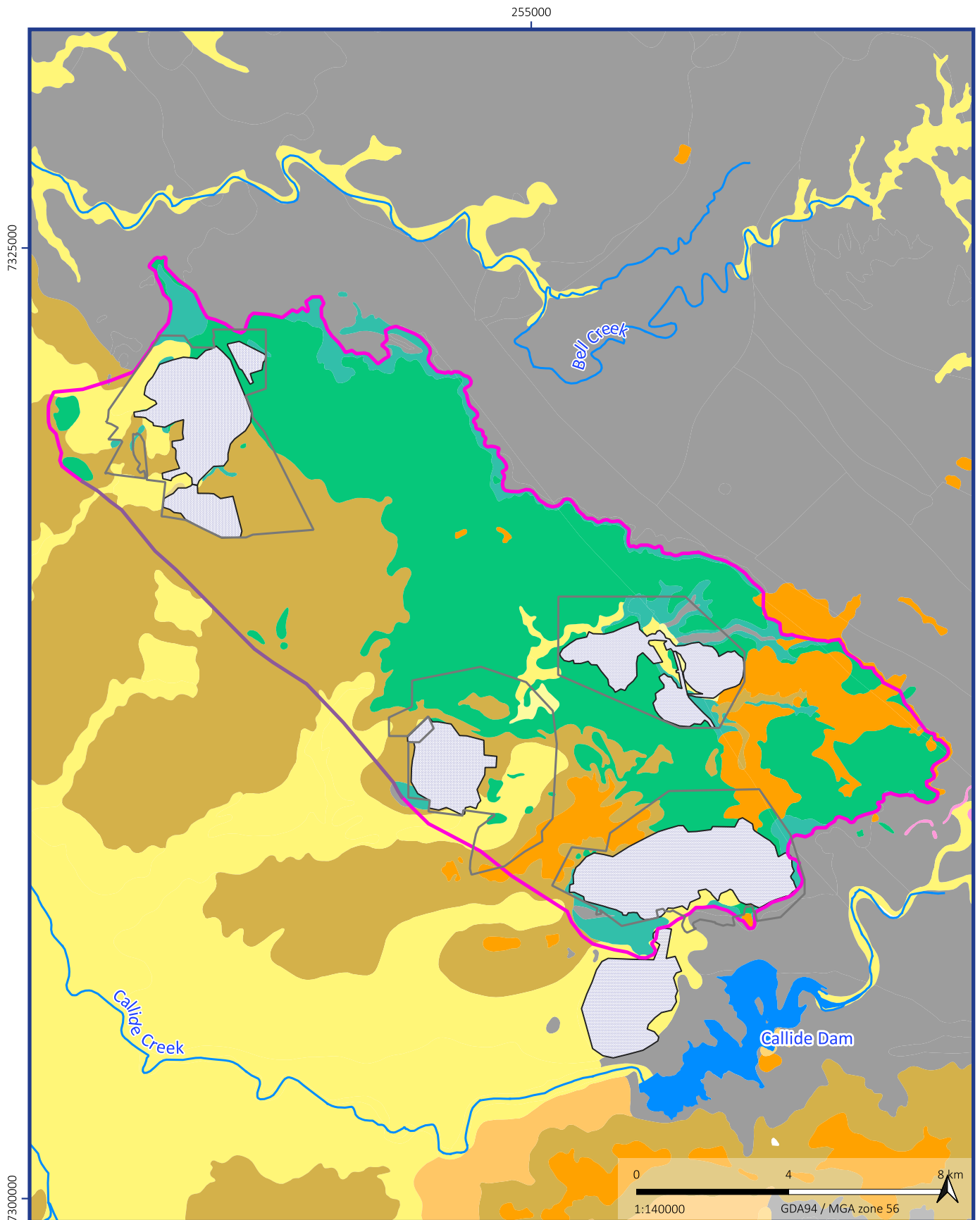
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Legend

- Drainage features
- Mining area boundary

Elevation (mAHD)

- | | |
|---|---|
| 100- 200 | 500- 600 |
| 200- 300 | 600- 700 |
| 300- 400 | 700- 800 |
| 400- 500 | |



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Legend

- Callide Basin extent (inferred)
- Callide Basin extent
- Mining area boundary
- ▨ Disturbed ground

Geology

- Recent residual surface sediments
- Tertiary basalt
- Biloela Formation
- Precipice Sandstone
- Callide Coal Measures
- Basement rocks

Surface geology

Callide Mine PRCP Groundwater Assessment (4112)

Figure 3

27/04/2023

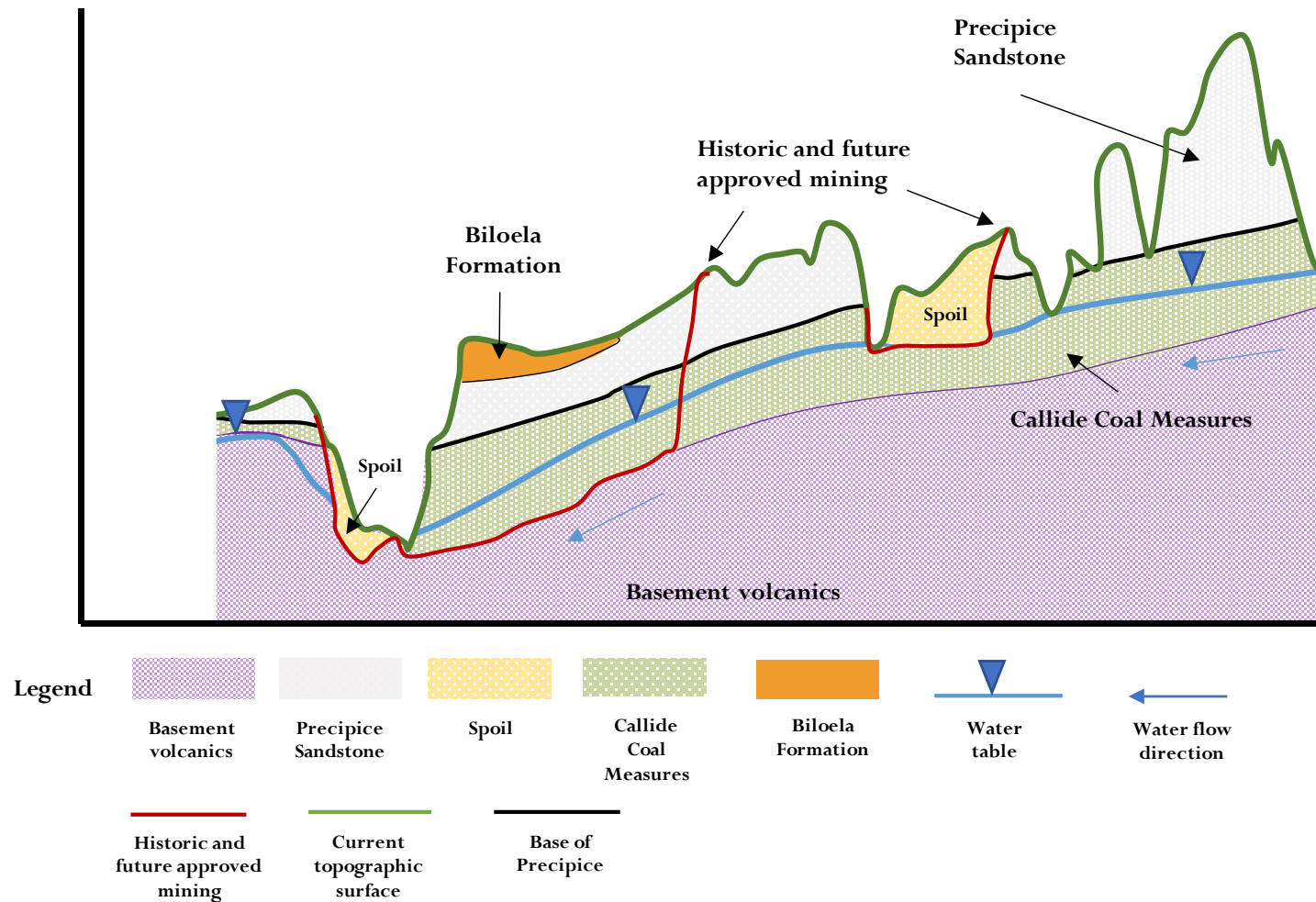
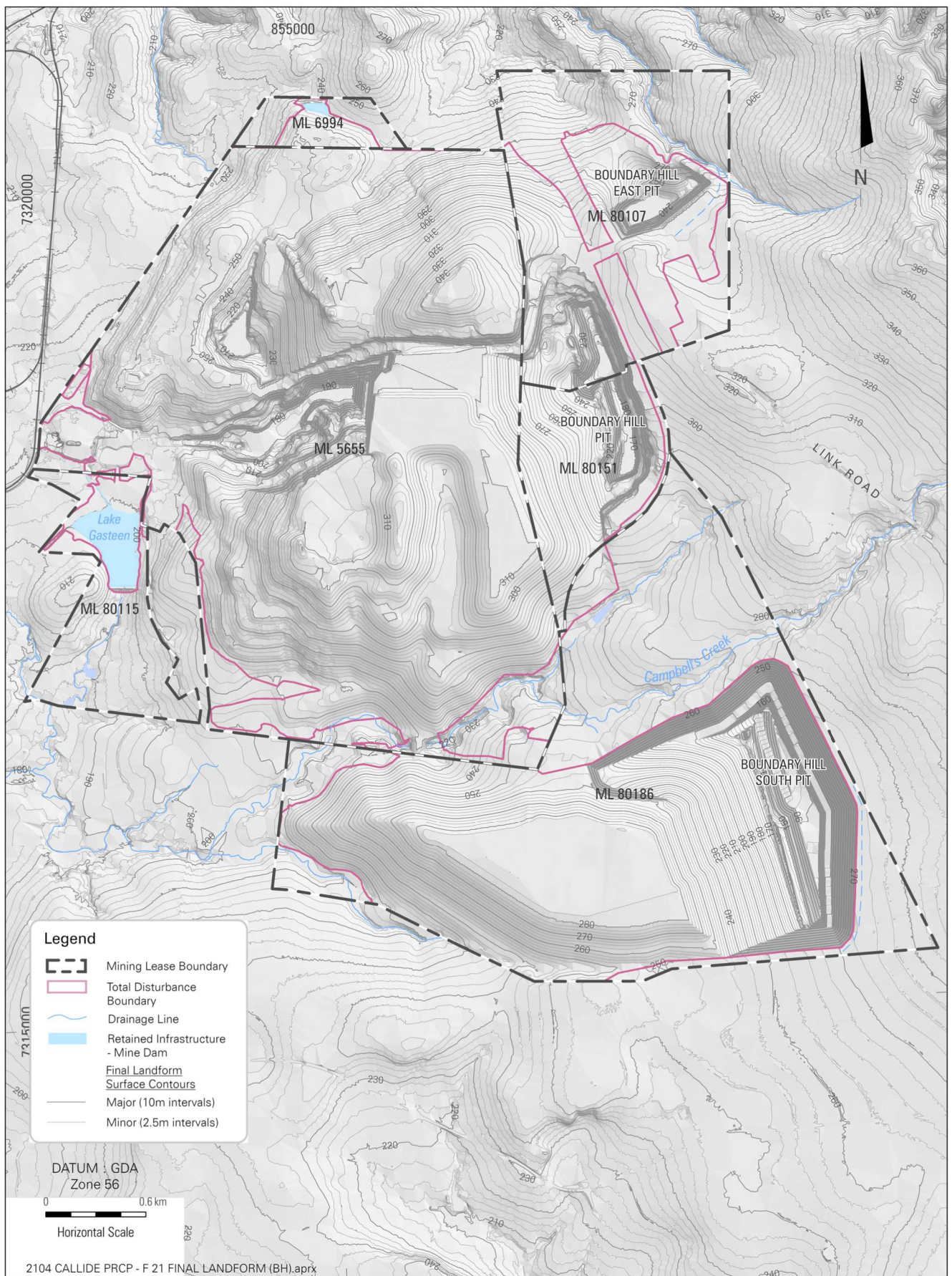
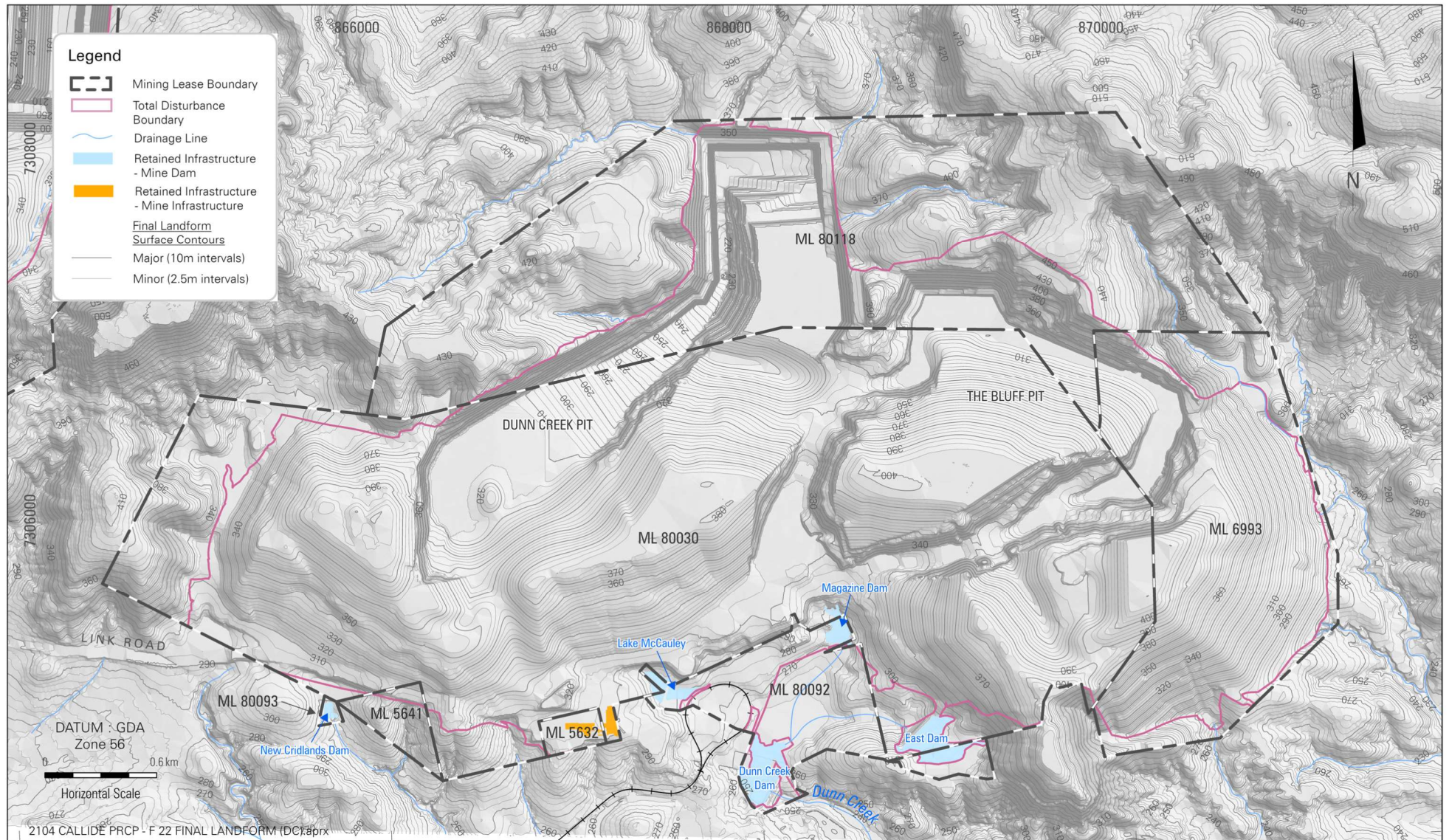
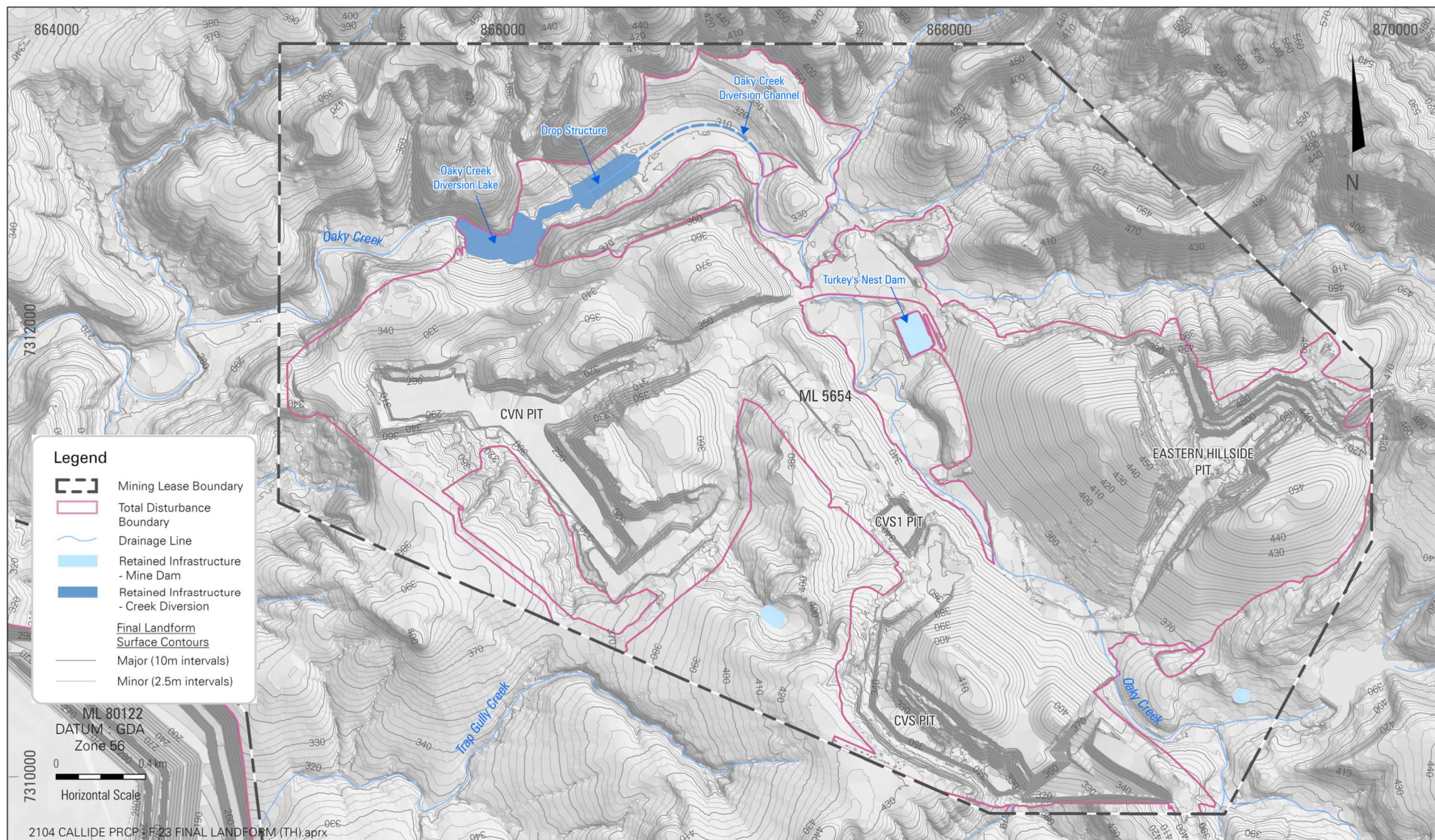
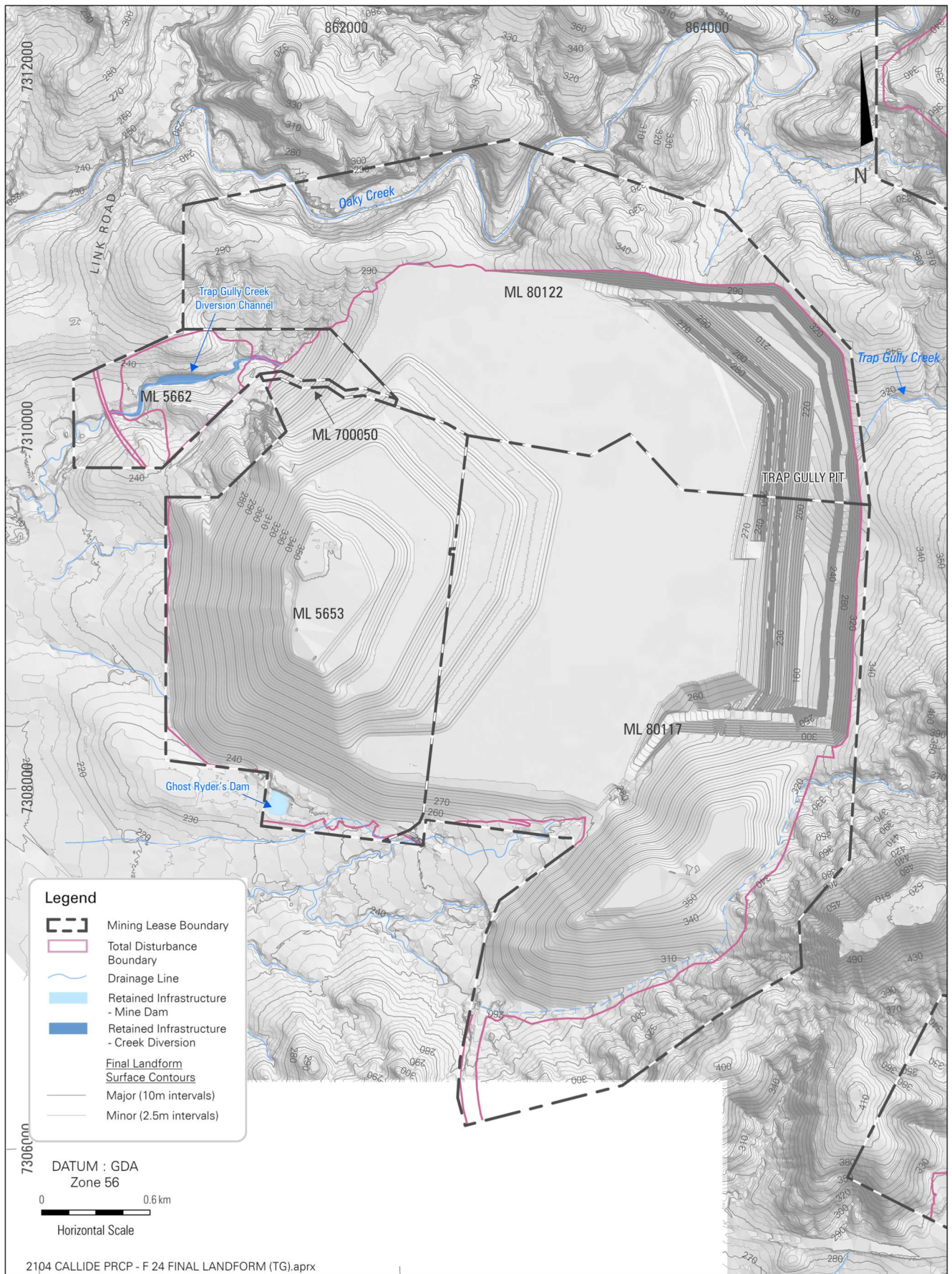


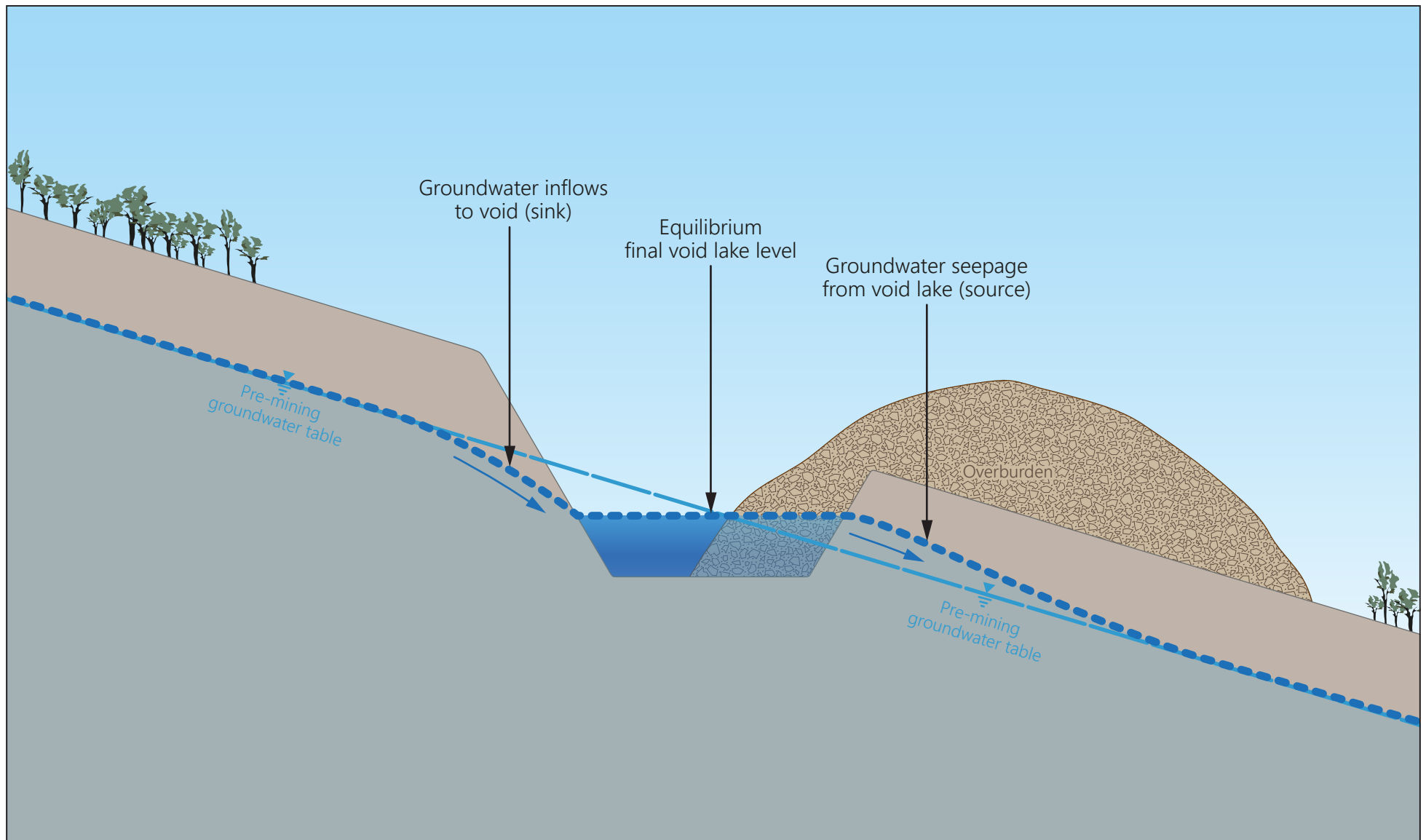
Figure 4 Conceptual groundwater regime











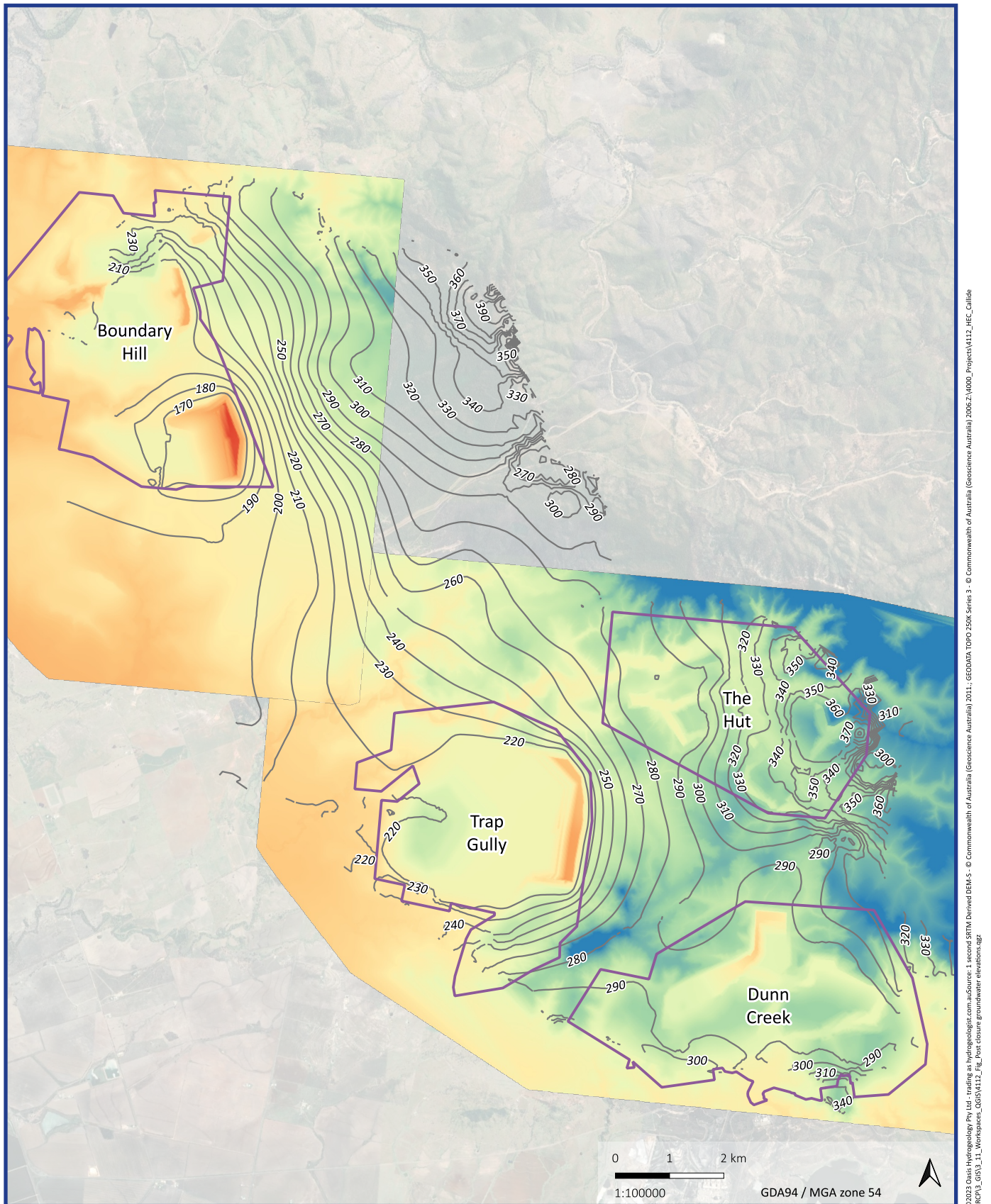
CALLIDE MINE

BATCHFIRE CALLIDE



Conceptual Final Void Groundwater Source and Sink Schematic

Figure 9



Post-closure groundwater elevation and flow - Callide Mine

Legend

- Mining area boundary
- Predicted GWL contour (mAHd)

Final landform elevation (mAHd)

Band 1 (Gray)

50- 99

100- 149

150- 199

200- 249

250- 299

300- 349

350- 399

400- 449

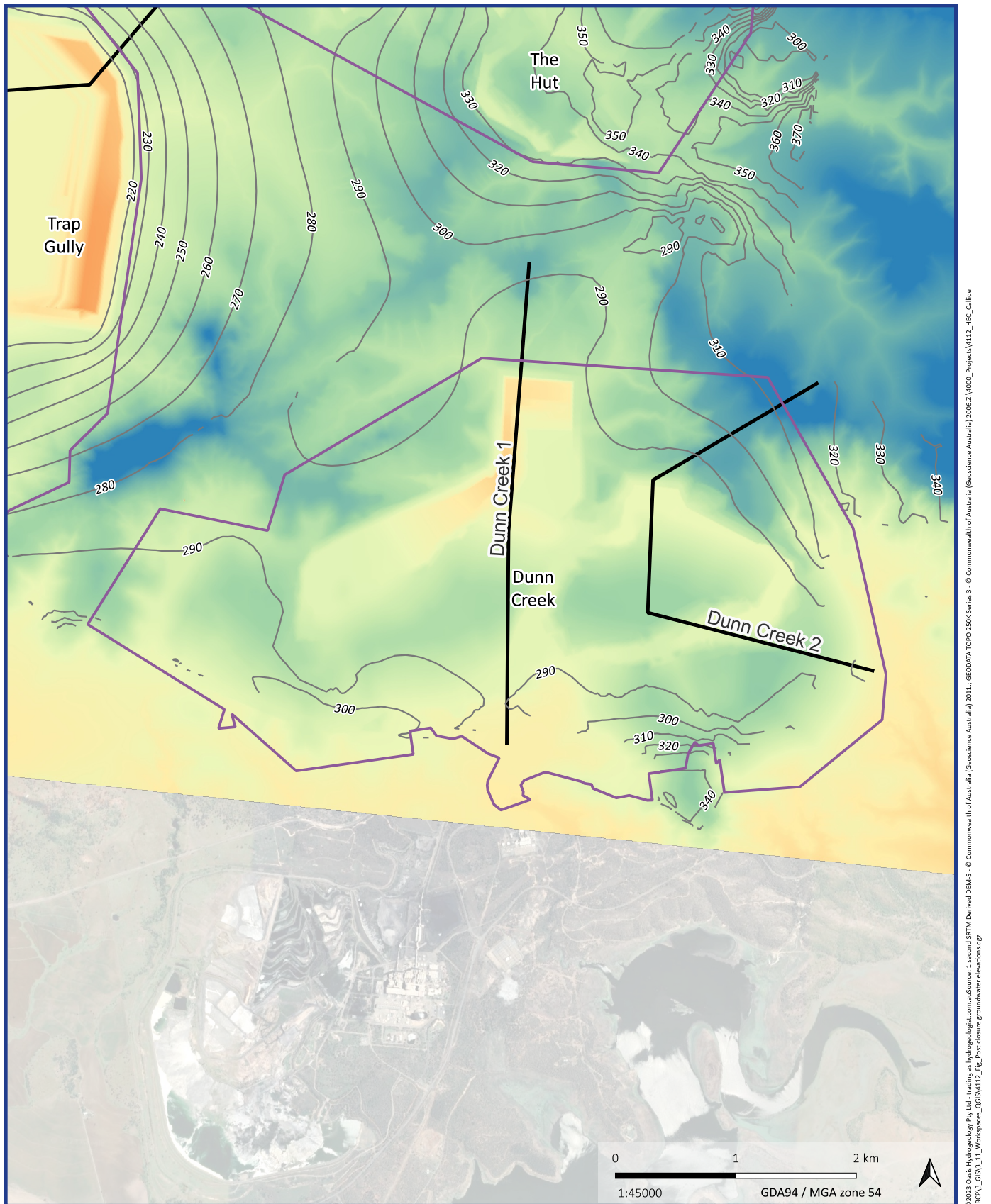
450- 499

500- 600

Callide Mine PRCP Groundwater Assessment (4122)

Figure 10

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Post-closure groundwater elevation and flow - Dunn Creek mining area

Legend

 Mining area boundary	Final landform elevation (mAHd)	 150- 199	 350- 399
 Predicted GWL contour (mAHd)	Band 1 (Gray)	 200- 249	 400- 449
 Cross-sections	 50- 99	 250- 299	 450- 499
	 100- 149	 300- 349	 500- 600

Callide Mine PRCP Groundwater Assessment (4122)

Figure 11

19/04/2023



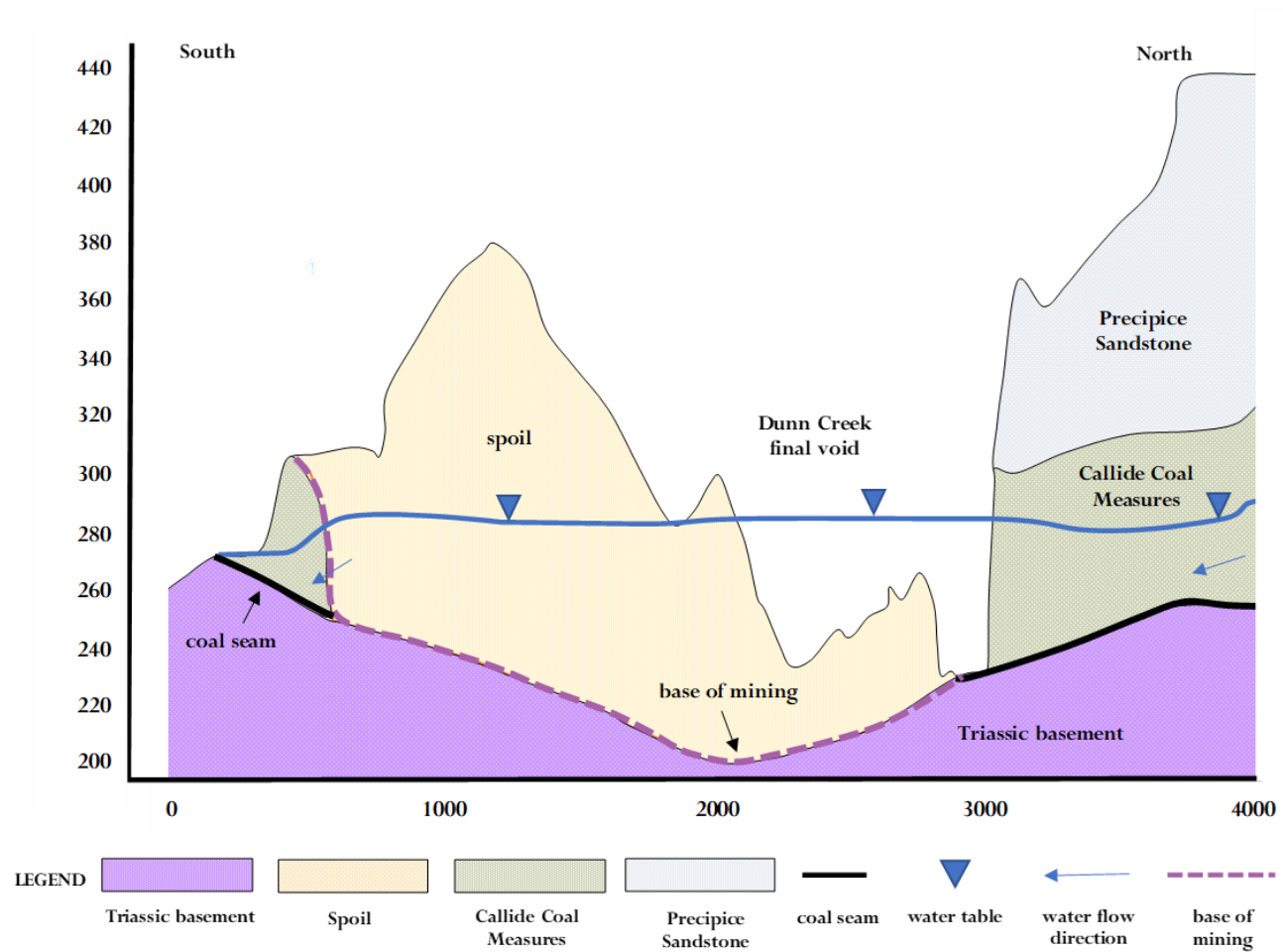


Figure 12 Dunn Creek mining area – post-closure groundwater regime cross-section 1

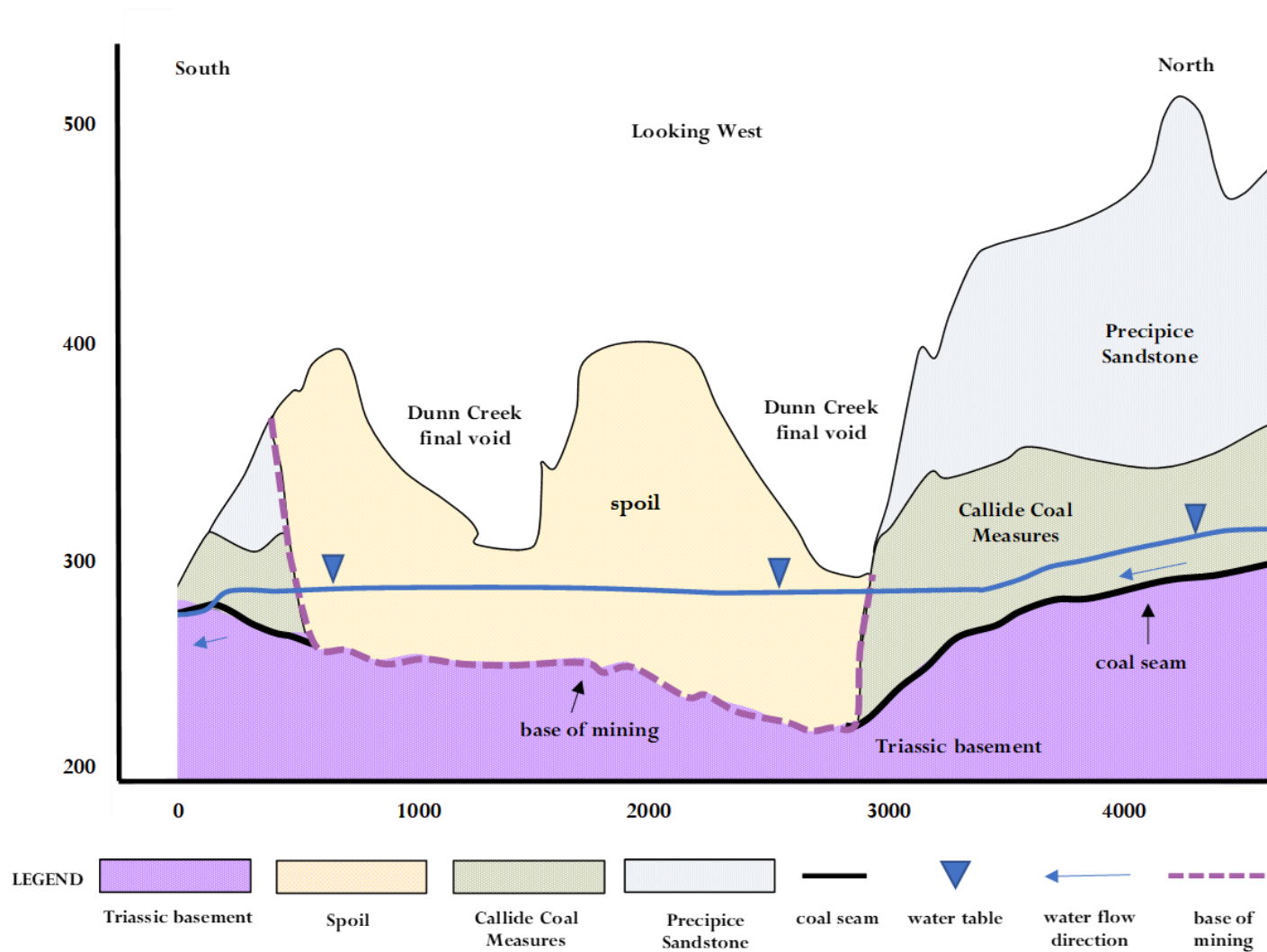
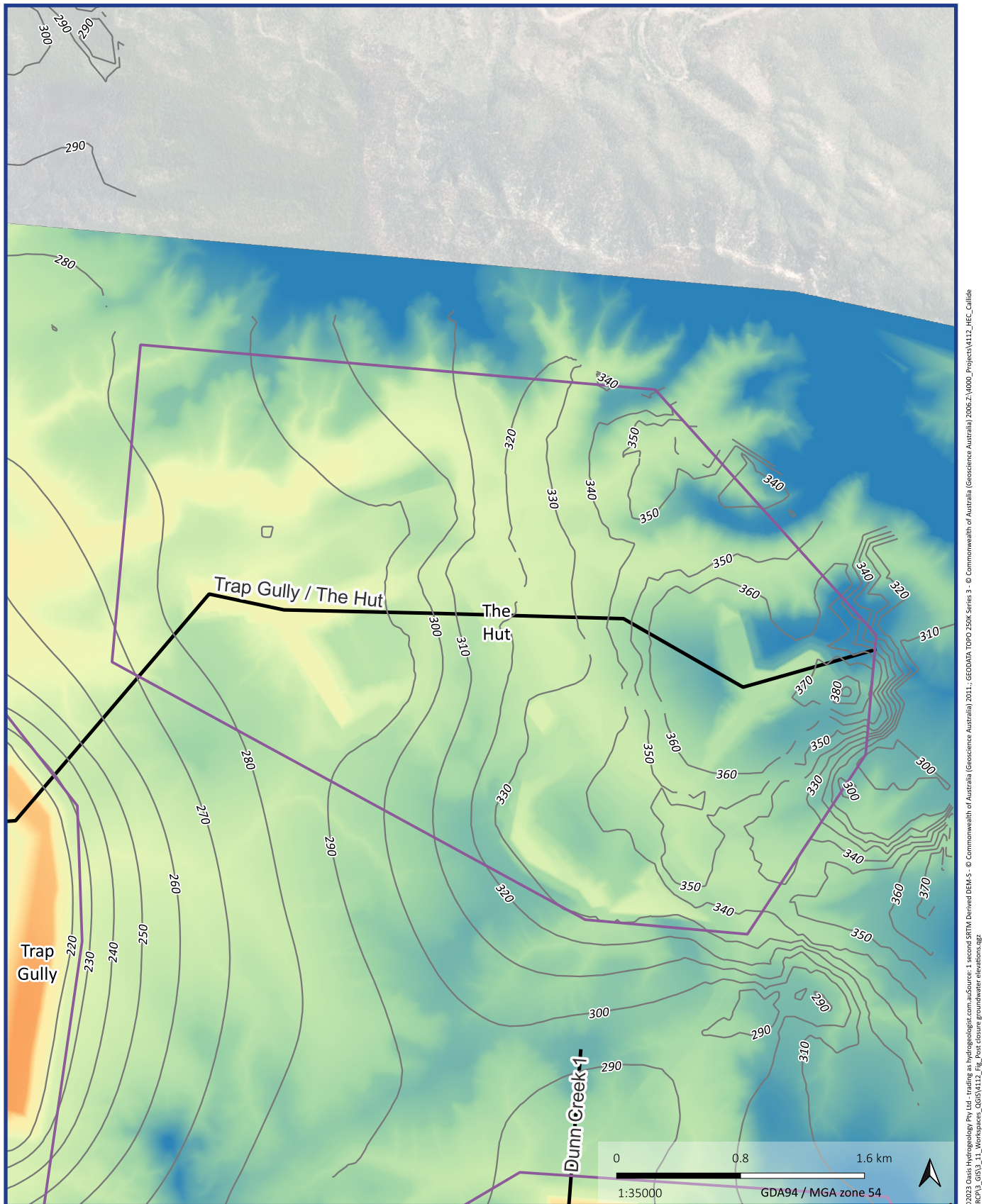


Figure 13 Dunn Creek mining area – post-closure groundwater regime cross-section 2



Post-closure groundwater elevation and flow - The Hut mining area

Legend

Callide Mine PRCP Groundwater Assessment (4122)

 Mining area boundary	Final landform elevation (mAHd)	 200- 249	 400- 449
 Predicted GWL contour (mAHd)	 50- 99	 250- 299	 450- 499
 Cross-sections	 100- 149	 300- 349	 500- 600
	 150- 199	 350- 399	

Figure 14

19/04/2023

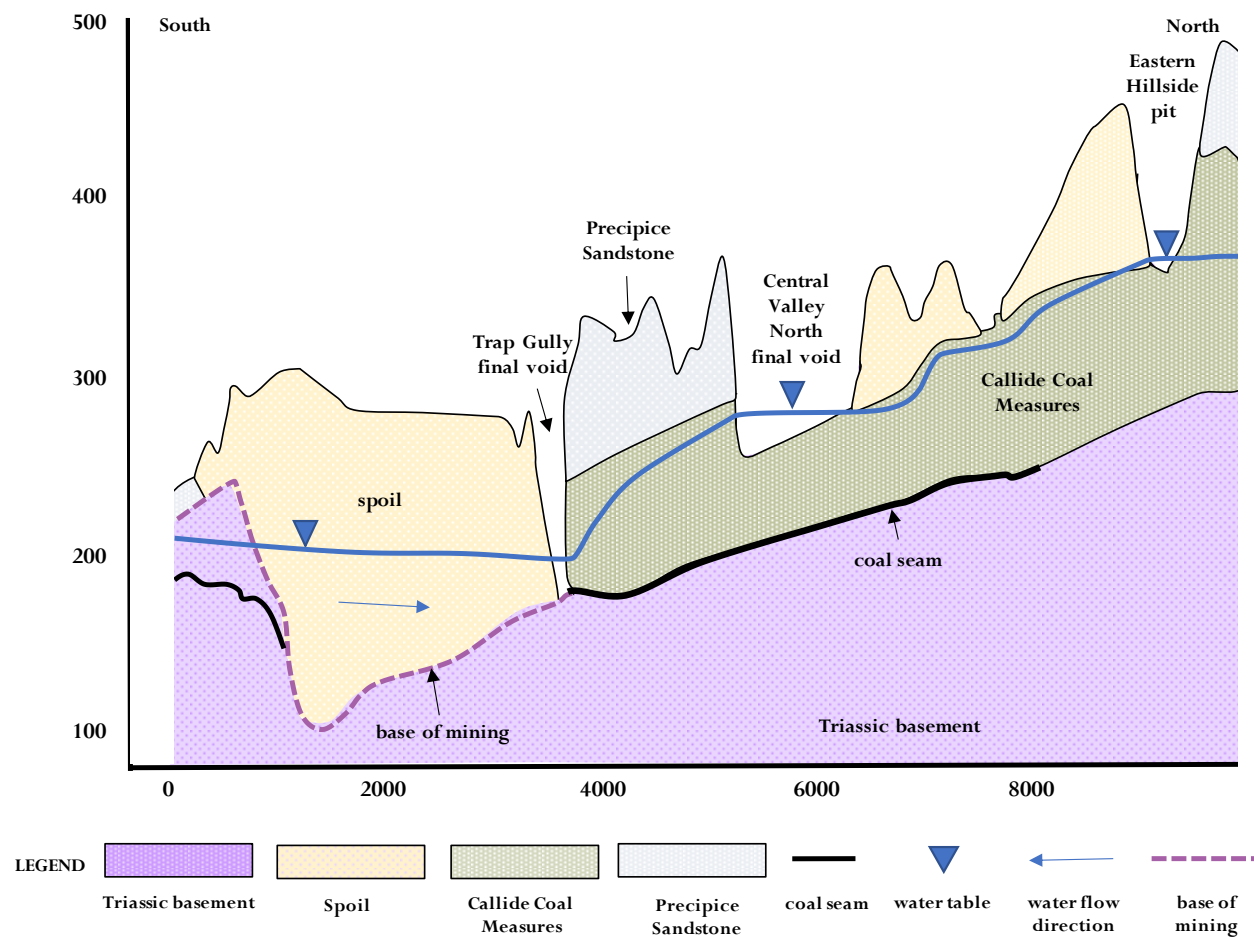
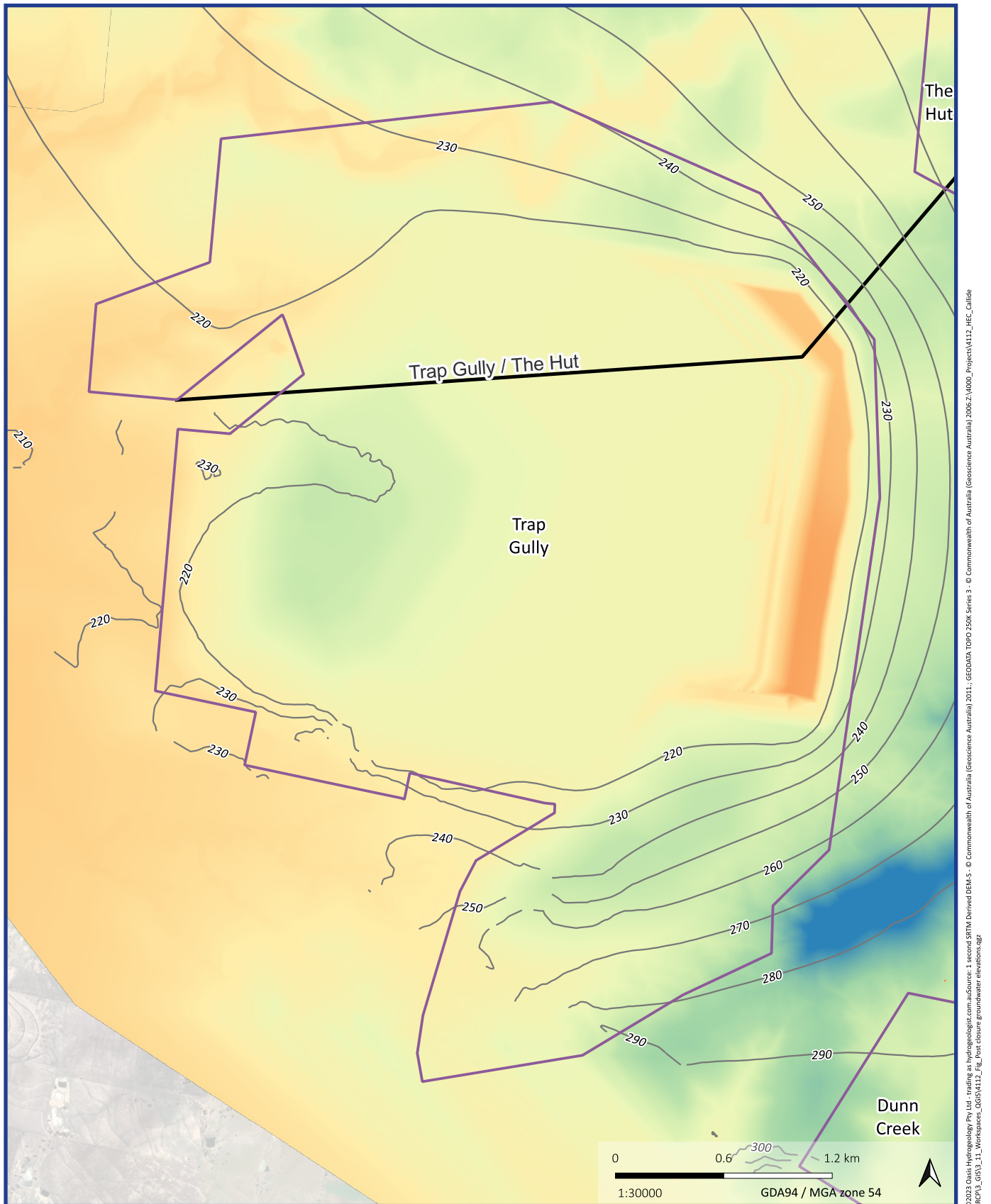


Figure 15 The Hut / Trap Gully mining area – post-closure groundwater regime cross-section



Post-closure groundwater elevation and flow - Trap Gully mining area

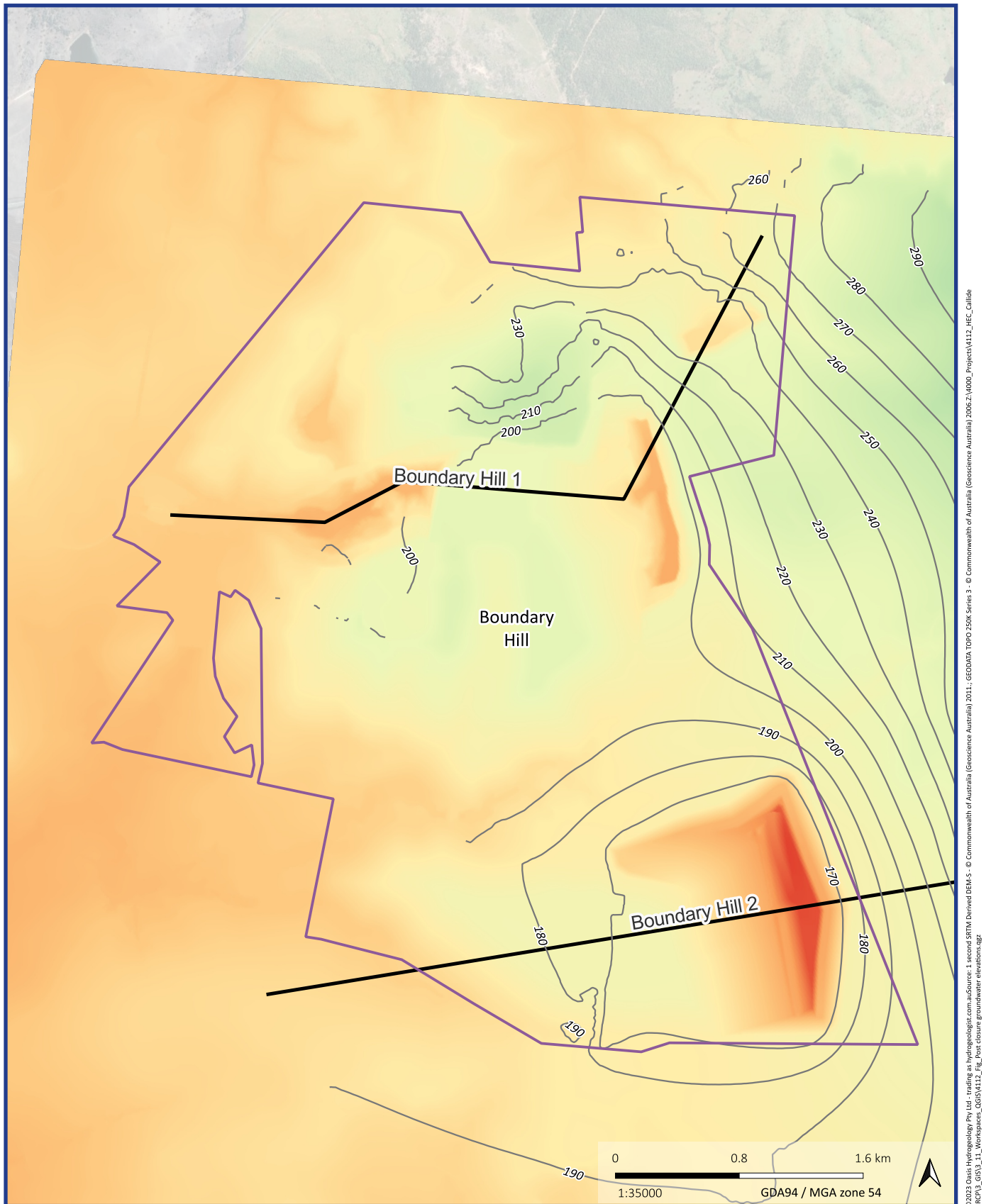
Legend

Callide Mine PRCP Groundwater Assessment (4122)

Mining area boundary	Final landform elevation (mAHd) 50- 99	200- 249	400- 449
Predicted GWL contour (mAHd)	100- 149	250- 299	450- 499
Cross-sections	150- 199	300- 349	500- 600
		350- 399	

Figure 16

19/04/2023



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Legend

Callide Mine PRCP Groundwater Assessment (4122)

Figure 17

19/04/2023



Mining area boundary	Final landform elevation (mAHD)	200 - 249	400 - 449
Predicted GWL contour (mAHD)	50 - 99	250 - 299	450 - 499
Cross-sections	100 - 149	300 - 349	500 - 600
	150 - 199	350 - 399	

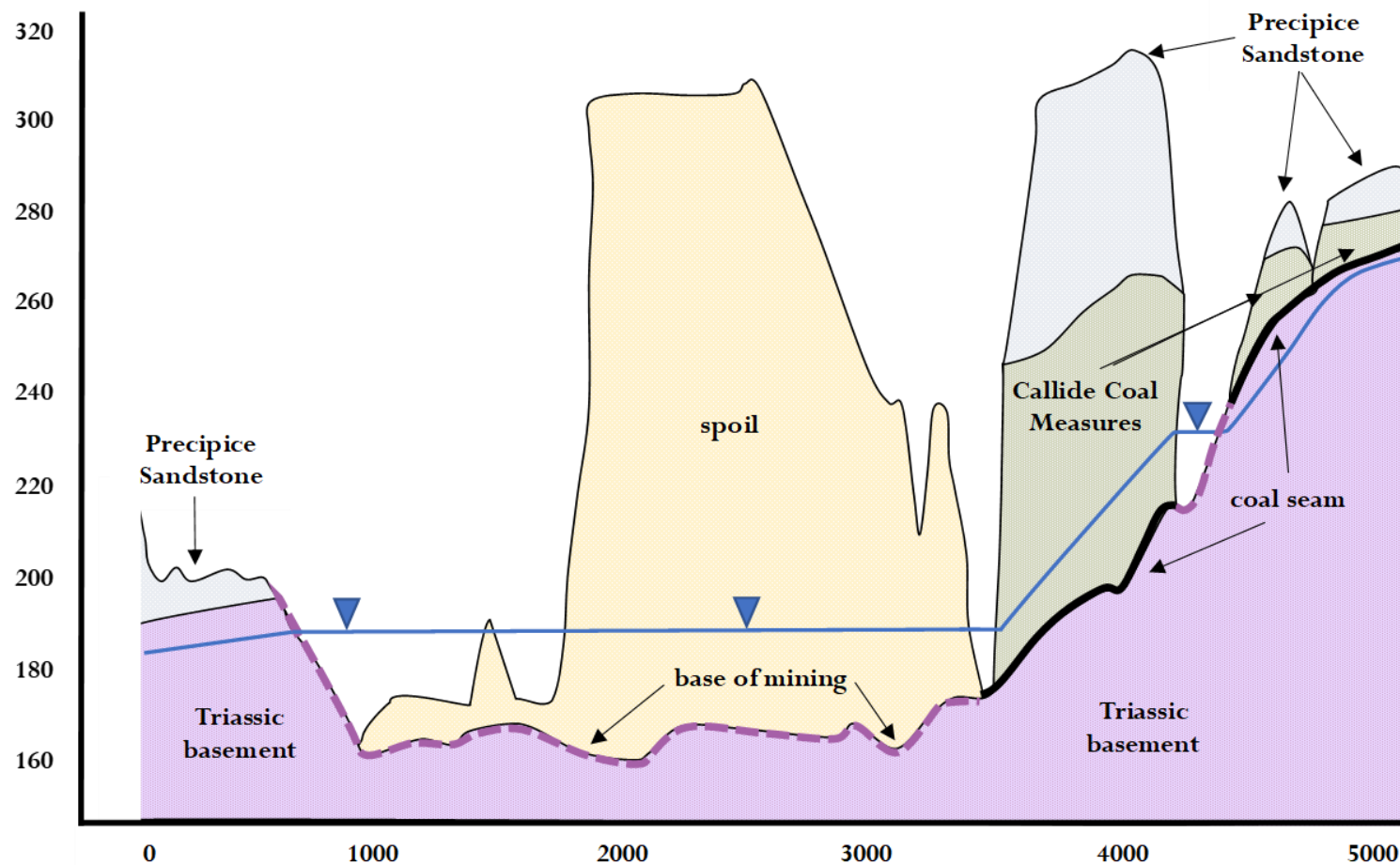


Figure 18 Boundary Hill mining area – post-closure groundwater regime cross-section 1

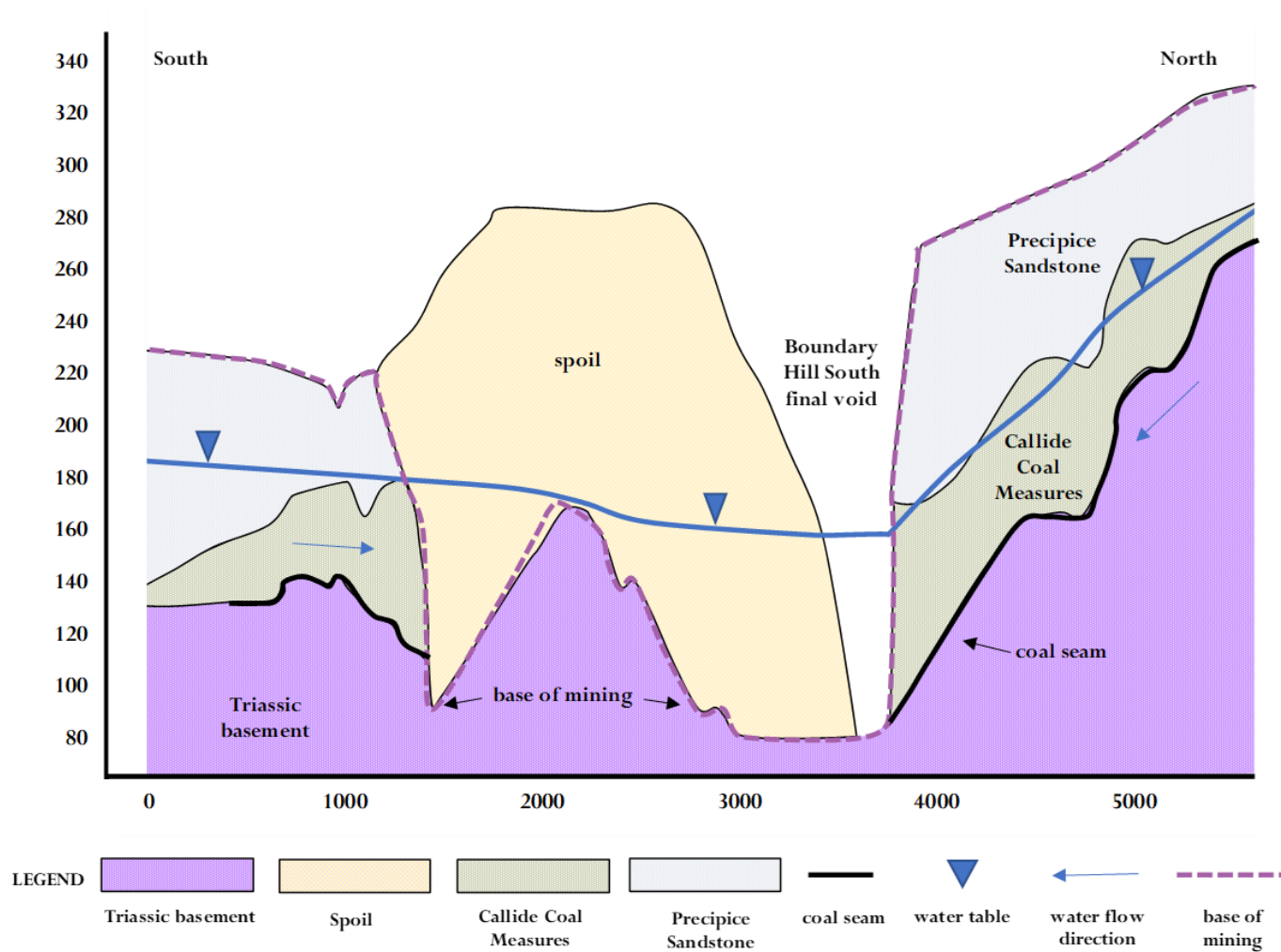
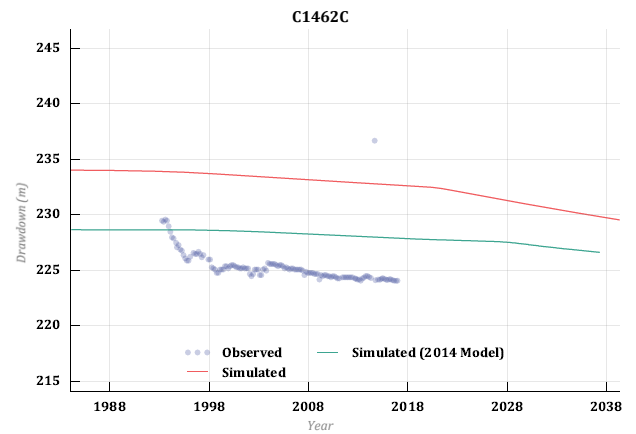
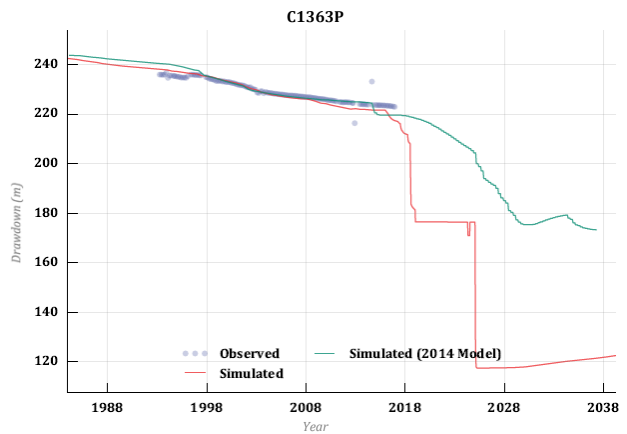
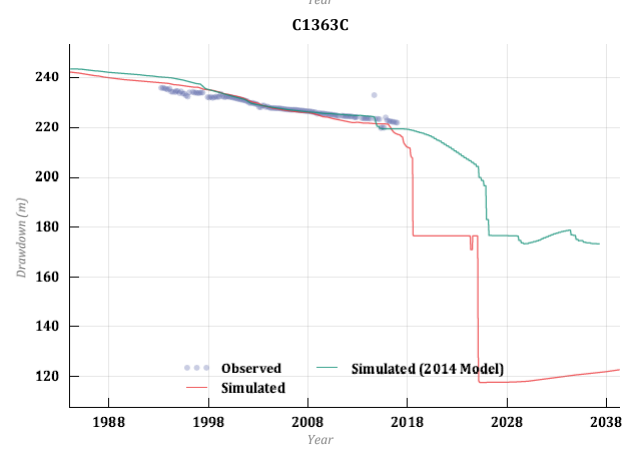
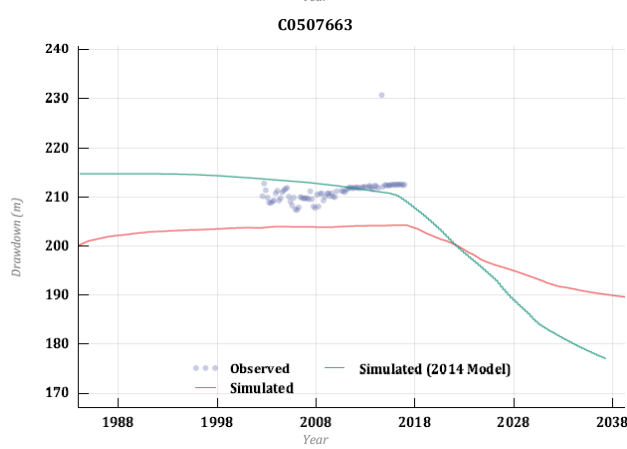
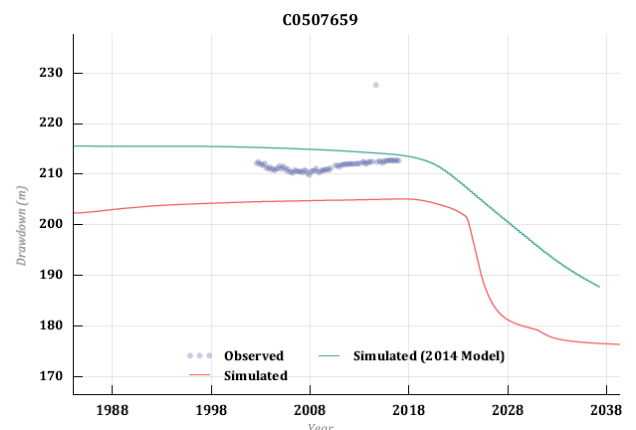
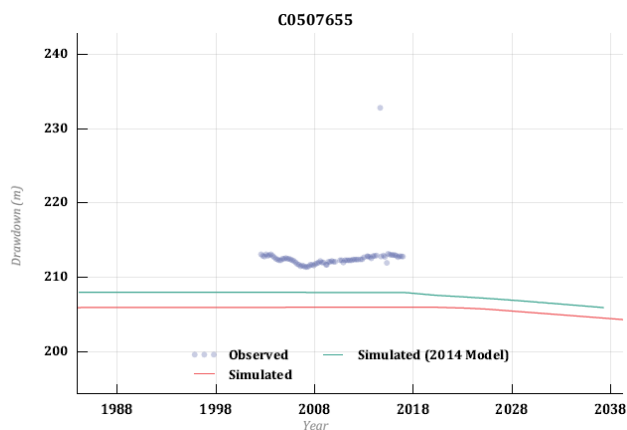
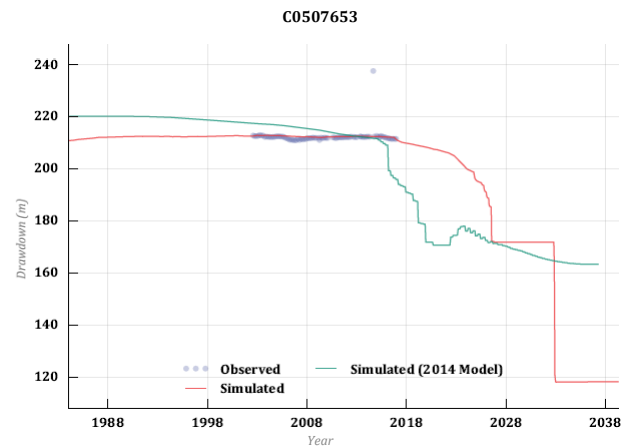
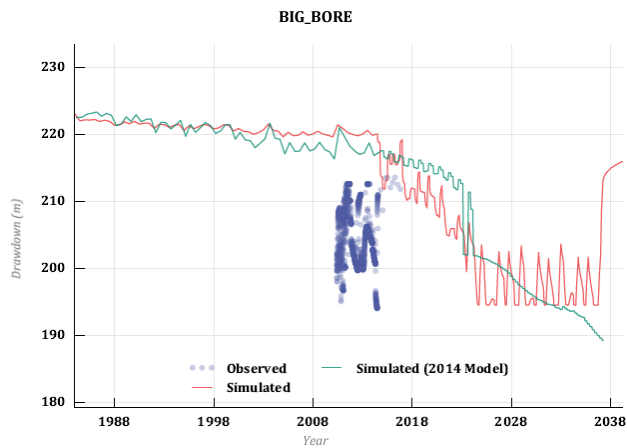
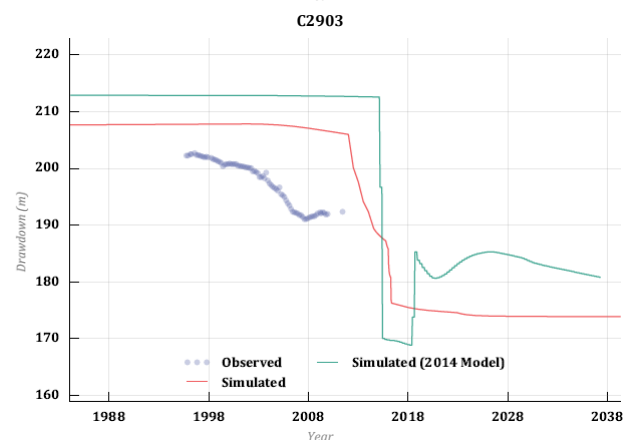
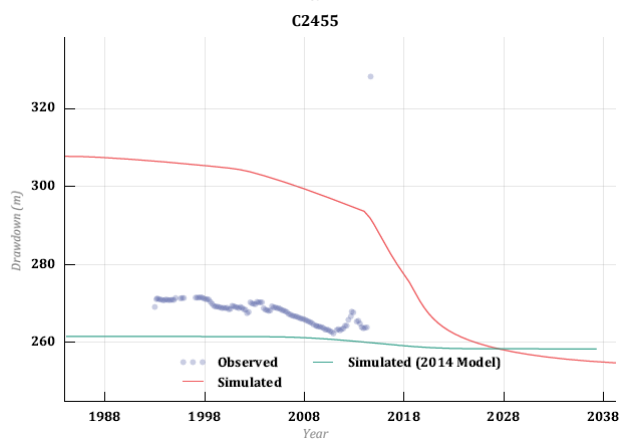
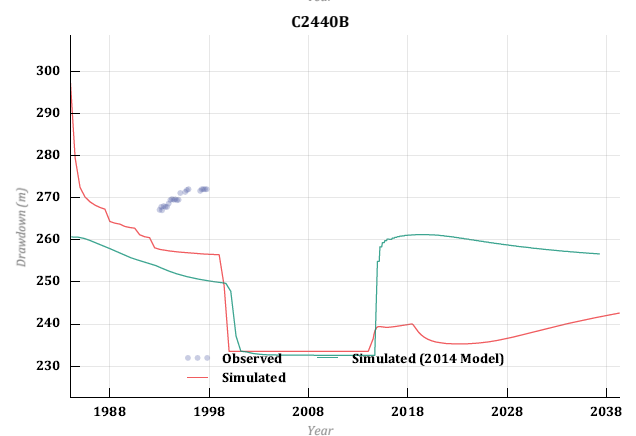
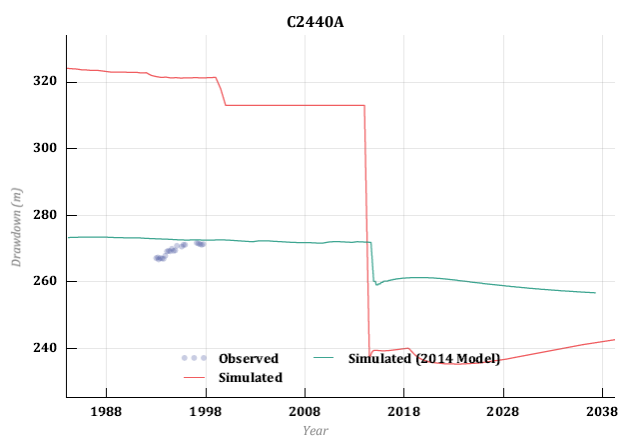
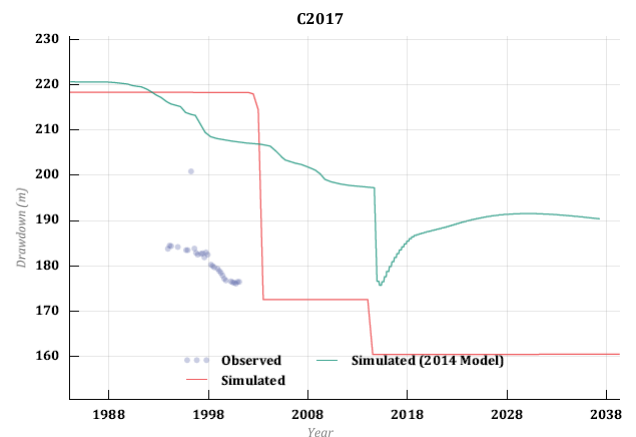
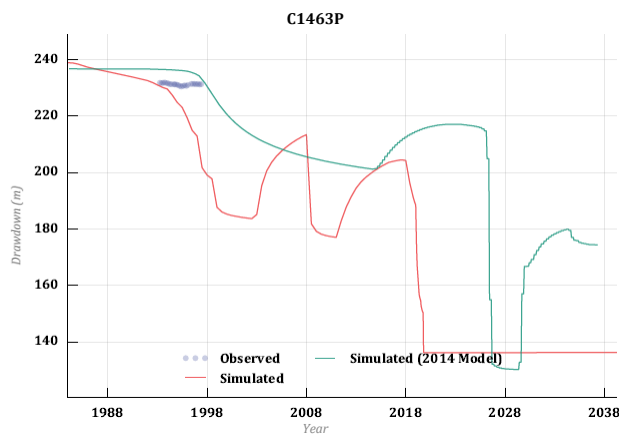
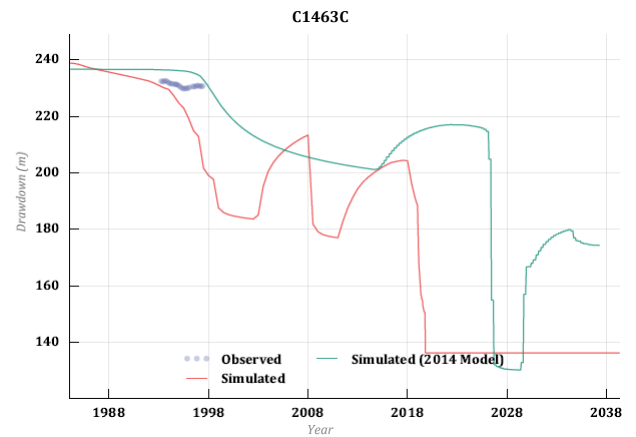
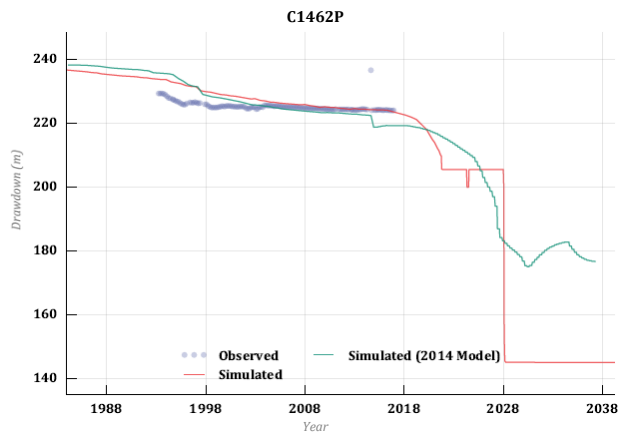


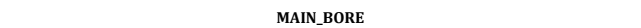
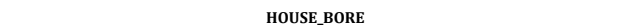
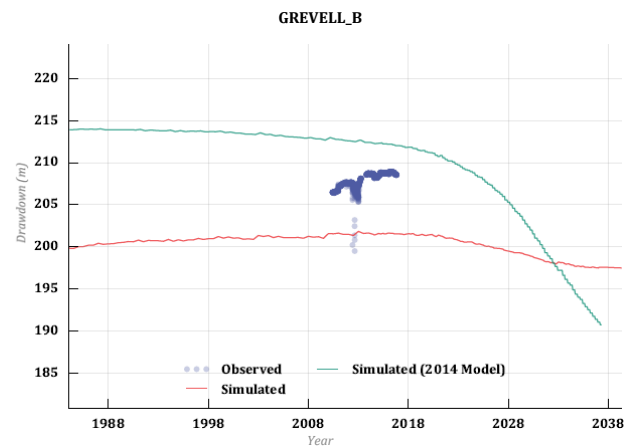
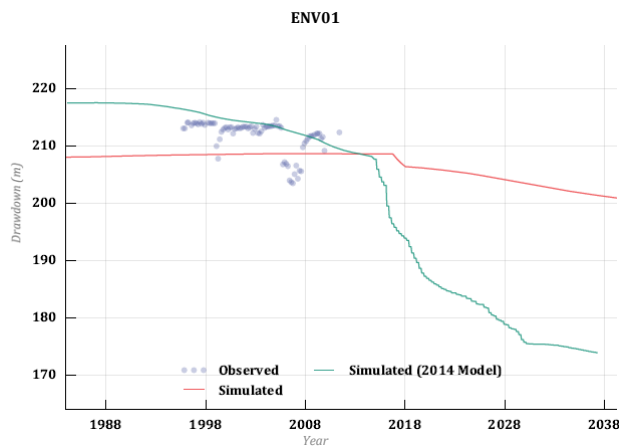
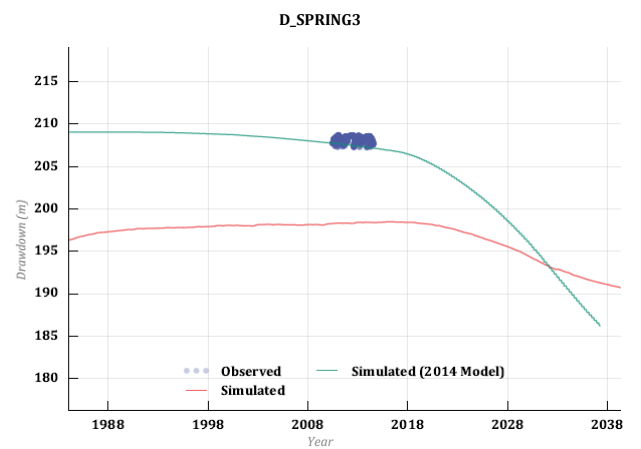
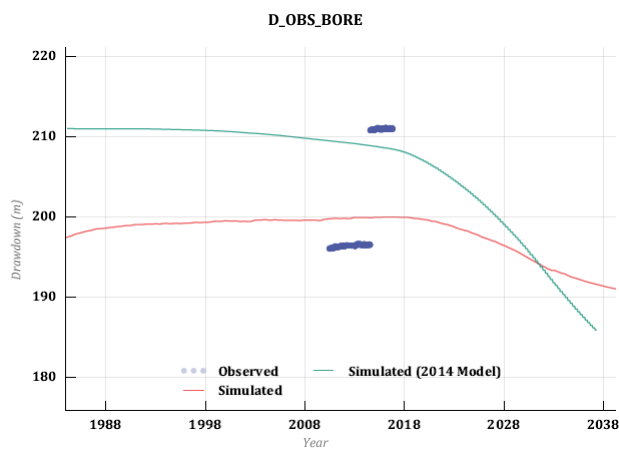
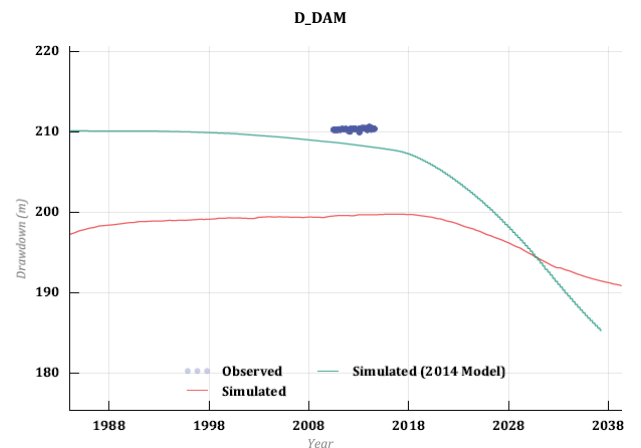
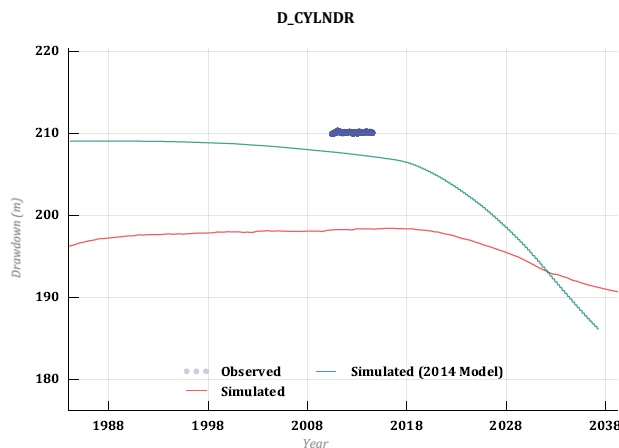
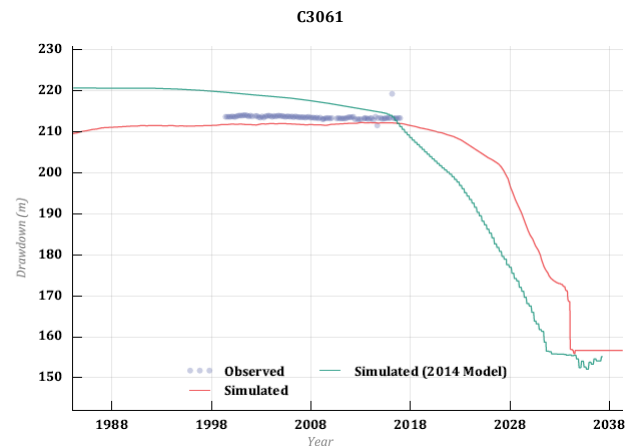
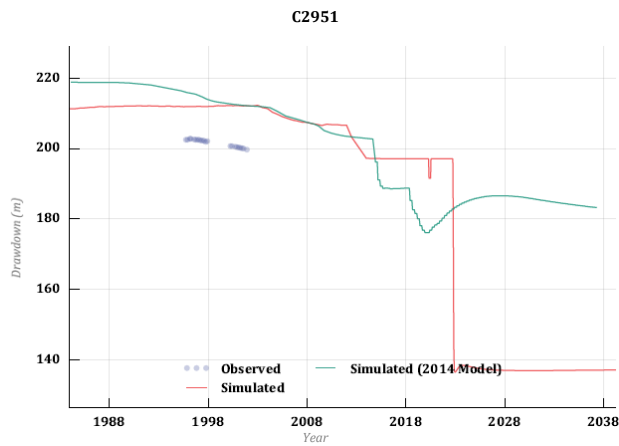
Figure 19 Boundary Hill mining area – post-closure groundwater regime cross-section 2

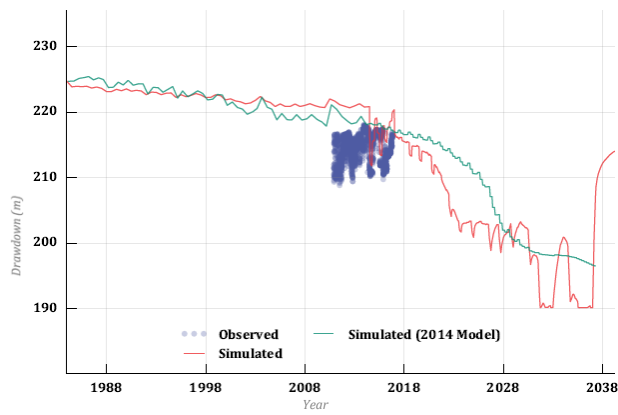
Appendix A Groundwater bores used in the groundwater modelling

Appendix B Groundwater level data used in the groundwater modelling

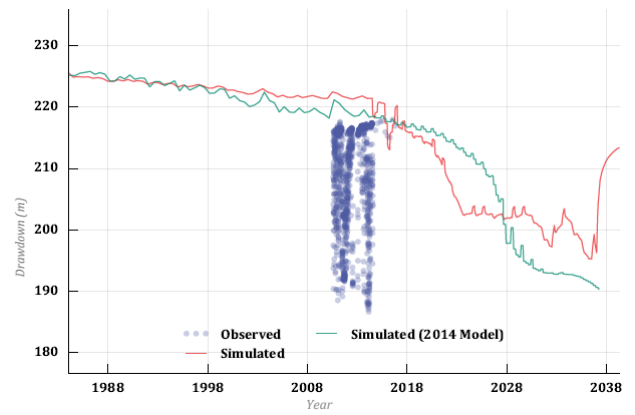




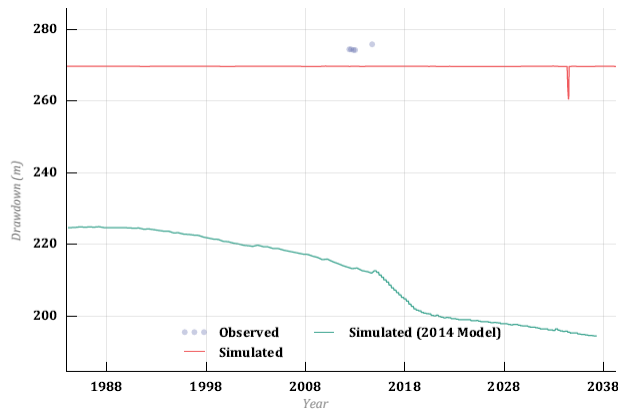




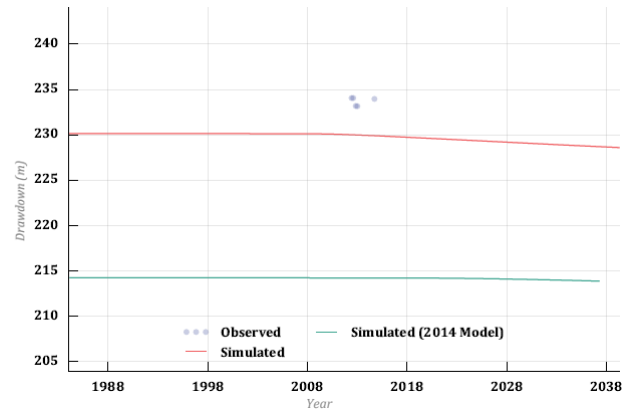
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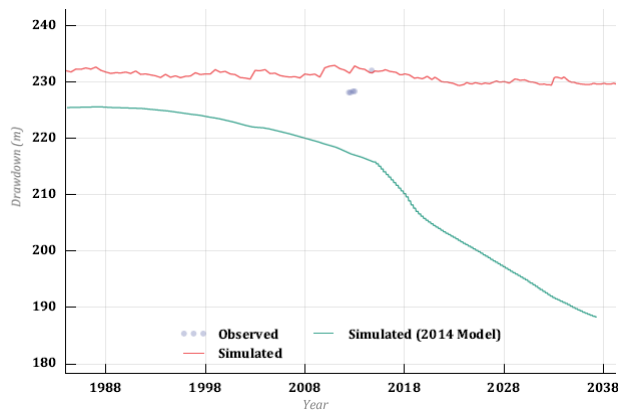
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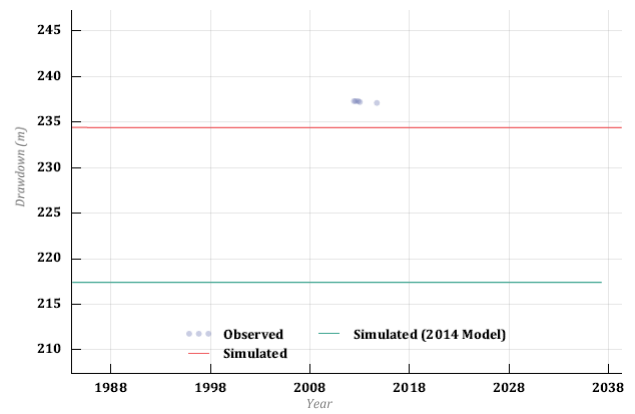
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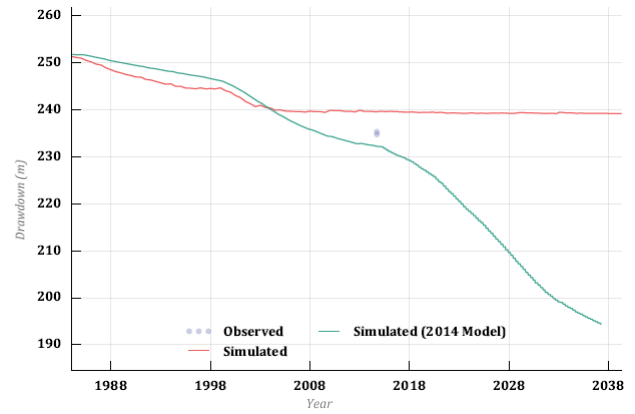
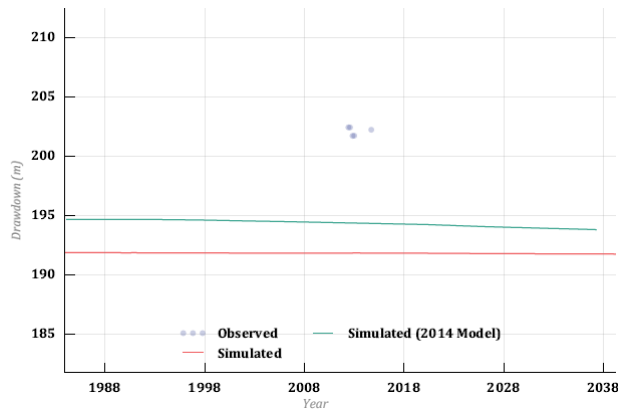
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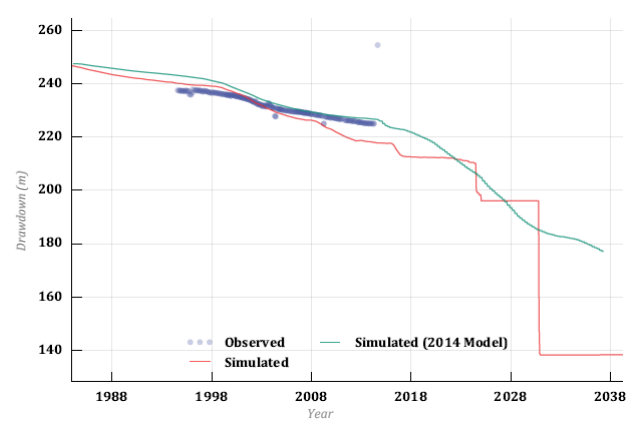
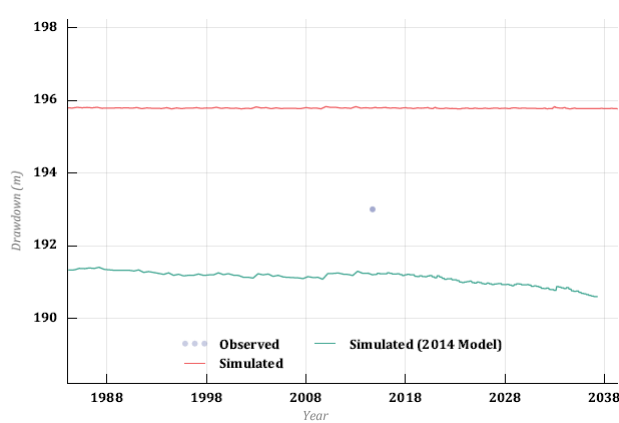
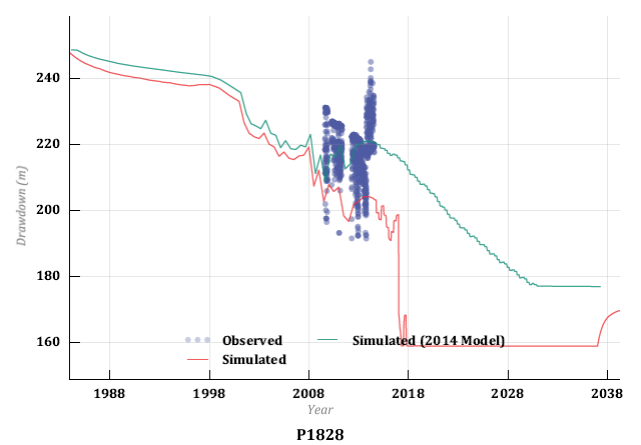
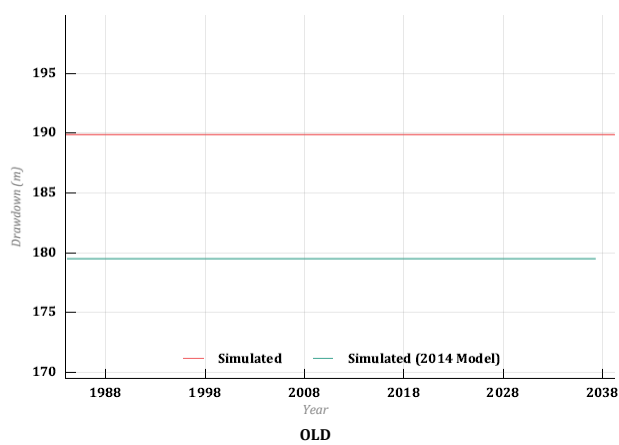
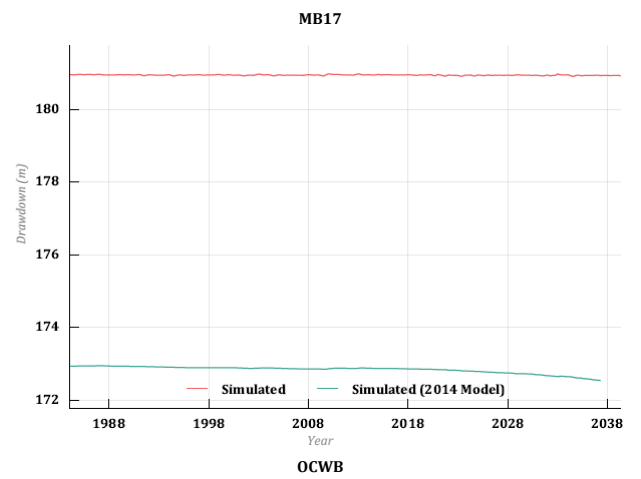
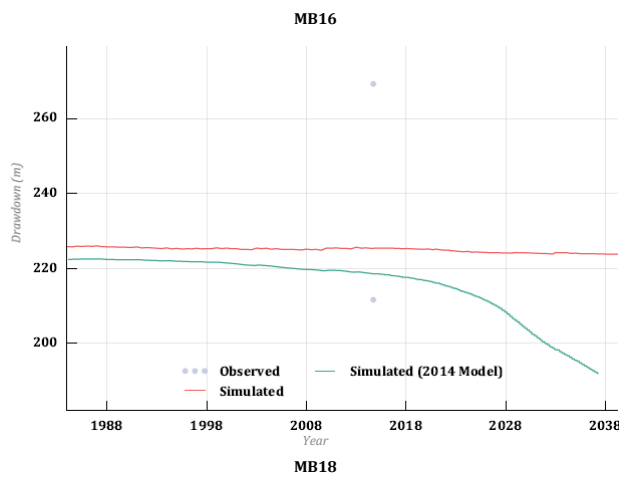
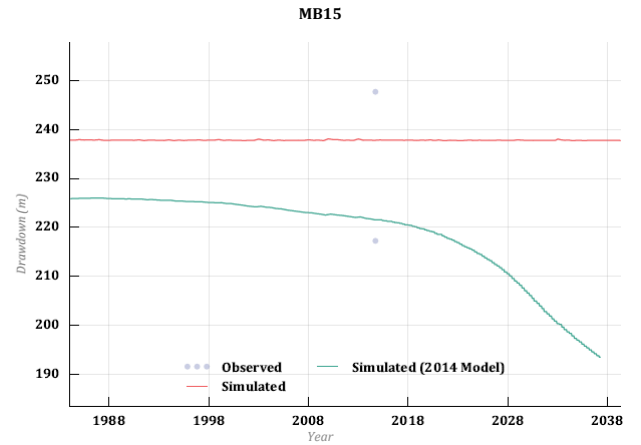
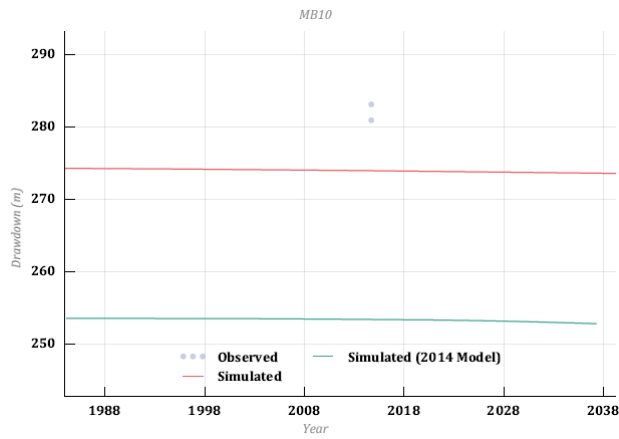


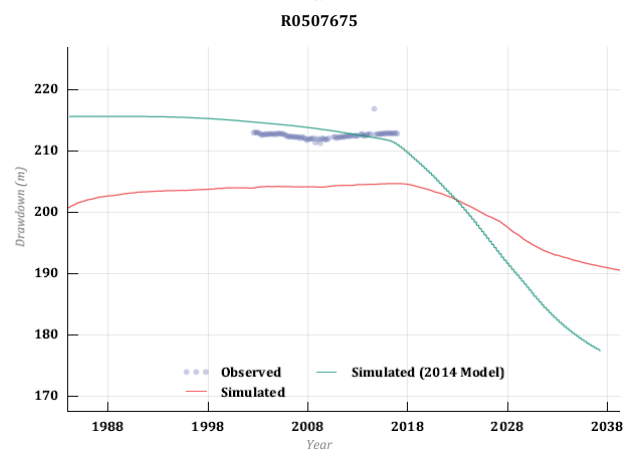
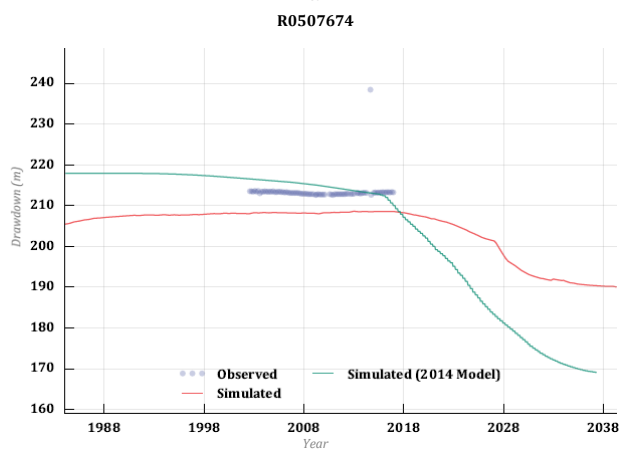
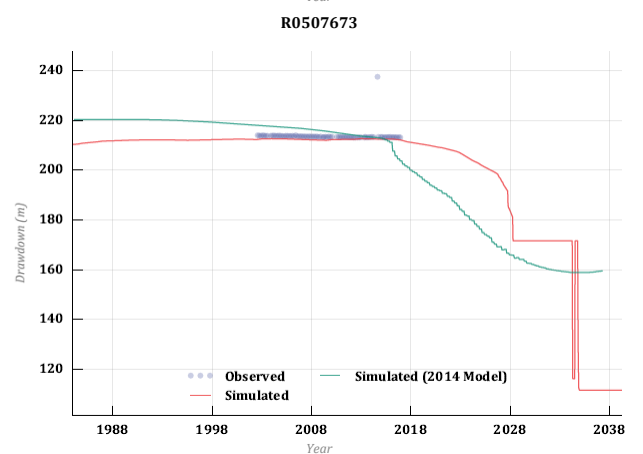
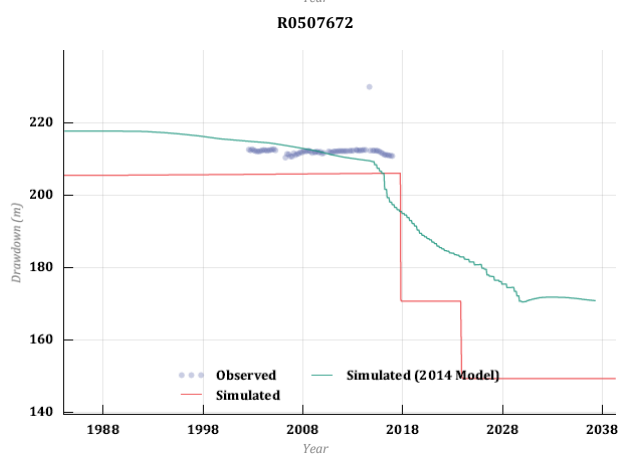
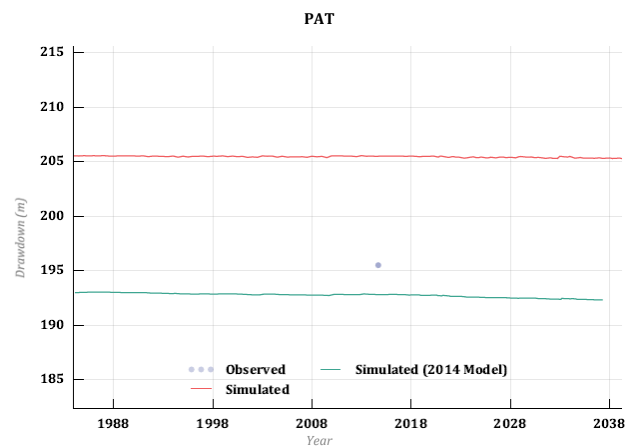
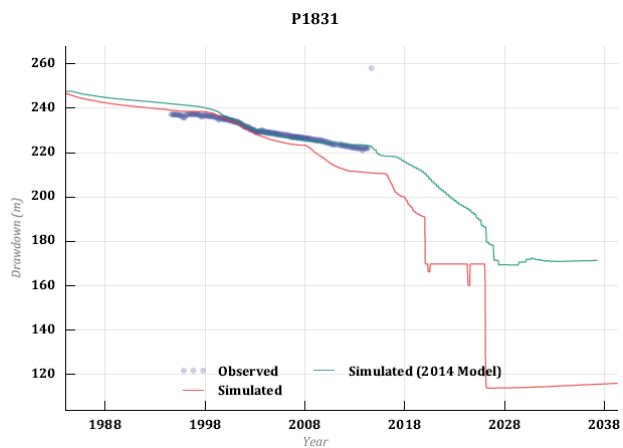
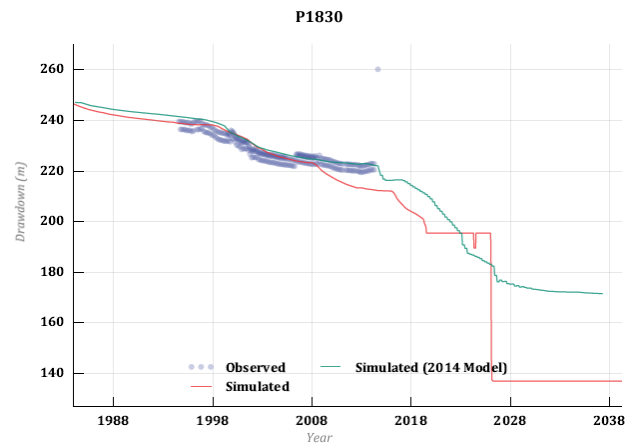
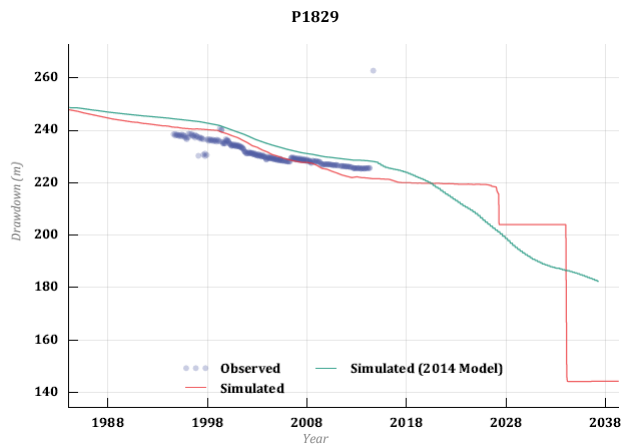
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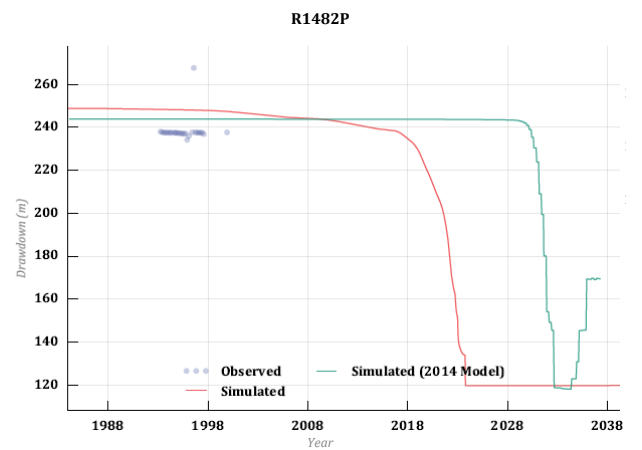
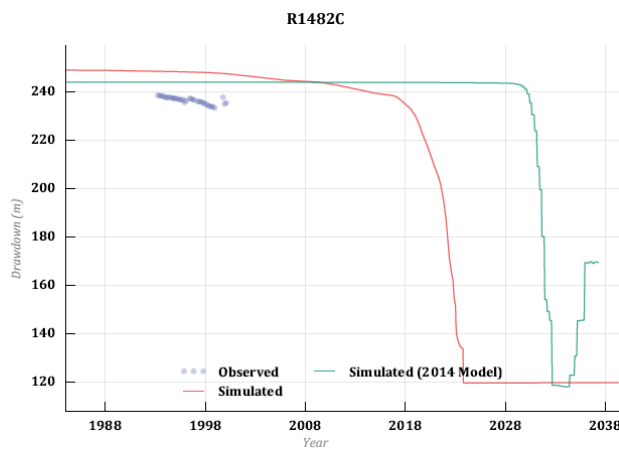
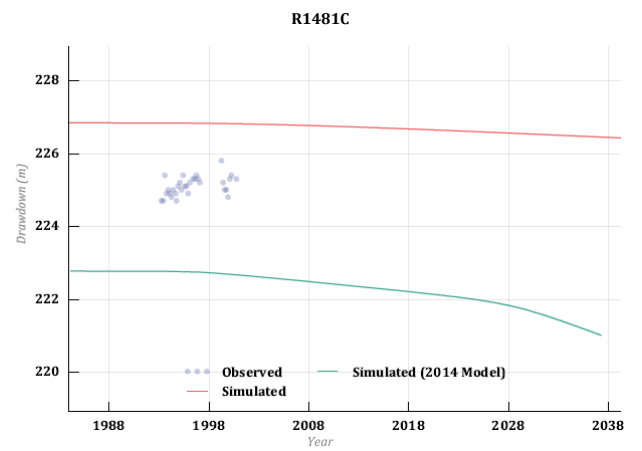
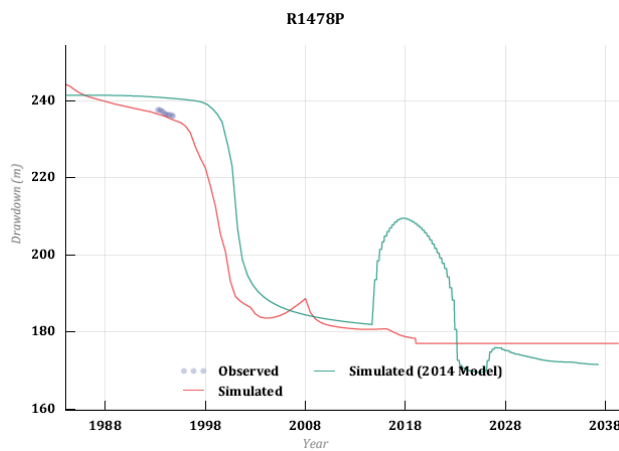
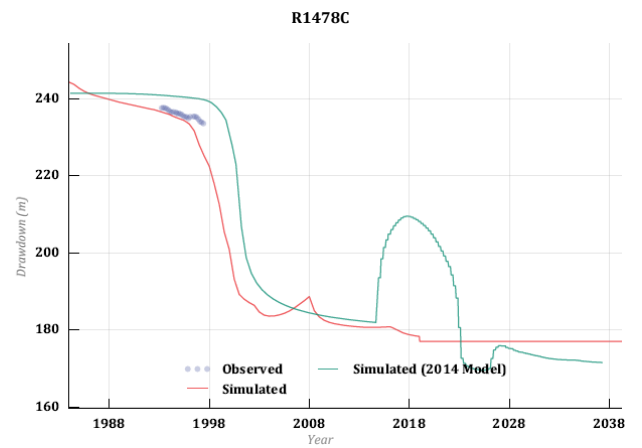
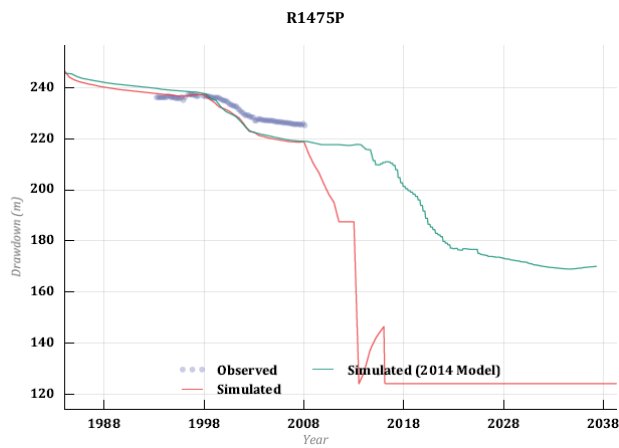
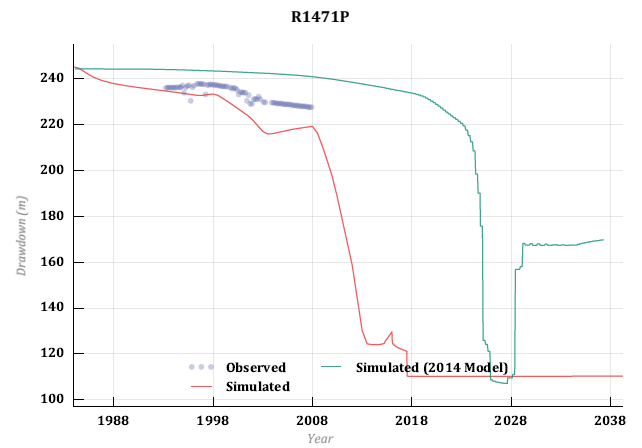
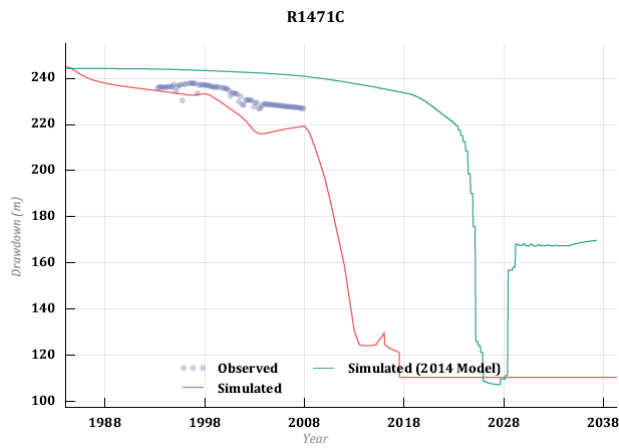


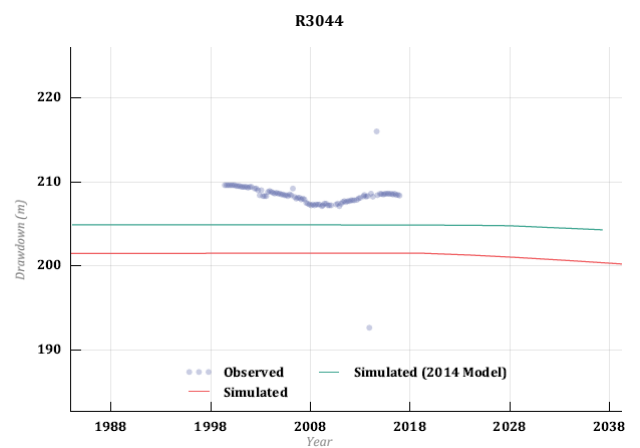
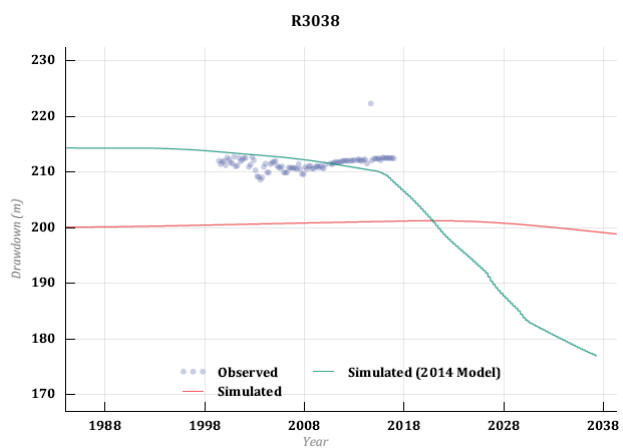
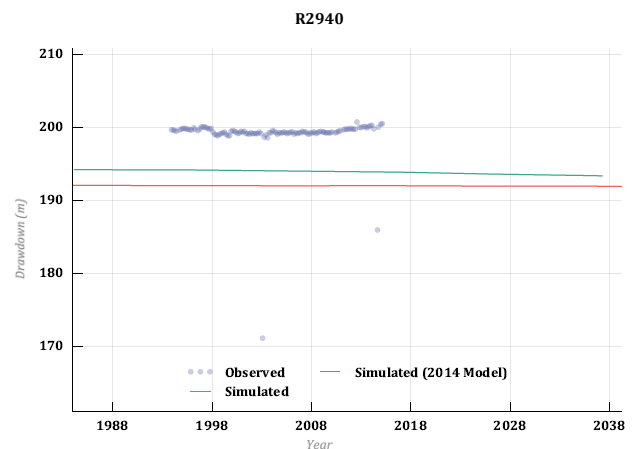
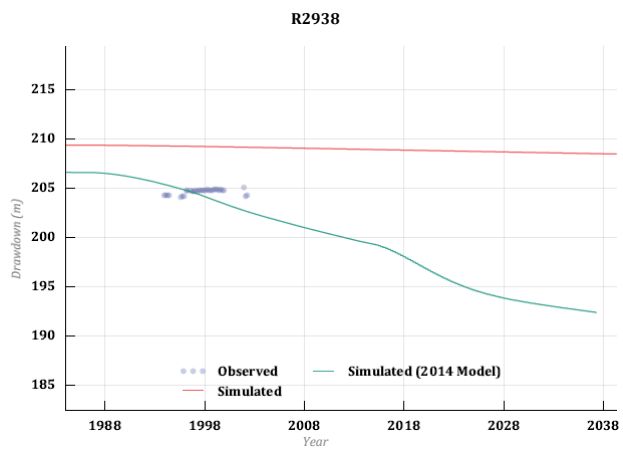
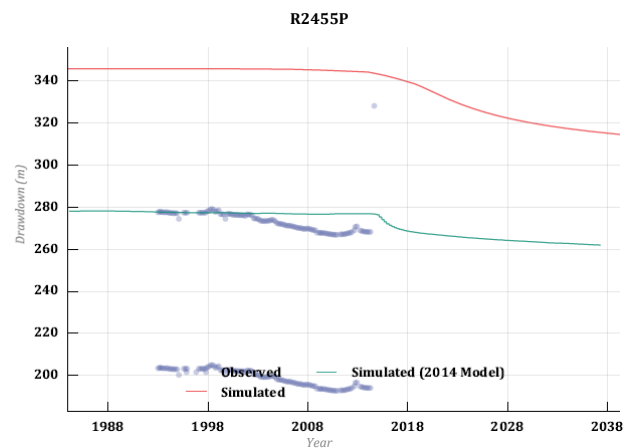
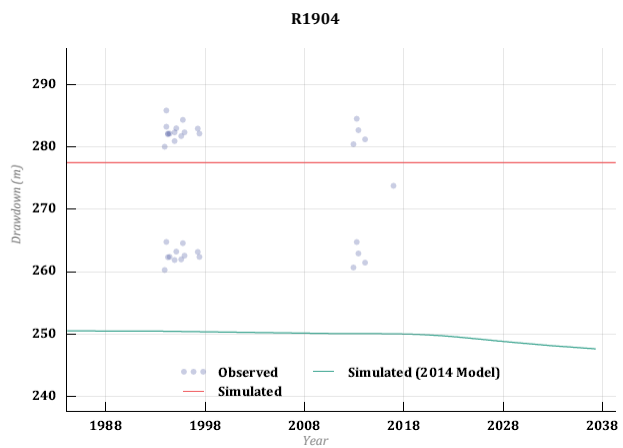
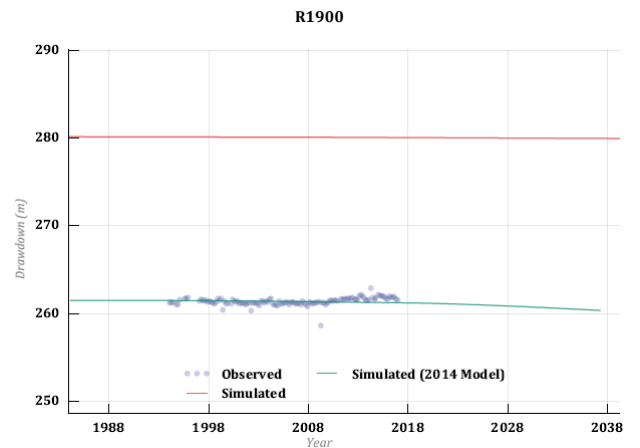
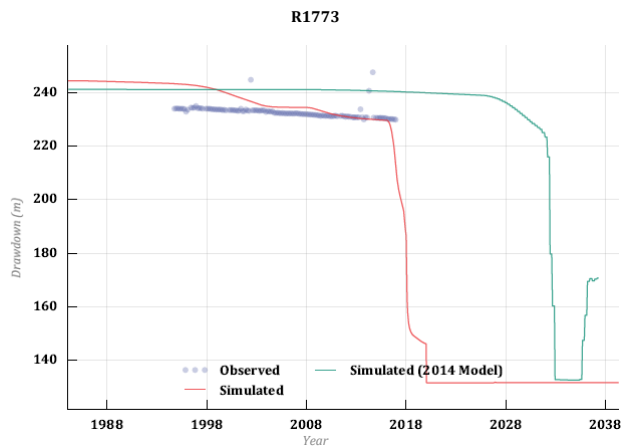
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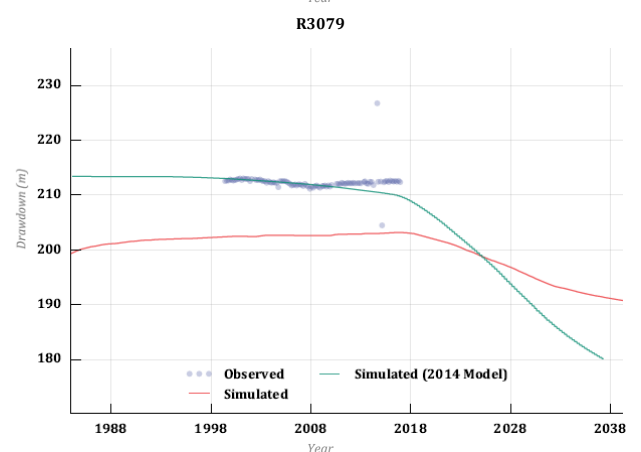
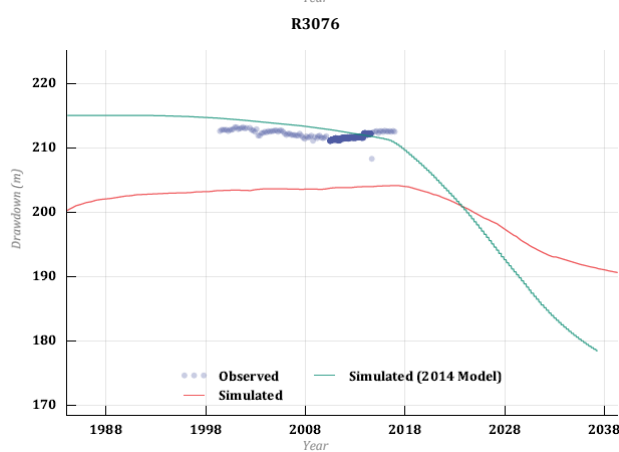
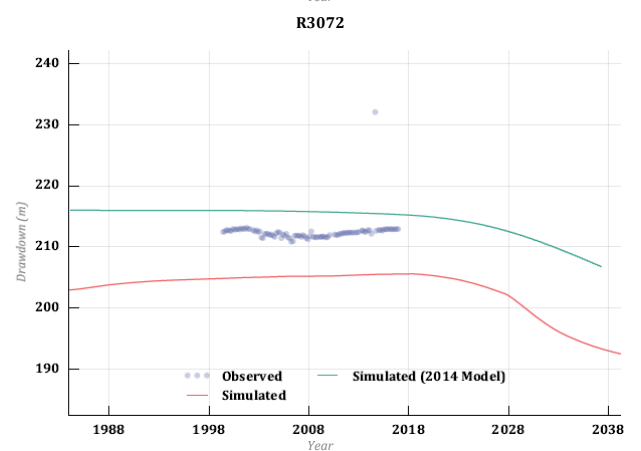
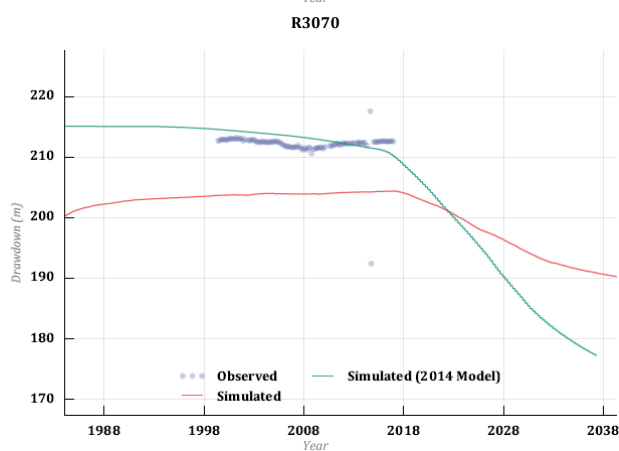
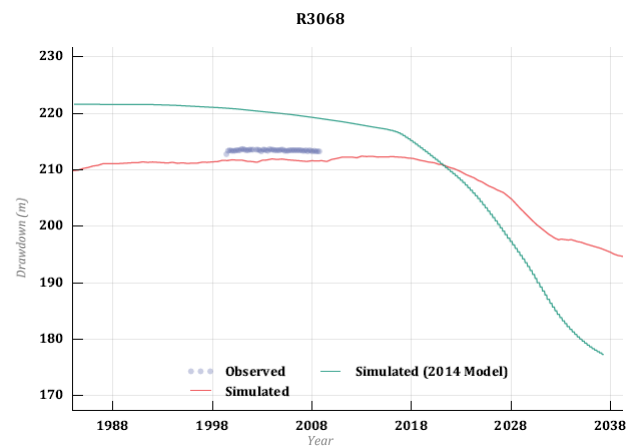
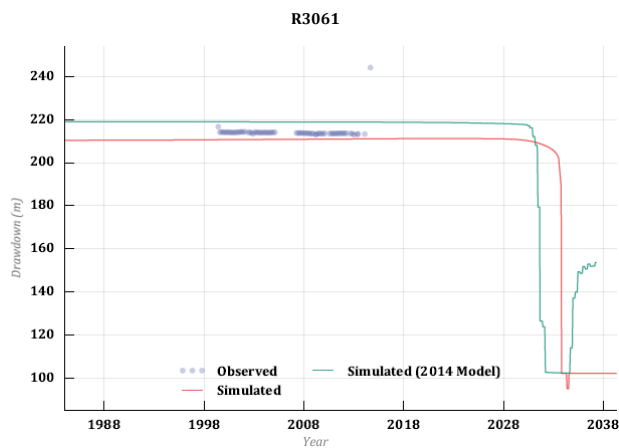
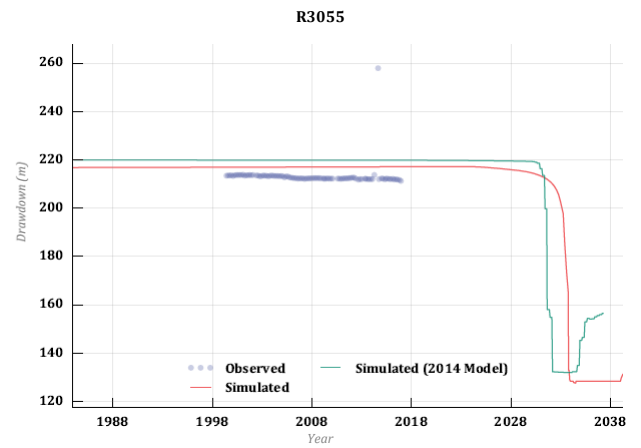
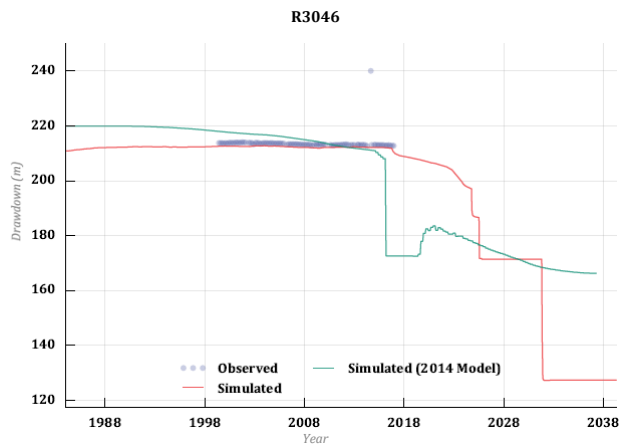


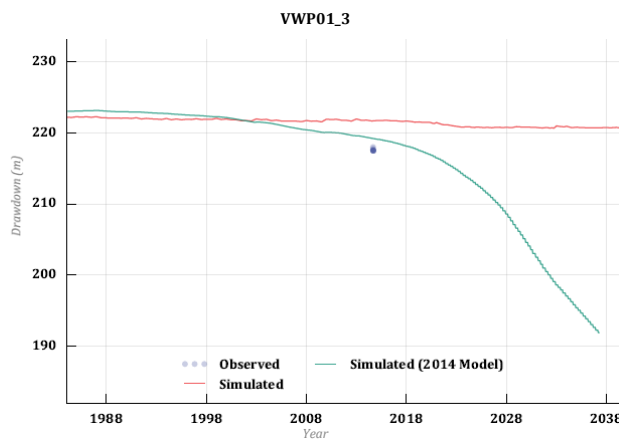
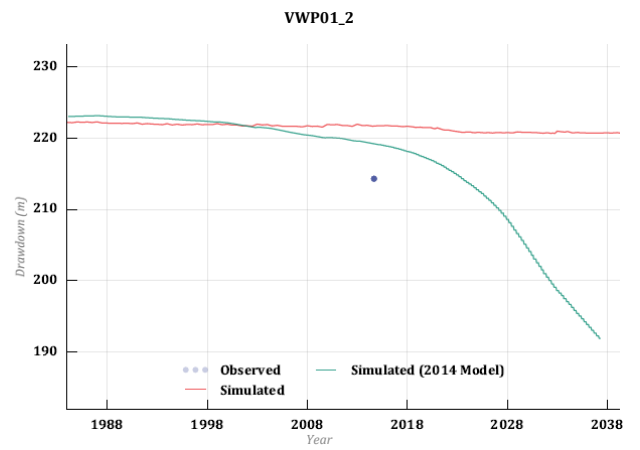
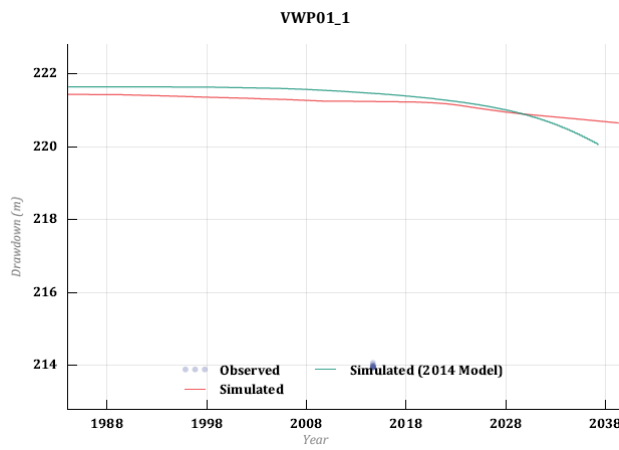
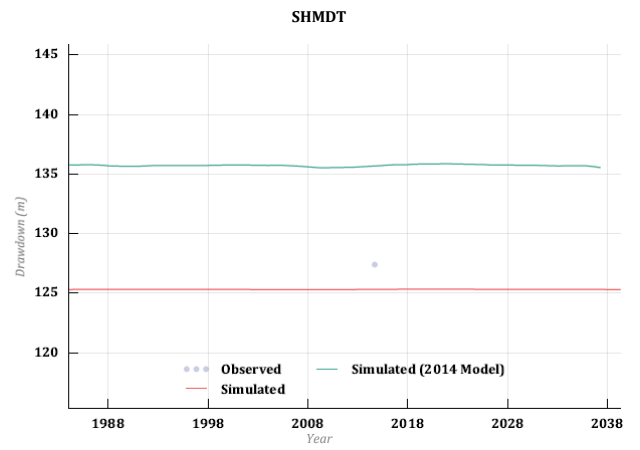
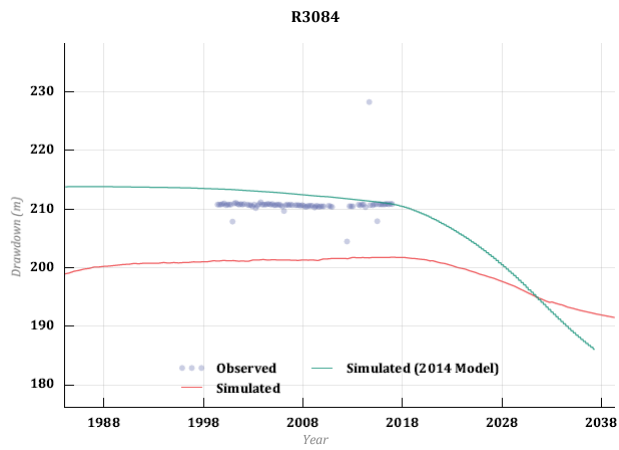












Appendix C Groundwater permeability data used in the groundwater modelling

Model layer	Lithology	Horizontal hydraulic conductivity (m/day)	Field data range
1	Surficial alluvium	2×10^{-1}	-
1	Quaternary sediments – colluvium and sheetwash	5×10^{-1}	-
1	Surficial cover (regolith)	1×10^{-1}	-
1	Tertiary basalt (fresh)	5.9	-
2	Callide Valley alluvium – basal sands and gravels	2×10^{-1} to 2×10^{-3}	Model parameters used across the Callide Valley alluvium were derived directly from the existing government model (DNRM 2001)
3/4	Biloela Formation – upper / lower	7.1×10^{-3} / 1.8×10^{-2}	1.4 (MB17 slug test)
5/6	Precipice Sandstone – upper / lower	1/1.5	5.2×10^{-3} to 2.81 * a)b)c)d)e)g)
7	Callide Coal Measures – coarse grained sandstone	1×10^{-2}	1.6×10^{-3} to 3.3×10^{-1} * b)c)e)f)
8/10/12	Callide Coal Measures – siltstone / shale	1×10^{-4} and 4.2×10^{-5}	4.0×10^{-4} to 1.4×10^{-2} * a)b)c)d)
9/11	Callide Coal Measures – upper and lower coal seams	1×10^{-3}	3.5×10^{-3} to 7.8×10^{-1} * d)
13	Basement volcanics	2.7×10^{-3}	3.9×10^{-2} (MB18 slug test)
-	Spoil	0.5	-

Notes:

*Field data derived from:

- a) 2014 slug tests of MB05 / MB07 (coal measures) and MB09, MB15, MB16 and R0507675 (Precipice Sandstone);
- b) Core analysis from VWPO1 in 2014;
- c) Coffey 1999;
- d) Golder 1979
- e) Pump tests conducted at landholder bores
- f) Boyd Mining 1991; and
- g) AGE 2007.

Appendix D Groundwater quality data analysis

Bore	1900	1904	BH01	BLUFF01D	BLUFF02D	BLUFF02S	C0507653	C0507655	C0507659
EA bore	Y	N	Y	N	N	N	N	N	N
Aquifer	Biloela Formation		Volcanic Basement						
MIN DATE	7/04/2014	29/04/2015	28/04/2015	29/04/2015	29/04/2015	29/04/2015	8/04/2014	9/04/2014	9/04/2014
MAX DATE	12/12/2022	12/12/2022	21/12/2022	20/12/2022	20/12/2022	20/12/2022	25/03/2021	2/04/2019	14/12/2022
Date Range	07/04/2014 - 12/12/2022	29/04/2015 - 12/12/2022	28/04/2015 - 21/12/2022	29/04/2015 - 20/12/2022	29/04/2015 - 20/12/2022	29/04/2015 - 20/12/2022	08/04/2014 - 25/03/2021	09/04/2014 - 02/04/2019	09/04/2014 - 14/12/2022
Count	18	1	18	5	5	5	6	4	7
pH - MIN	6.83	5.59	6.28	6.66	7.09	6.76	6.74	6.89	6.63
pH - 5th %	6.95	5.59	6.40	6.66	7.11	6.79	6.76	6.89	6.67
pH - 10th %	6.99	5.59	6.45	6.66	7.13	6.82	6.77	6.90	6.71
pH - 20th %	7.00	5.59	6.57	6.67	7.17	6.88	6.80	6.90	6.81
pH - 50th %	7.08	5.59	6.88	6.69	7.31	7.11	6.93	6.92	7.04
pH - 80th %	7.15	5.59	7.11	6.84	7.46	7.14	7.01	6.98	7.09
pH - 90th %	7.20	5.59	7.15	6.87	7.51	7.18	7.10	7.03	7.13
pH - 95th %	7.21	5.59	7.22	6.89	7.53	7.20	7.15	7.06	7.15
pH - MAX	7.28	5.59	7.30	6.90	7.55	7.22	7.19	7.08	7.17
EC - MIN	3680	1654	28000	6560	8220	8450	1556	1660	1278
EC - 5th %	3850	1654	32845	6743	8240	9740	1561	1667	1285
EC - 10th %	3915	1654	34050	6925	8260	11030	1567	1674	1292
EC - 20th %	4002	1654	37960	7290	8300	13610	1596	1689	1368
EC - 50th %	4450	1654	39700	7555	8670	14610	1750	1773	1582
EC - 80th %	5138	1654	41520	7780	9240	17030	1816	1860	1716
EC - 90th %	5270	1654	43430	8055	9240	17085	8595	1877	1755
EC - 95th %	5345	1654	43530	8193	9240	17113	13668	1886	1766
EC - MAX	5370	1654	43700	8330	9240	17140	18740	1894	1776

C0507663 Y Callide Coal Measures 9/04/2014 14/12/2022	C1363C N 8/04/2014 23/03/2021	C1363P N 8/04/2014 23/03/2021	C1462C N 8/04/2014 20/12/2022	C1462P N 8/04/2014 20/12/2022	C3061 N 8/04/2014 13/12/2022	DC01 Y Precipice Sandstone 19/10/2016 12/12/2022	DC02 Y Precipice Sandstone 29/04/2015 12/12/2022	DC040C Y Callide Coal Measures 29/04/2015 12/12/2022	DC040P Y Callide Coal Measures 29/04/2015 12/12/2022	HUT01 Y Callide Coal Measures 19/10/2016 12/12/2022
09/04/2014 - 14/12/2022 18	08/04/2014 - 23/03/2021 5	08/04/2014 - 23/03/2021 5	08/04/2014 - 20/12/2022 4	08/04/2014 - 20/12/2022 4	08/04/2014 - 13/12/2022 7	19/10/2016 - 12/12/2022 17	29/04/2015 - 12/12/2022 18	29/04/2015 - 12/12/2022 17	29/04/2015 - 12/12/2022 17	19/10/2016 - 12/12/2022 17
6.52	6.48	6.41	6.10	6.44	6.50	5.77	6.69	6.65	6.66	6.74
6.72	6.49	6.45	6.13	6.44	6.51	6.38	6.70	6.69	6.68	6.74
6.79	6.50	6.48	6.16	6.44	6.52	6.56	6.73	6.73	6.70	6.74
6.90	6.51	6.55	6.21	6.45	6.57	6.59	6.76	6.75	6.75	6.80
7.05	6.60	6.63	6.38	6.50	6.73	6.70	6.89	6.79	6.85	7.00
7.21	6.65	6.66	6.51	6.55	6.75	6.82	7.28	6.85	6.87	7.08
7.27	6.70	6.68	6.55	6.55	6.79	6.87	7.36	6.88	7.04	7.16
7.33	6.73	6.69	6.57	6.56	6.83	6.92	7.39	6.90	7.16	7.17
7.38	6.75	6.70	6.59	6.56	6.86	7.02	7.43	6.90	7.22	7.17
462	925	884	127	747	1490	5130	4470	1316	1160	385
1165	935	903	142	806	1517	5410	4606	1714	1212	583
1381	946	921	157	864	1545	5654	4777	1835	1226	640
1448	966	958	186	981	1669	6049	4904	1943	1234	669
1517	983	965	224	1061	1865	6550	5290	2047	1335	710
1668	1018	1064	354	1113	1942	6850	5492	2354	1383	730
1721	1069	1068	565	1141	1966	6960	5643	2388	1406	737
1750	1094	1070	671	1155	1993	7068	5656	2404	1590	742
1764	1119	1072	777	1169	2020	7260	5690	2420	2260	745

HUT03 Y	MB06 Y	MB07 Y	MB08 Y	MB12 N	MB13 N	MB14 N	MB15 Y	MB16 Y	MB18 Y	MB23 Y
Callide Coal Measures	Precipice Sandstone	Callide Coal Measures	Volcanic Basement				Precipice Sandstone	Precipice Sandstone	Volcanic Basement	Callide Coal Measures
29/04/2015	18/04/2018	18/04/2018	8/01/2019	30/04/2015	30/04/2015	13/04/2016	25/09/2014	25/09/2014	25/09/2014	13/12/2018
20/12/2022	18/04/2018	21/12/2022	21/12/2022	21/12/2022	21/12/2022	21/12/2022	14/12/2022	14/12/2022	13/12/2022	14/12/2022
29/04/2015 - 20/12/2022	18/04/2018 - 18/04/2018	18/04/2018 - 21/12/2022	08/01/2019 - 21/12/2022	30/04/2015 - 21/12/2022	30/04/2015 - 21/12/2022	13/04/2016 - 21/12/2022	25/09/2014 - 14/12/2022	25/09/2014 - 14/12/2022	25/09/2014 - 13/12/2022	13/12/2018 - 14/12/2022
18	1	15	13	5	5	5	16	16	9	15
6.58	7.27	6.18	6.17	5.60	4.82	4.47	5.68	5.52	7.05	6.46
6.66	7.27	6.33	6.21	5.62	4.85	4.50	5.68	5.53	7.11	6.51
6.68	7.27	6.47	6.24	5.64	4.88	4.52	5.74	5.54	7.17	6.55
6.69	7.27	6.66	6.27	5.68	4.94	4.57	6.18	5.63	7.21	6.67
6.78	7.27	6.80	6.50	5.82	5.00	4.65	6.56	5.94	7.29	6.75
6.83	7.27	6.92	7.10	5.90	5.17	5.25	6.75	6.29	7.33	6.78
6.88	7.27	7.02	7.28	5.97	5.34	5.30	6.78	6.53	7.37	6.90
6.90	7.27	7.03	7.32	6.01	5.43	5.32	6.83	6.67	7.38	7.02
6.94	7.27	7.05	7.33	6.05	5.51	5.35	6.90	6.98	7.39	7.13
3010	786	342	28500	1804	2570	3320	354	413	2253	1483
3282	786	378	32220	1903	2688	3350	575	482	2352	1520
3505	786	419	34740	2002	2805	3380	667	570	2451	1552
3676	786	470	36700	2200	3040	3440	699	689	2506	1593
3945	786	833	41600	2750	3150	5615	794	1351	2590	1634
4082	786	1127	43320	2960	3540	6180	1118	1647	2840	1684
4132	786	1455	44040	13315	3610	6970	1183	1702	2872	1735
4271	786	1695	44960	18493	3645	7365	1211	1724	2876	1774
4900	786	1990	46100	23670	3680	7760	1276	1755	2880	1840

MB26 Y	MB27 Y	MB28 Y	MB29 Y	Oaky Ck East N	Oaky Ck West N	R0507672 N	R0507673 N	R0507674 N	R0507675 N	R1773 N
Callide Coal Measures	Callide Coal Measures	Alluvium	Precipice Sandstone							
13/12/2018	12/12/2019	15/10/2020	15/10/2020	18/04/2018	18/04/2018	9/04/2014	8/04/2014	8/04/2014	8/04/2014	7/04/2014
12/12/2022	12/12/2022	14/12/2022	14/12/2022	16/10/2018	16/10/2018	2/04/2019	25/03/2021	14/12/2022	14/12/2022	6/04/2021
13/12/2018 - 12/12/2022	12/12/2019 - 12/12/2022	15/10/2020 - 14/12/2022	15/10/2020 - 14/12/2022	18/04/2018 - 16/10/2018	18/04/2018 - 16/10/2018	09/04/2014 - 02/04/2019	08/04/2014 - 25/03/2021	08/04/2014 - 14/12/2022	08/04/2014 - 14/12/2022	07/04/2014 - 06/04/2021
15	15	10	10	2	2	4	6	6	7	4
6.00	5.87	4.15	4.33	6.26	6.26	6.02	5.31	5.94	5.96	5.51
6.04	5.89	4.51	4.34	6.26	6.26	6.02	5.37	6.03	5.98	5.51
6.13	5.94	4.88	4.35	6.27	6.26	6.03	5.43	6.12	6.01	5.52
6.29	6.09	5.54	4.39	6.27	6.26	6.04	5.54	6.29	6.04	5.52
6.36	6.23	6.00	4.49	6.29	6.27	6.07	5.65	6.87	6.14	5.58
6.43	6.26	6.42	5.01	6.31	6.28	6.11	5.69	6.95	6.24	5.64
6.45	6.40	6.52	5.65	6.31	6.28	6.13	5.76	7.01	6.30	5.64
6.46	6.60	6.61	5.73	6.32	6.28	6.14	5.80	7.04	6.34	5.65
6.47	6.87	6.70	5.81	6.32	6.28	6.15	5.83	7.07	6.37	5.65
1155	1285	5180	865	816	717	842	881	481	110	768
1329	1286	5351	866	817	722	847	906	497	434	768
1429	1290	5522	867	817	728	852	931	513	759	769
1485	1480	5576	877	818	739	862	970	575	1058	769
1595	1921	10555	914	821	772	912	999	787	1096	784
1634	2121	15320	938	824	804	952	1068	851	1127	819
1651	2147	17250	944	825	815	955	1094	911	1154	836
1663	2163	18375	949	826	821	957	1104	952	1172	844
1677	2170	19500	953	826	826	958	1113	992	1189	852

R1829 N	R1830 N	R1831 N	R3038 Y Precipice Sandstone	R3044 N	R3046 N	R3055 Y Callide Coal Measures	R3070 Y Callide Coal Measures	R3072 Y Callide Coal Measures	R3076 Y Precipice Sandstone	R3079 Y Precipice Sandstone
7/04/2014 20/12/2022	7/04/2014 18/04/2018	7/04/2014 10/10/2017	9/04/2014 14/12/2022	9/04/2014 9/06/2020	8/04/2014 31/03/2021	8/04/2014 13/12/2022	8/04/2014 14/12/2022	8/04/2014 14/12/2022	8/04/2014 13/12/2022	8/04/2014 13/12/2022
07/04/2014 - 20/12/2022	07/04/2014 - 18/04/2018	07/04/2014 - 10/10/2017	09/04/2014 - 14/12/2022	09/04/2014 - 09/06/2020	08/04/2014 - 31/03/2021	08/04/2014 - 13/12/2022	08/04/2014 - 14/12/2022	08/04/2014 - 14/12/2022	08/04/2014 - 13/12/2022	08/04/2014 - 13/12/2022
5	3	2	20	4	6	18	21	18	18	18
5.85	6.52	6.63	5.84	6.79	6.29	6.52	6.22	6.67	6.04	6.56
5.85	6.53	6.64	5.85	6.81	6.33	6.68	6.25	6.69	6.28	6.75
5.85	6.53	6.64	5.98	6.82	6.38	6.71	6.27	6.87	6.38	6.78
5.86	6.55	6.66	6.05	6.86	6.46	6.74	6.44	6.97	6.53	6.80
5.99	6.59	6.70	6.58	6.90	6.67	6.89	6.69	7.13	6.70	6.93
6.09	6.66	6.73	6.82	6.94	6.78	7.06	6.81	7.20	6.81	7.07
6.12	6.69	6.75	6.85	6.97	6.83	7.07	6.86	7.24	6.96	7.12
6.14	6.70	6.75	6.95	6.99	6.85	7.09	6.89	7.43	7.02	7.13
6.15	6.71	6.76	7.13	7.00	6.87	7.12	6.98	8.45	7.24	7.13
800	847	1180	1146	2630	812	1862	1015	1169	1197	1106
801	852	1180	1217	2668	843	1929	1050	1219	1210	1124
802	858	1181	1226	2705	874	1951	1071	1229	1237	1140
804	868	1181	1340	2780	955	2004	1105	1257	1382	1155
812	900	1183	1500	2930	1252	2090	1196	1511	1456	1347
879	986	1185	1617	3016	1482	2146	1280	1901	1551	3256
897	1014	1185	1650	3043	1727	2183	1294	1986	1617	3480
906	1029	1186	1653	3057	1883	2201	1295	2011	1629	3552
915	1043	1186	1708	3070	2040	2260	1308	2015	1675	3560

R3084	TG01
Y	Y
Precipice	Callide Coal
Sandstone	Measures
8/04/2014	29/04/2015
13/12/2022	12/12/2022

08/04/2014 -	29/04/2015 -
13/12/2022	12/12/2022

18

18

6.51

6.32

6.64

6.43

6.67

6.51

6.83

6.53

6.97

6.63

7.07

6.69

7.10

6.71

7.12

6.73

7.18

6.77

252

1346

532

1406

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1420

1102

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1317

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Appendix E

Final Void Water Balance Report

Batchfire – Callide Mine

PRCP Final Void Hydrology Assessment

Callide Mine PRCP

13 March 2023

M60000_011_REP_001-1

Job no. and Project Name: M60000_011 PRCP Final Void Hydrology Assessment

Doc Path File: \\online.com\files\Management\Projects\M60000 Batchfire\M60000_011 Callide PRCP SW Studies\07 Deliv\2. Report\Final Void Hydrology Assessment\Final\M60000_011-REP-001-0A-Callide PRCP Residual Void Hydrology Assessment.docx

Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	7/10/2022	Client issue	Nutan Gothwal	Tim Wallis	Matthew Curtis	Matthew Curtis
1	13/03/23	Client issue	Nutan Gothwal	Tim Wallis	Matthew Curtis	Matthew Curtis

Signatures



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1 BACKGROUND

1.1 PROJECT LOCATION

The Callide Coal Mine (CCM) is an open cut coal mine owned and operated by Batchfire Resources Pty Ltd. The site is located approximately 10km north-east of Biloela and is situated within the Fitzroy basin. The mine site is separated into four distinct areas of mining: Dunn Creek, The Hutt, Trap Gully, and Boundary Hill. Each mining area is separated by between 3km to 15km with Boundary Hill located to the north-west and The Hutt, Dunn Creek, and Trap Gully located relatively close together to the southeast.

Mining activities at CCM are currently approved under Environmental Authority (EA) EPML00720413. Batchfire are preparing a Progressive Rehabilitation and Closure Plan (PRCP) which includes a design of the proposed rehabilitated final landform for the site. This report assesses the final void hydrology to support the submission of the PRCP. The hydrologic behaviour of the proposed final voids as part of the PRCP have been assessed through the development of long-term water balance model simulations for void lake water quantity and quality.

1.2 ASSESSMENT SCOPE

The key objectives of the Callide Coal Mine residual void hydrology assessment are:

- Review final void configuration and determine final drainage catchments including any final landform drainage diversions to manage void catchments.
- Water balance (using GoldSim) assessment to determine void water storage containment risk and:
 - Identify changes to storage volumes and water quality over time as well as predicted equilibrium status.
 - Quantify overflow probability and filling times.

1.3 WATER BALANCE CONCEPTUALISATION

Figure 1-1 shows the water balance conceptual model and considers the following key fluxes:

- Inflows
 - Surface runoff inflows from the void catchment – this includes areas of rehabilitated spoil, walls and floor of the void and any undisturbed areas.
 - Direct rainfall on the void lake.
 - Groundwater inflows to the void (if the void lake level is lower than the regional groundwater table, refer to Section 2.5).
 - Seepage through spoil from adjacent voids where relevant.
- Outflows:
 - Evaporative losses from the water surface area of the void lake.
 - Seepage losses to groundwater (if the void lake level is higher than the regional groundwater table, refer to Section 2.5).
 - Seepage losses through spoil – where void lake containment loss may occur to the receiving environment via backfilled spoil.
 - Infiltration through indirectly connected rehabilitated spoil catchments.
 - Surface overflow if void storage capacity is exceeded.
 - Seepage through spoil to adjacent voids where relevant.

Section 1.3.1 provides additional details on the key assessment criteria adopted for the assessment. Table 1-1 below summarises the modelling approach adopted for each void. Voids have either been assessed independently as single voids or as multiple voids hydraulically connected through backfilled spoil. Where voids are assumed to be connected no allowance has been made for seepage transmission through spoil and equalisation is therefore assumed to occur instantaneously each timestep (daily).

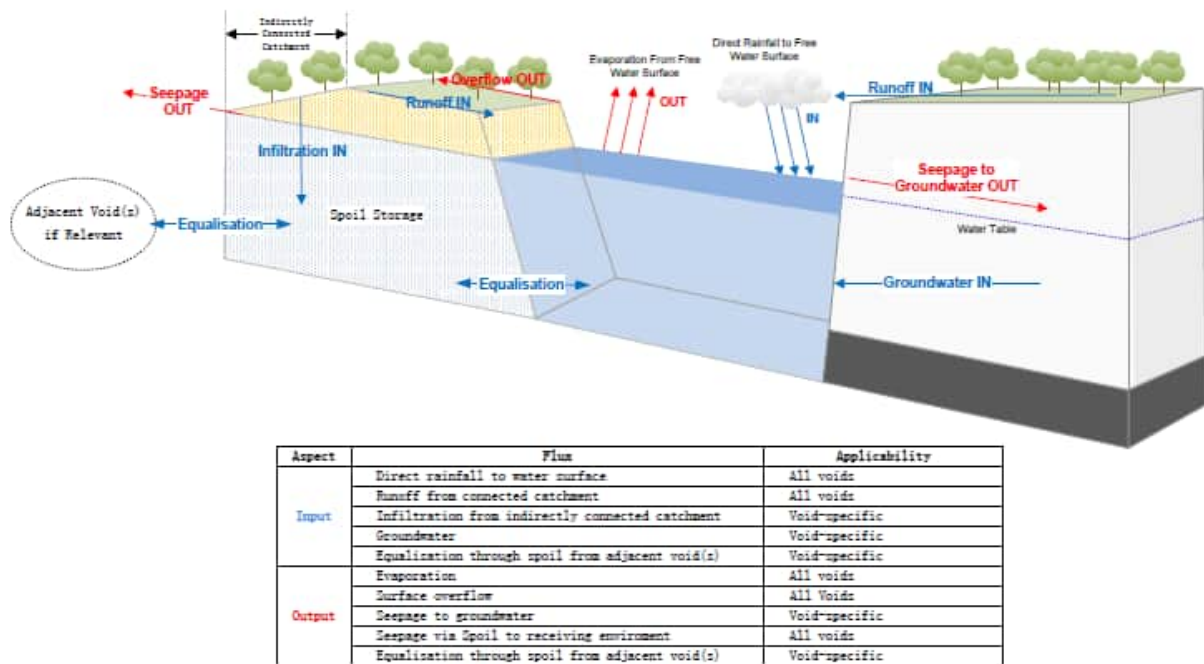


Figure 1-1 Water Balance Conceptual Model

Table 1-1: Residual Voids and Assessment Approach

Mining Area	Final Void ID	Assessment Approach
Boundary Hill	BH1	Single void
	BH2	Modelled as single element. Each final void is located within single pit shell and hydraulically connected through spoil. No allowance made for seepage rates through spoil - equalisation assumed to occur instantaneously.
	BH4	
	BH5	
	BH3	Single void
Dunn Creek	DC1	Modelled as single element. Each final void located within single pit shell and hydraulically connected through spoil. No allowance made for seepage rates through spoil - equalisation assumed to occur instantaneously.
	DC2	
Trap Gully	TG1	Single void
The Hut	TH1	Modelled discretely but connected via seepage through spoil. No allowance made for seepage rates through spoil - equalisation assumed to occur instantaneously.
	TH3	
	TH2	Single void

1.3.1 Assessment Criteria (Critical RLs)

To assess the containment risk for each void three critical relative levels (RLs) were considered as summarised in Table 1-2 and shown in Figure 1-2. The locations of each critical RL are shown on Figure 2-1 to Figure 2-4 below, summarised in Table 2-2 below and shown on each final void storage curve (Appendix A.2).

Table 1-2 Critical RLs - Description

Critical RL	Description
Seepage	Elevation at which seepage loss from the final void may enter the receiving environment through any backfilled spoil. This is typically the lowest elevation on the mined-out pit shell crest.
Surface overflow	Elevation at which surface overflow to the receiving environment could occur i.e., the total storage capacity of the final void is exceeded.

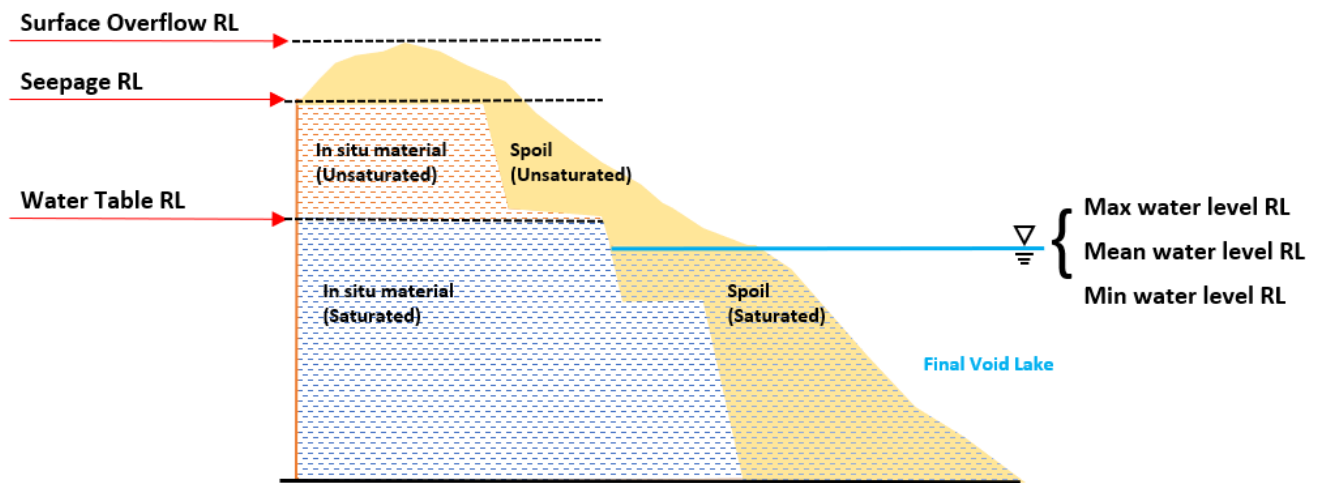


Figure 1-2 Critical RLs – General Arrangement

2 MODEL DATA INPUTS

2.1 CLIMATE DATA

Long-term daily climate data (rainfall and evaporation) was obtained from the SILO climate database facility (Qld Government, 2022). The patched point data utilises data from the Bureau Meteorology (BOM) weather station network with missing data infilled from grids of data interpolated from point observations from surrounding BOM weather stations.

Input data for the assessment comprised of a SILO Patched Point Data climate series obtained for BOM station 39150 (Callide Open Cut) and covering the period January 1889 to September 2019. A composite data set was obtained by merging the SILO data with SCM site rainfall to obtain a continuous record from January 1889 to April 2022 (133 years of data). Table 2-1 below summarises mean monthly totals for the following input data:

- Rainfall – used to estimate catchment runoff (refer to Section 2.4.2) and direct rainfall to each void lake surface.
- Mortons lake evaporation – used to estimate void lake evaporative losses.
- Evapotranspiration – used to inform the rainfall-runoff model (AWBM, refer to Section 2.4.2).

Table 2-1: Residual Void Hydrology Input Climate Data (Qld Government, 2022)

Month	Mean Rainfall (mm)	Mean Mortons Lake Evaporation (mm)	Mean Evapotranspiration (mm)
January	108.2	194.6	168.7
February	101.3	162.8	140.7
March	70.9	159.2	138.9
April	35.0	123.5	112.1
May	35.2	92.2	88.2
June	39.4	70.8	70.3
July	30.5	80.2	78.2
August	24.7	107.2	99.4
September	28.2	139.0	126.1
October	50.3	174.4	155.7
November	70.7	188.0	167.0
December	95.3	201.4	175.8

2.2 FINAL VOID STORAGE CURVES

Storage curves were developed for each final void to establish the relationship between elevation, final void water storage capacity and water surface area. The storage curves are used in the model to estimate daily evaporative losses from the void lake water surface. Storage curves for each final void are provided in Appendix A.2 and include consideration of potential spoil water storage. The volume of spoil within each final void was estimated by using the final landform and life of mine (LOM) pit shell digital elevation models (DEMs). The volume of spoil was estimated as the difference between each DEM for a given elevation interval. Potential water storage within the spoil was then estimated assuming a spoil porosity of 30%.

Each storage curve is presented with the following information:

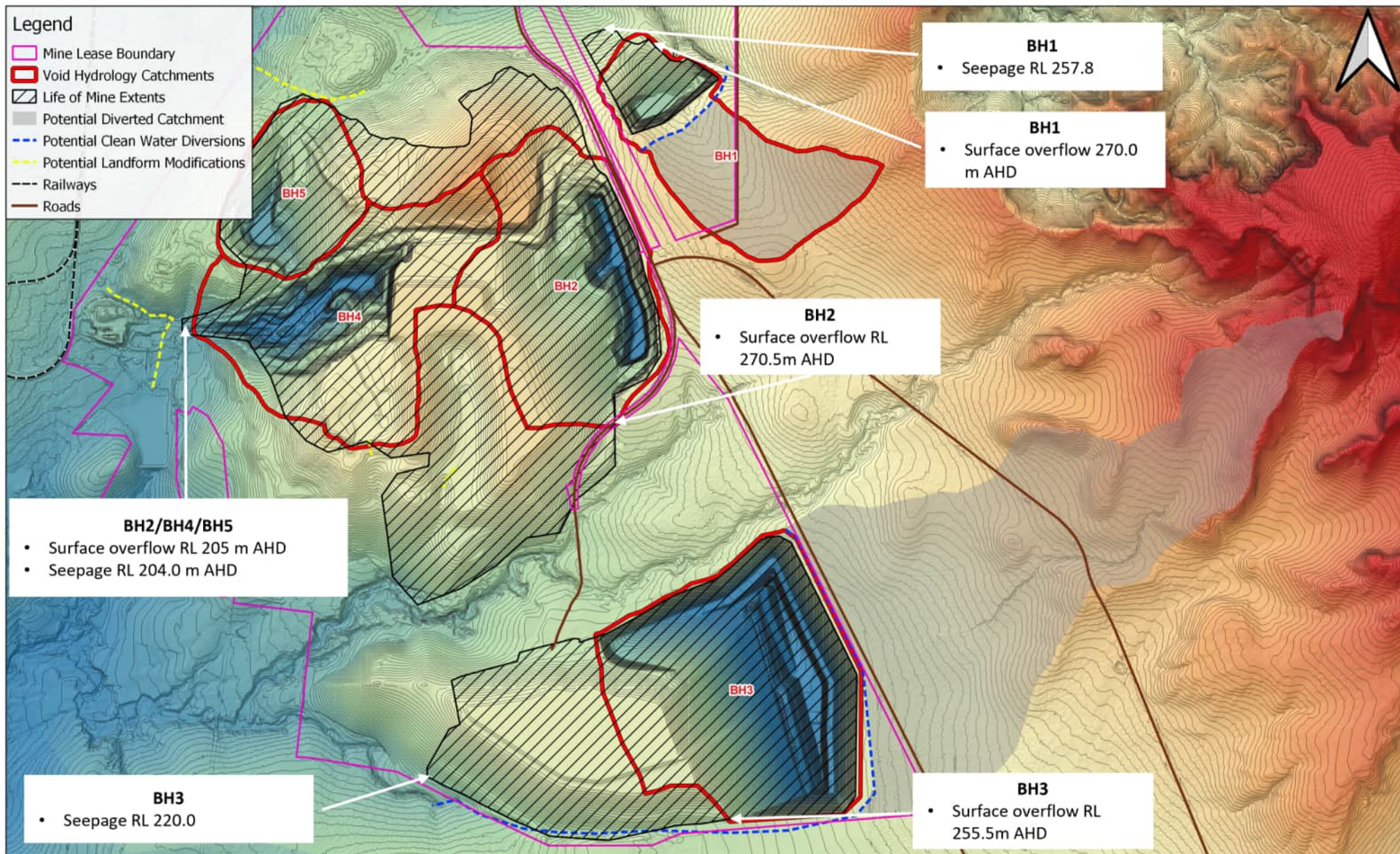
- RL:volume relationship (including potential spoil water storage)
- RL:area relationship
- Critical RLs:
 - Seepage
 - Surface overflow
- Additional relevant RLs:
 - Base of the LOM pit shell (lowest elevation in the mined-out pit shell)
 - Base of final void (lowest elevation in the final landform i.e., base of potential void lake)

2.3 FINAL VOID CRITICAL RLS SUMMARY

Critical RLs for each final void are summarised below in Table 2-2 and Figure 2-1 to Figure 2-4.

Table 2-2: Residual Voids – Critical RLs Summary

Mining Area	Final Void ID	Approach	Comments				
			Base of Pit Shell	Base of Final Void	Seepage	Surface Overflow	
Boundary Hill	BH1	Single void	220	230	257.8	270	• Surface overflow/seepage is to receiving environment
	BH2	Modelled as single structure. Each final void located within single pit shell and hydraulically connected through spoil	128	169	204	205	• Surface overflow/seepage is to receiving environment
	BH4			169.8			
	BH5			200			
	BH3	Single void	76	80	220	255.5	• Surface overflow/seepage is to receiving environment
Dunn Creek	DC1	Modelled as single structure. Each final void located within single pit shell and hydraulically connected through spoil	191	209	304	315.1	• Surface overflow/seepage is to receiving environment
	DC2						
Trap Gully	TG1	Single void	91	153	221.7	284	• Surface overflow/seepage is to receiving environment
The Hut	TH1	Modelled discretely but connected via seepage through spoil	246	283	323.5	324.9	• Surface overflow/seepage is to receiving environment
	TH3		320	320	338.5	359.5	• Seepage is to TH1 • No GW inflow as base of final void/shell above water table
	TH2	Single void	344	361	257.8	270	• Surface overflow/seepage is to receiving environment • No GW inflow as base of final void/shell above water table



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0 500 1,000 m

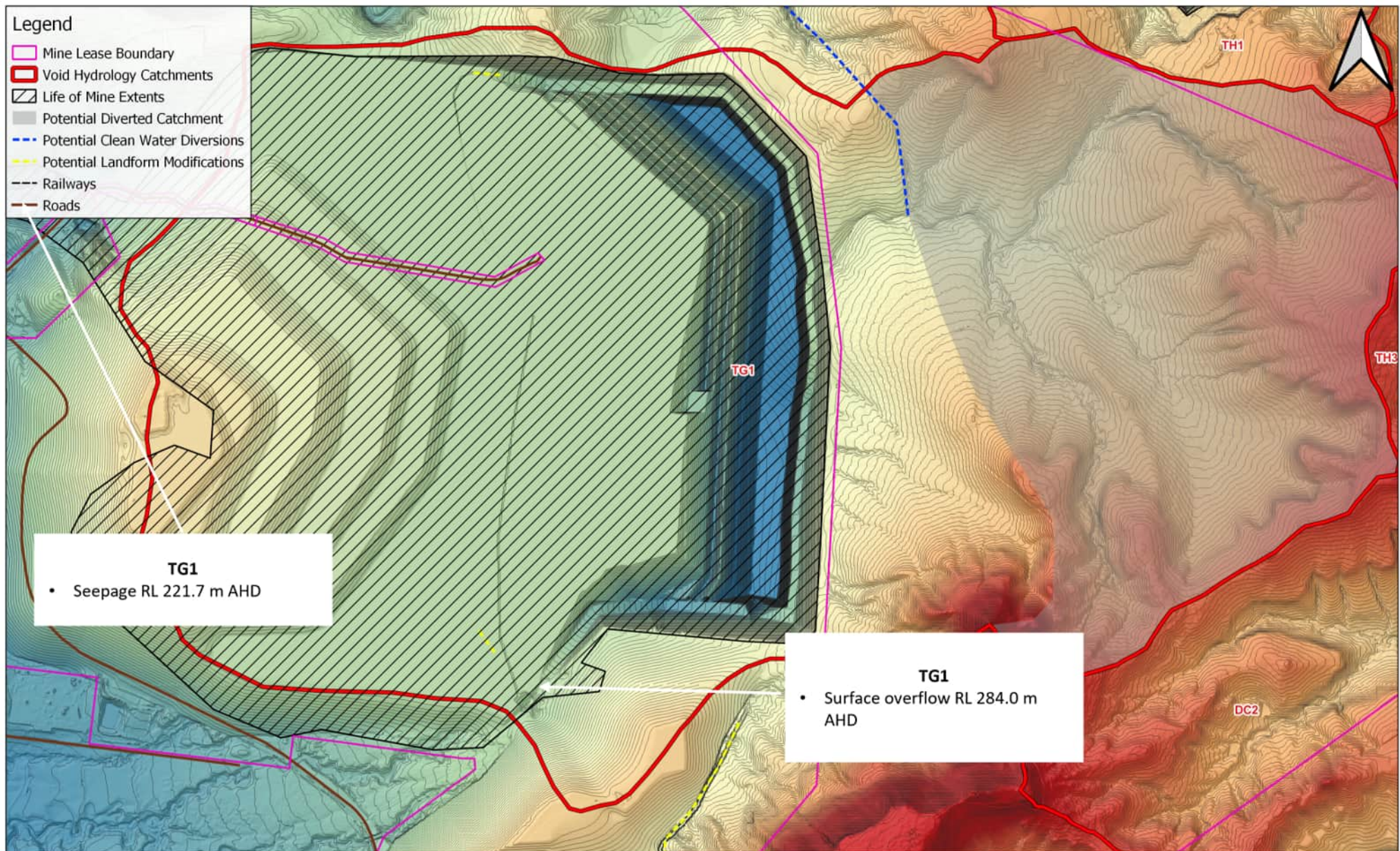
Scale in metres (21,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: GDA94 / MGA zone 56

Batchfire - Callide PRCP
Void Hydrology Catchments

Figure 2-1 Boundary Hill

Job Number:
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Revision: 0
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0 300 600 m

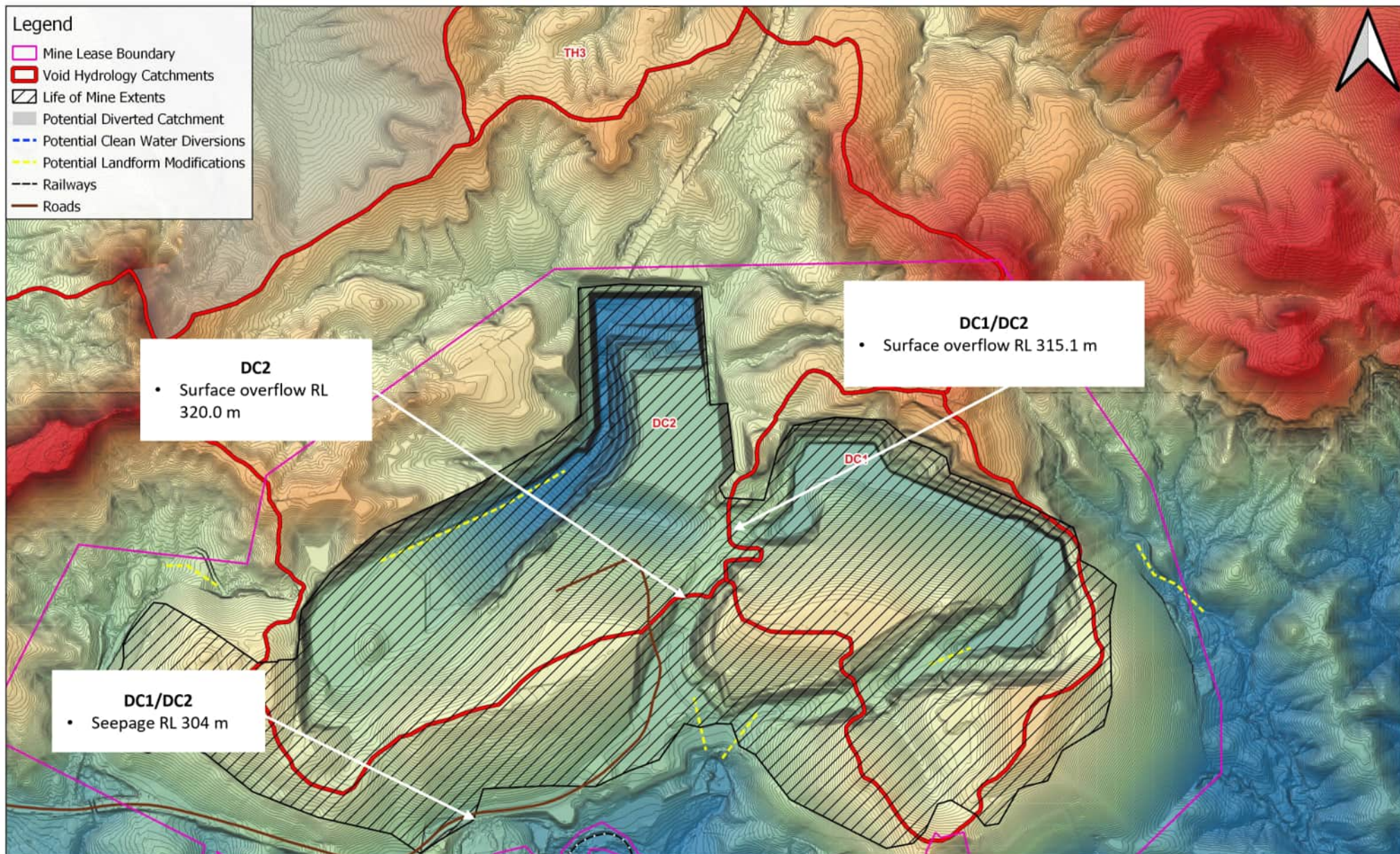
Scale in metres (15,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: GDA94 / MGA zone 56

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Figure 2-2 Trap Gully

Job Number:
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0 400 800 m

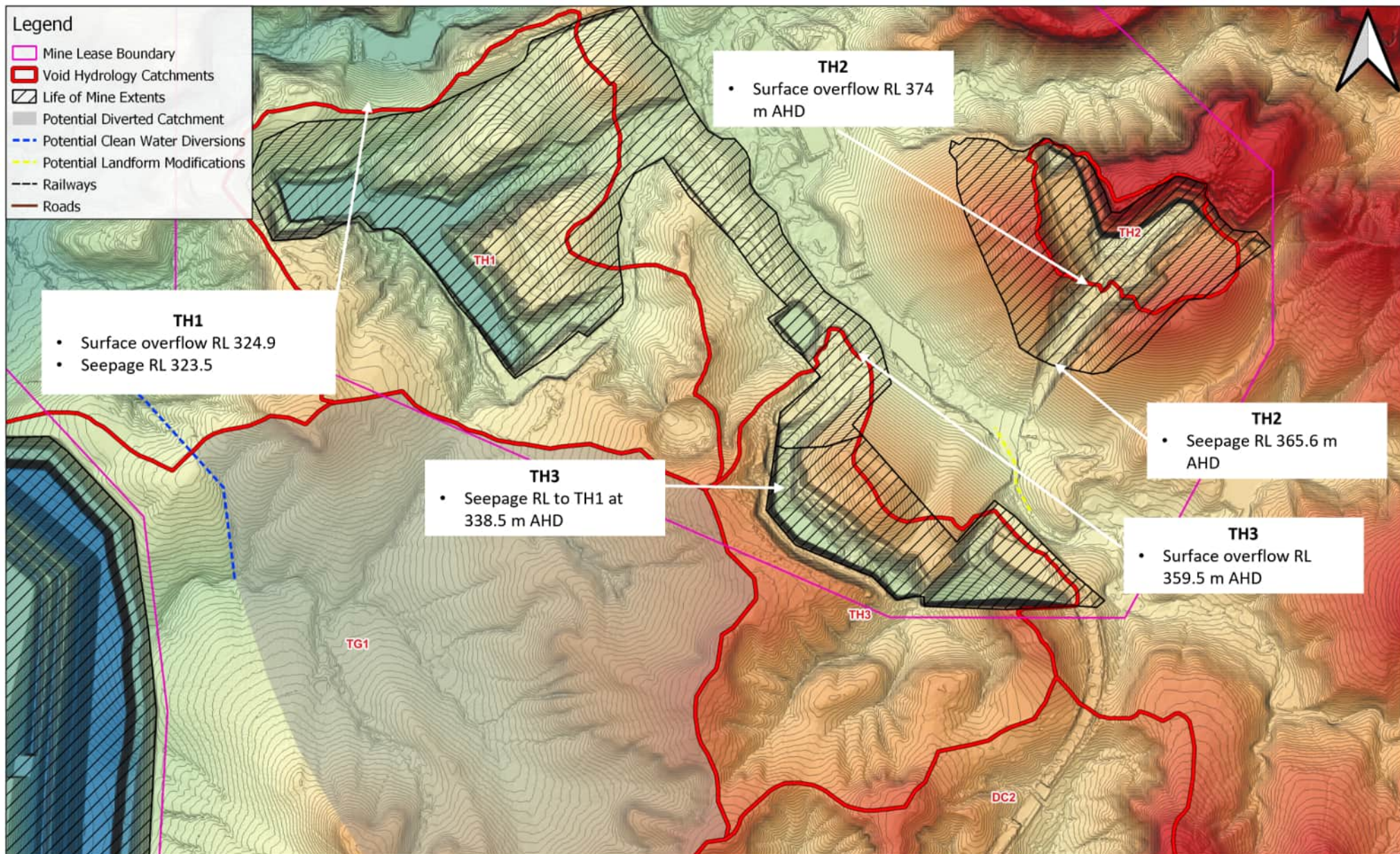
Scale in metres (18,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: GDA94 / MGA zone 56

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Void Hydrology Catchments

Figure 2-3 Dunn Creek

Job Number:
M60000_011
Revision: 0
Drawn: SW
Date: 10 / 3 / 2023



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0 300 600 m

Scale in metres (15,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: GDA94 / MGA zone 56

Batchfire - Callide PRCP
Void Hydrology Catchments

Figure 2-4 The Hut

Job Number:
M60000_011
Revision: 0
Drawn: SW
Date: 7 /10 /2022

2.4 CATCHMENT CHARACTERISTICS

2.4.1 Catchment Delineation and Optimisation (Clean Water Diversions)

Where practical and feasible diversion of external catchments reporting to each final void have been identified in order reduce potential inflows or provide for stability of final void high walls. Table 2-3 below summaries potential catchment diversions for each relevant final void.

Table 2-3 Catchment Diversion Opportunities

Final Void	Catchment Diverted	Comment
Boundary Hill – BH1	79 Ha	Catch drain to maintain stability of highwall (Figure 2-1)
Boundary Hill – BH3	391 Ha	Catchment diversion to reduce potential inflows (Figure 2-1)
Trap Gully – TG1	456 Ha	Catchment diversion to reduce potential inflows (Figure 2-2)

2.4.2 Catchment Landuse, Runoff and Water Quality

Catchment runoff has been simulated using the Australian Water Balance Model (Boughton, 1993). The model represents the catchment using three conceptual surface stores to simulate partial areas of runoff. The water balance of each surface store is calculated independently of the others. The model calculates the water balance of each partial area at daily time steps. At each time step, rainfall is added to each of the three surface stores and evapotranspiration is subtracted from each store. If the depth of water in the store exceeds the capacity of the store, the excess water becomes runoff. Part of this runoff becomes recharge of the baseflow store if there is a baseflow component to the streamflow.

A total of three distinct landuses have been represented in the model as follows:

- **Natural** – undisturbed areas that have not been subjected to mining. Australian Water Balance Model (AWBM) parameters have been adopted from the Callide Mine operational water balance model and are based on calibration to stream gauge 130319A (Bell Creek at Craiglands) which is located approximately 5.5km north of Boundary Hill.
- **Open cut pit** – areas of the final void that have been assumed not be rehabilitated such as the floor, high wall or other areas too steep for rehabilitation. AWBM parameters have been taken from Callide Mine operational water balance model and have been based on parameters for similar sites.
- **Rehabilitated spoil** – rehabilitated areas of spoil that comprise former spoil dumps and areas reshaped as part of mine closure. Predominately assumed to comprise of a forested final landuse similar to existing undisturbed areas. AWBM parameters have been selected to provide similar levels of runoff to natural areas whilst recognising that rehabilitated spoil catchments are likely to have higher effective runoff due to generally steeper gradients and more hydraulically efficient drainage. Adopted parameters have been tested for sensitivity (Section 4.2).
- **Spoil infiltration** - indirectly connected spoil catchments (runoff is directed away from the final void but infiltration seepage may still enter the LOM pit shell). Rainfall infiltration to these areas was modelled using a fixed percentage of rainfall (0.5%) i.e., rainfall infiltration through these areas was assumed to be 0.5% of daily rainfall.

AWBM parameters and catchment areas are shown below in Table 2-4 and Table 2-5 respectively.

Table 2-4: Adopted AWBM Runoff Parameters

Parameters	Natural	Rehabilitated Spoil	Open Cut Pits
C1 (mm)	75.8	70	6
C2 (mm)	175.5	150	23.9
C3 (mm)	400.9	200	48.1
A1	0.134	0.134	0.134
A2	0.433	0.433	0.433
A3	0.433	0.433	0.433
BFI	0.2	0.0	0.0
Kb	0.99	1.0	1.0
Ks	0.4	0.0	0.6
Mean effective runoff ¹	3.2%	5.0%	28.1%

¹ Achieved when simulated for the duration of the input climate data (133 years)

Table 2-5 Final Void Catchment Landuse Areas

Final Void	Catchment Area (Ha)				Total (Ha)
	Natural	Open Cut Pits	Rehabilitated Spoil	Spoil Infiltration	
BH1	4	10	20	4	38 ¹
BH2, 4, 5	0	64	342	209	615
BH3	0	101	113	127	341 ²
DC1/DC2	623	146	485	282	1,537
TG1	162	159	707	99	1,127
TH1	71	45	147	58	321
TH2	0	10	33	0	43
TH3	125	19	63	53	261

¹ After 79 ha highwall diversion

² After 391 Ha catchment diversion

² After 456 Ha catchment diversion

Runoff water quality has been considered through application of conservative, fixed runoff salinity rates for each model landuse as detailed in Table 2-6 below. No allowance was made for salinity decay over time i.e., runoff concentrations remain fixed both throughout individual storm events and over the duration of the model simulation. Salinity is modelled as total dissolved solids (TDS) and a conversion rate of 0.67 was applied to convert EC to TDS i.e., $TDS = EC \times 0.67$.

Table 2-6 Adopted Landuse Runoff Quality

AWBM Landuse	Assumed TDS (mg/L)	Assumed EC (µS/cm)	Comment
Natural	201	300	As per Callide Coal Mine REMP
Rehabilitated Spoil	550	821	Adopted from existing operational WBM
Hardstand/ Pits	1,100	1,642	Adopted from existing operational WBM
Spoil infiltration	550	821	As per rehabilitated spoil

2.5 GROUNDWATER

Groundwater ingress to each final void was estimated using recovery curves (refer to Appendix A.1) which provide a relationship between elevation and estimated inflow. The curves were provided by the consultant hydrogeologist who conducted the PRCP groundwater modelling. Table 2-7 below summaries key groundwater assumptions adopted in the water balance:

- Groundwater inflow quality was assumed to remain fixed.
- A loss factor of 40% was applied to the groundwater inflow rates in the groundwater recovery curves to account for losses such as surface evaporation of the saturated parts of the pit walls.
- Both TH2 and TH3 are located above the groundwater table and will not be subject to groundwater inflow.

Table 2-7: Key Groundwater Assumptions

Residual Void	Groundwater Inflow	Assumed TDS (mg/L)	Assumed EC (µS/cm)
BH1	Refer to Figure 7-1	1,072	1,600
BH2, 4, 5	Refer to Figure 7-2	1,072	1,600
BH3	Refer to Figure 7-3	1,072	1,600
DC1/DC2	Refer to Figure 7-5	1,240	1,850
TG1	Refer to Figure 7-4	637	950
TH1	Refer to Figure 7-6	1,541	2,300
TH2	Void is above water table	N/A	N/A
TH3	Void is above water table	N/A	N/A

3 WATER BALANCE MODEL DEVELOPMENT

3.1 SOFTWARE

A dynamic water balance model (WBM) was developed for the assessment using GoldSim probabilistic modelling software. GoldSim is a Monte Carlo simulation software package that is commonly used in the mining industry for water balance modelling and water resource assessments.

3.2 MODELLING APPROACH AND RESULTS STATISTICS

Table 3-1 summarises the water balance modelling approach and derivation of key results. Key assumptions and limitations are detailed in Section 3.3.

Table 3-1 Modelling Approach and Results Statistics

Aspect	Description	Attributes
Simulation properties	Timestep, technique, duration	- Deterministic model run using a daily timestep - Simulation length set at 500 years. - Input climate data (131 years) wrapped as required
Results statistics	<i>Mean equilibrium water level</i> – the relative level at which the void lake water level reaches stability (within the context of seasonal variability) <i>Min and max water level</i> – the lowest and highest water level RL <i>Time to fill</i> – how long the void lake takes to reach equilibrium	- Min, max and mean water levels derived from last wrap of climate data (131 years) - Time to fill estimated as the time taken from the start of the simulation to reach the mean equilibrium water level

3.3 KEY MODEL ASSUMPTIONS AND LIMITATIONS

The following key assumptions and limitations were applied to the water balance modelling:

- All residual voids are assumed empty at the start of simulation.
- Final void lake evaporative losses are estimated daily based on the final void storage curve.
- A spoil porosity assumption of 30%.
- Water quality is modelled assuming fully conserved, advective transport:
 - Assumed runoff and groundwater quality remains fixed within rainfall events and the duration of the simulation.
 - Void lakes are therefore assumed to be fully mixed (i.e., no stratification) and no allowance is made for potential differences in water quality within water stored within spoil of open water withing each final void lake.
 - Water quality results are therefore indicative of the average salt concentration of the entire void lake and saturated spoil zone.
 - A salinity evaporation correction factor has been adopted to reflect the lower evaporative potential of high salinity water where the evaporation reduction factor, F is calculated as:
 - $F = 1.025 - 0.0246 \times \text{EXP}(0.00879 \times S)$ where S is the salinity (CSIRO, 2000).
- Where voids are assumed to be connected, no allowance has been made for seepage transmission through spoil and equalisation is therefore assumed to occur instantaneously each timestep (daily).
- Loss of containment to the receiving environment via seepage through spoil or to surrounding geology (where water table is exceeded) has not been modelled – reporting has indicated where estimated void lake water levels exceed the seepage or water table RLs however estimated seepage fluxes have not been calculated.

- Storage curves and catchment areas have been inferred from the best available mine planning information. Adopted storage curves are assumed to be representative of proposed residual voids.
- Potential seepage loss through the base of final voids located above the water table have not been considered.
- Potential impacts resulting from climate change have not been considered.
- Catchment diversions have been assumed to be fully functional for the duration of the simulation period and during all rainfall events.

4 MODEL RESULTS

4.1 FINAL VOID MODELLING RESULTS

Modelling results are summarised in below in Table 4-1. Time series plots of final void water level and water quality are shown in Figure 4-1 to Figure 4-9:

Containment risk

- Permanent void lakes form in all final voids however BH1, TH1 and TH2 form relatively variable and shallow water bodies less than 10m in depth.
- As indicated by a positive minimum freeboard to the lowest critical RL, containment is achieved for all final voids except:
 - TH2 (Figure 4-8) where the maximum water level reaches 3.5 m above the seepage RL (mean water level is 2.3 m above the seepage RL).
 - Further examination of this result indicates that this risk could be minimised through the placement of a levee structure located across the former pit entry ramp (refer to seepage RL location in Figure 2-4).
 - This structure would need to extend to a height of at least 3.5 m (above the seepage RL of 365.6 m AHD) in order to contain the maximum estimated water level. No further cut-off structures would be required as the next lowest seepage RL of 381 m AHD significantly exceeds the surface overflow RL of 374 m AHD.
 - TG1 (Figure 4-4) shows that the seepage level may be exceeded after approximately 410 years.
 - As noted in Section 2.4.1, TG1 has a large external catchment of 456 Ha (Table 2-3) that could potentially be diverted away from the void.
 - An additional scenario was therefore considered for TG1 which assumed diversion of the external catchment. As a result of the diversion (Figure 4-5) the modelling indicates a lower final equilibrium level that does not exceed the seepage RL.
 - For the purpose of this assessment, and the following sensitivity assessment (Section 4.2), it has been assumed that a diversion is present. As Batchfire progresses through more detailed stages of mine closure planning the requirement for a diversion at TG1 will be reviewed and confirmed.

Estimated time to fill to equilibrium level

Estimated times to fill vary significantly between final voids and are a function of, and the interaction between, key variables such as:

- Catchment area (and subsequent runoff contribution) relative to final void storage capacity
- Potential spoil water storage capacity below the base of the final void – while the final void water level remains below the final void base (i.e., water is only contained in the saturated spoil and the water level has yet to reach the base of the final void) no losses (water surface evaporation) are applied. Consequently, voids with relatively small spoil storage volumes below the final void base (e.g., BH1 and TH3 (refer to storage curve Figure 7-7 and Figure 7-14 respectively) have relatively rapid fill times
- Storage geometry such as relationship between total storage volume and water surface area - where there is a large surface area relative to storage volume, equilibrium (balance between inflows and outflows) is reached more rapidly e.g., TH1 (refer to storage curve Figure 7-12)
- Estimated fill times range from 2 years (BH1) to over 400 years (BH3, TG1 and DC1/2) for the largest voids.

Final void lake water quality

Salinity enters each void lake via runoff and groundwater (where relevant). Salt mass does not leave the final voids unless via a surface overflow and consequently each void will be subject to evapo-concentration over time. This is predominately a function of the relationship between evaporative loss, inflow and final void storage volume.

- BH1, TH1 and TH3 represent final voids with a high rate of evaporation loss relative to inflows and/or storage volume and therefore experience more rapid rises in EC over time as well as higher maximum EC.
 - These shallow void lakes which are generally subject to greater variability in water level periodically experience significant evaporative drawdown and evapo-concentration resulting in high EC levels which reach saturation (e.g., BH1, Figure 4-1)
- All remaining voids generally show relatively consistent, low to moderate increases in EC. Final ECs range from around 2,300 $\mu\text{S}/\text{cm}$ (TG1, Figure 4-5) to 11,000 $\mu\text{S}/\text{cm}$ (TH2, Figure 4-8)

Table 4-1 Final Void Water Balance Results Summary

Statistic	Units	BH1	BH2, 4, 5	BH3	TG1	DC1/2	TH1	TH2	TH3
Mean water level	m AHD	233.6	192	162.7	210.8	287	286.8	367.9	334.5
Min water Level	m AHD	230.2	189.6	159.8	205.5	283.2	284.3	366.5	328.8
Max water Level	m AHD	240.3	193.7	164.9	215.7	290	291.6	369.1	338.5 ¹
Time to reach mean water level	Years	2	359	403	406	404	22	138	17
Min. freeboard to lowest critical RL	m	17.5	10.3	55.1	6.0	14	31.9	-3.5	21
Lowest critical RL		Seepage	Seepage	Seepage	Seepage	Seepage	Seepage	seepage	Surface overflow

1 Max water level for TH3 is governed by the assumed seepage RL to TH1 at 338.5 m AHD (all water above this RL is assumed to enter TH1 via seepage through spoil)

4.1.1 Boundary Hill

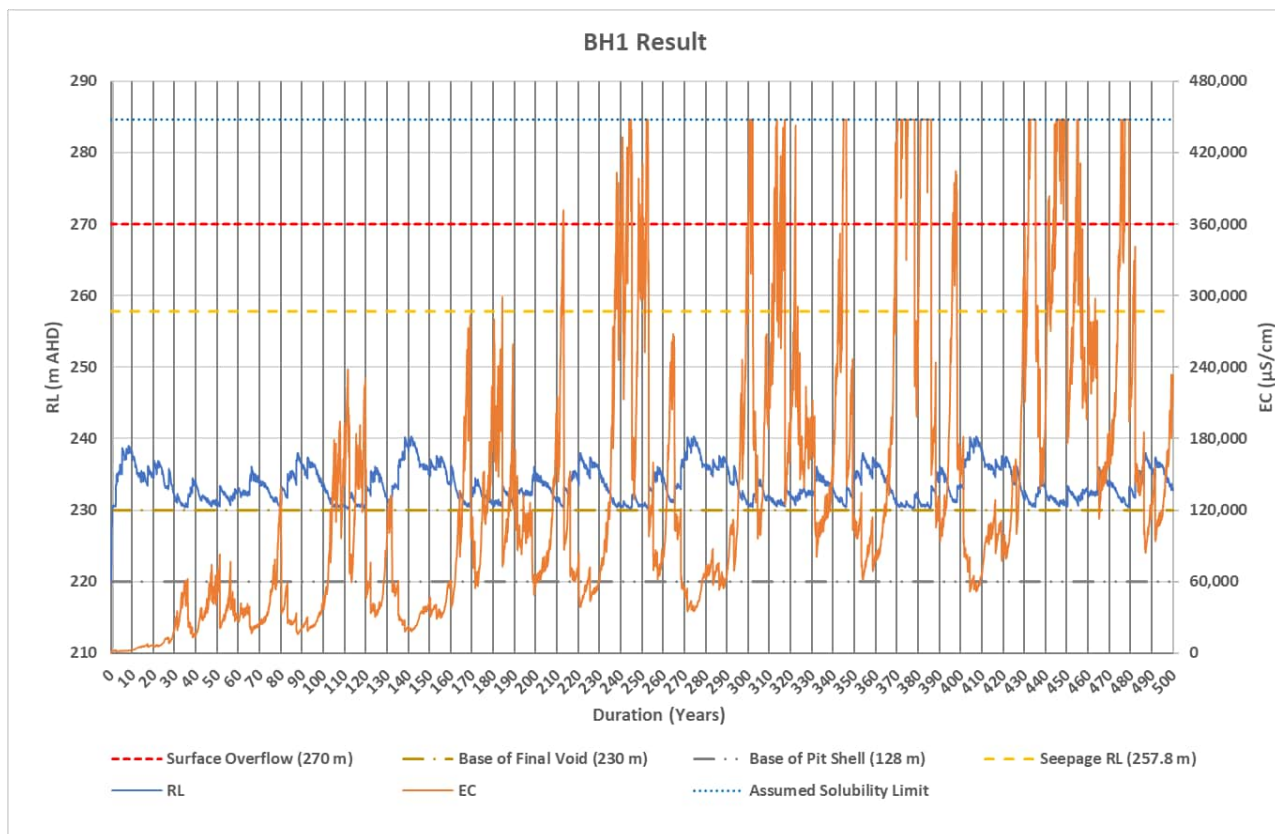


Figure 4-1 Water Balance Result - BH1

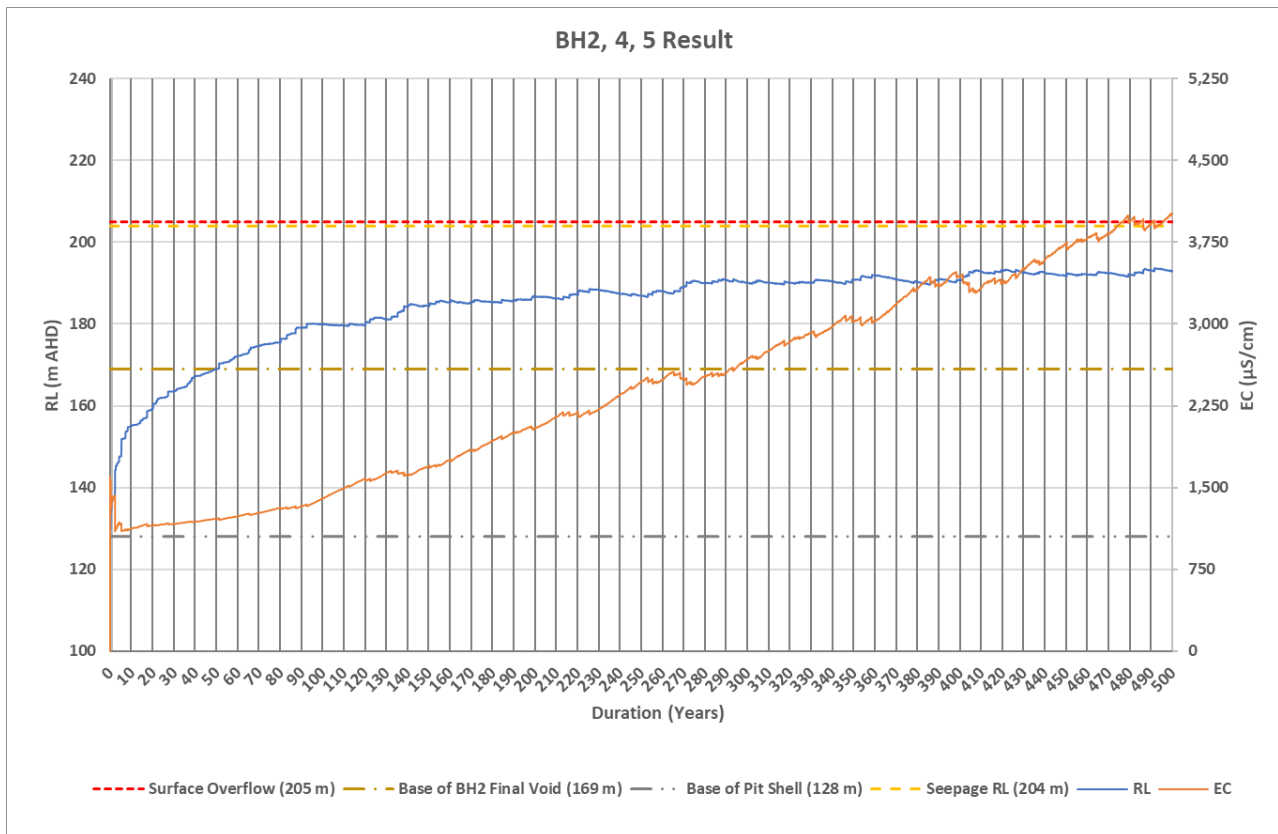


Figure 4-2 Water Balance Result – BH2, 4, 5

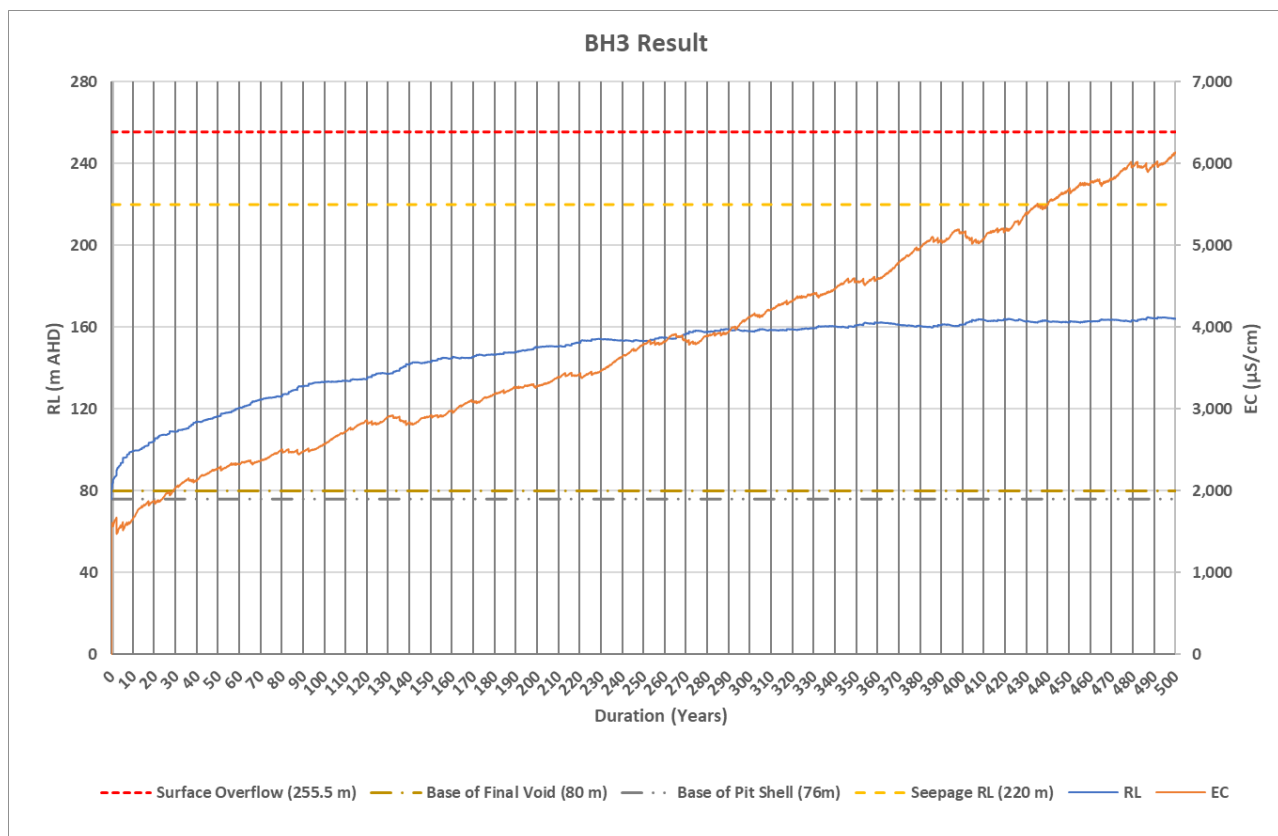


Figure 4-3 Water Balance Result – BH3

4.1.2 Trap Gully

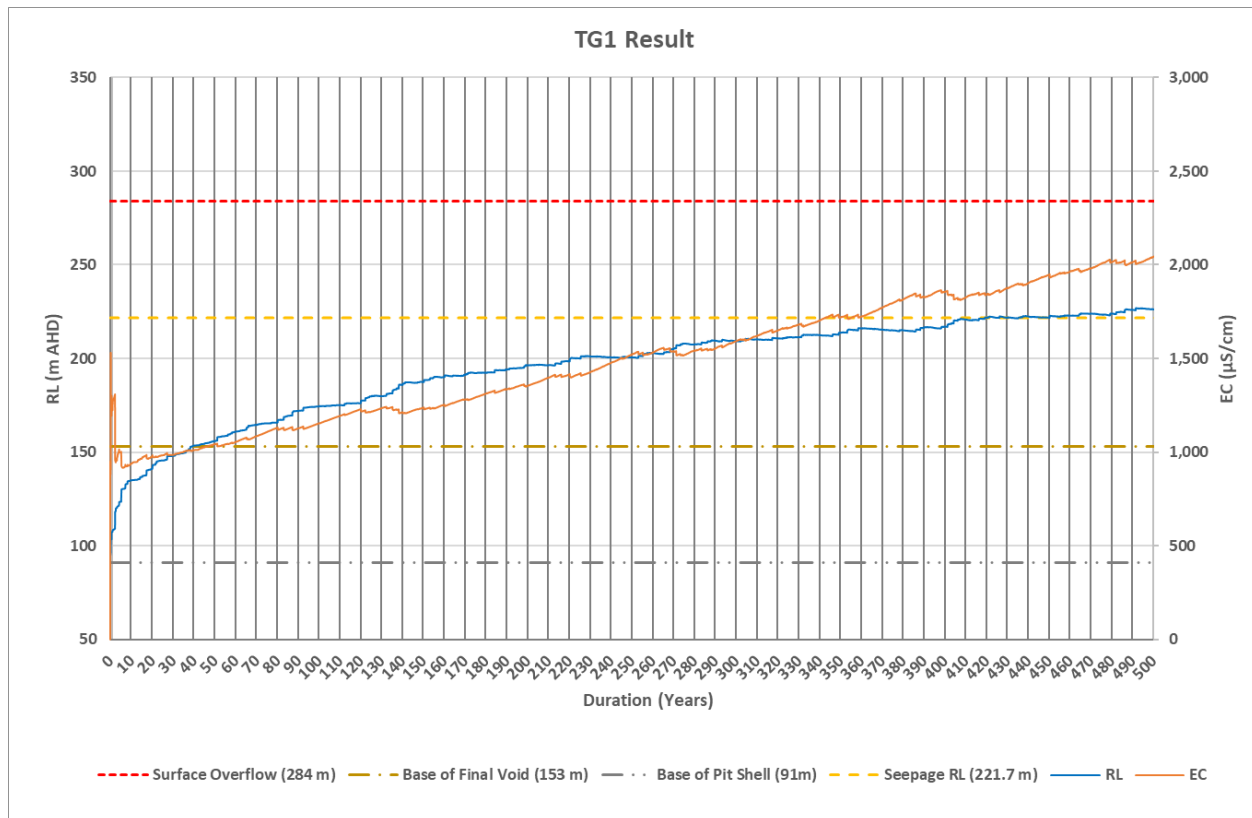


Figure 4-4 Water Balance Result – TG1 (Preliminary Result)

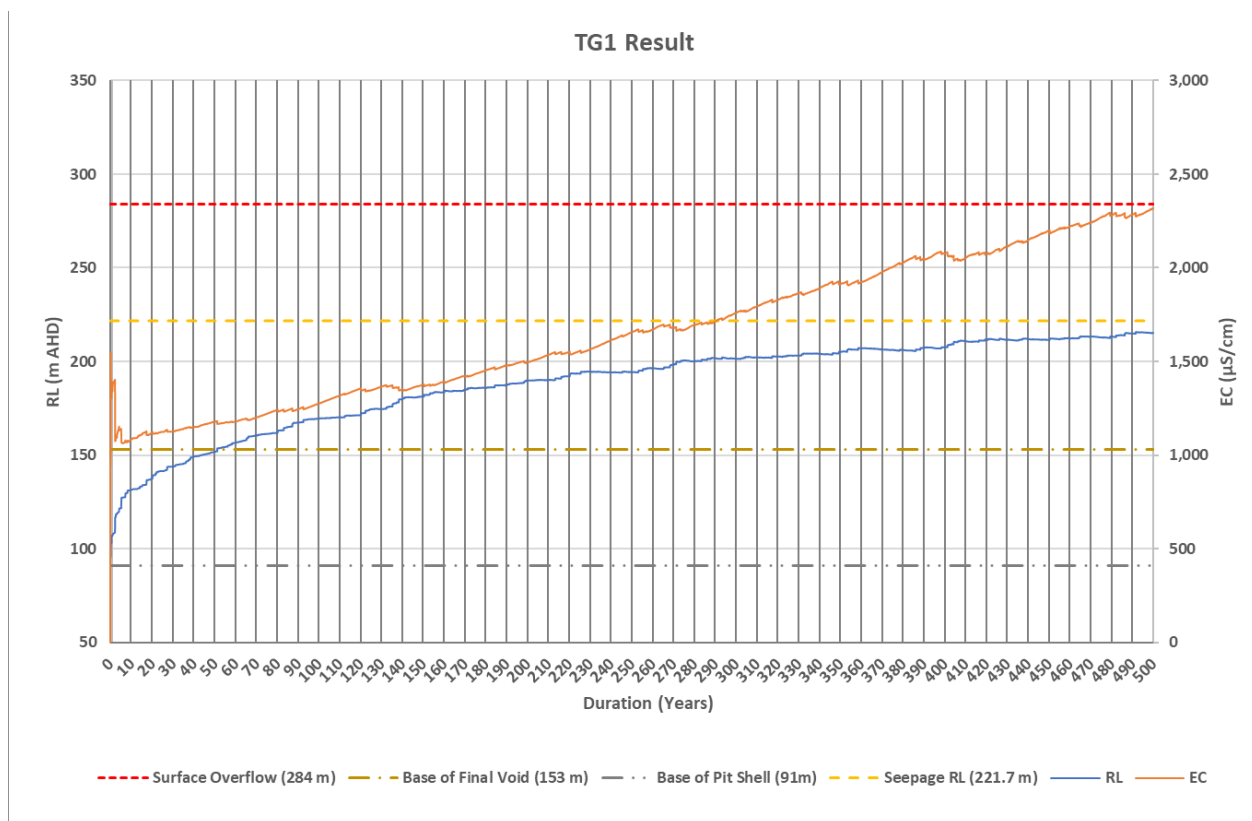


Figure 4-5 Water Balance Result – TG1 (With Diversion)

4.1.3 Dunn Creek

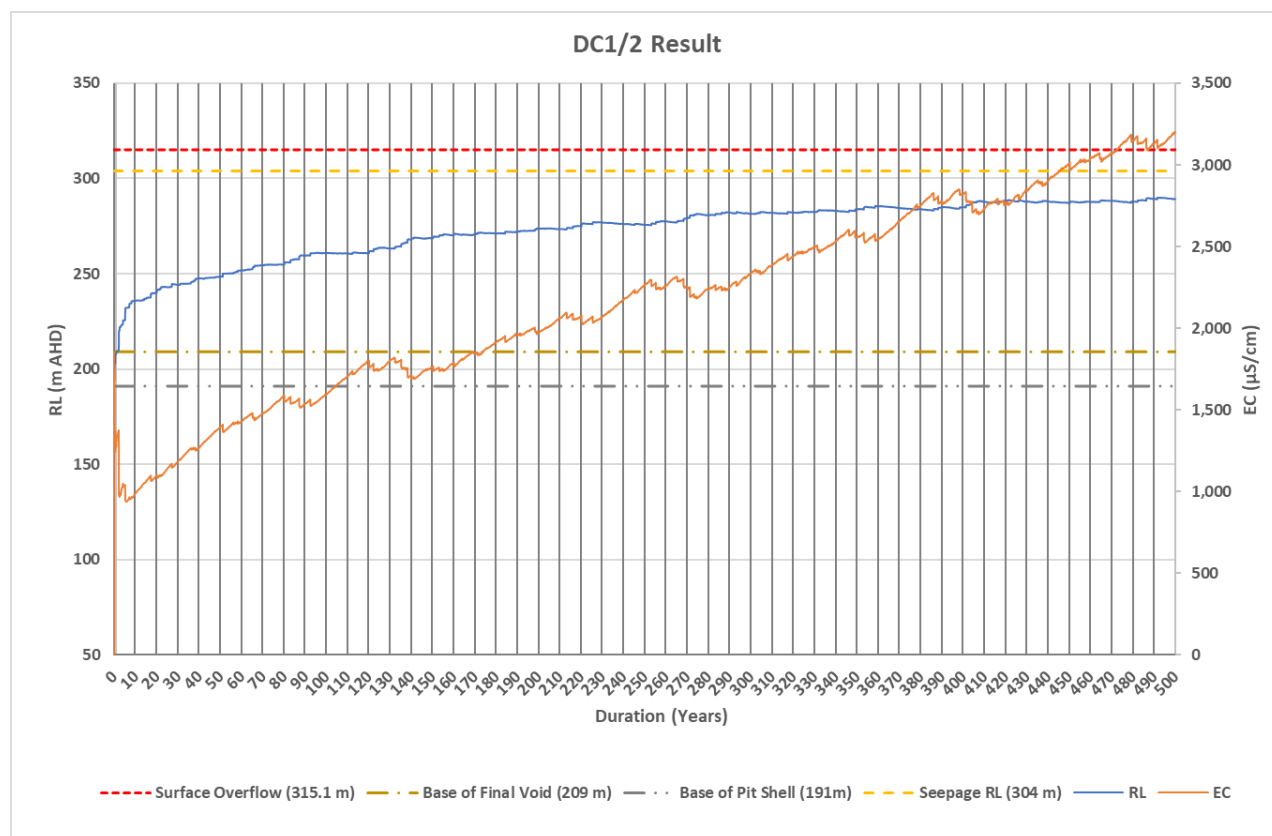


Figure 4-6 Water Balance Result – DC1/2

4.1.4 The Hut

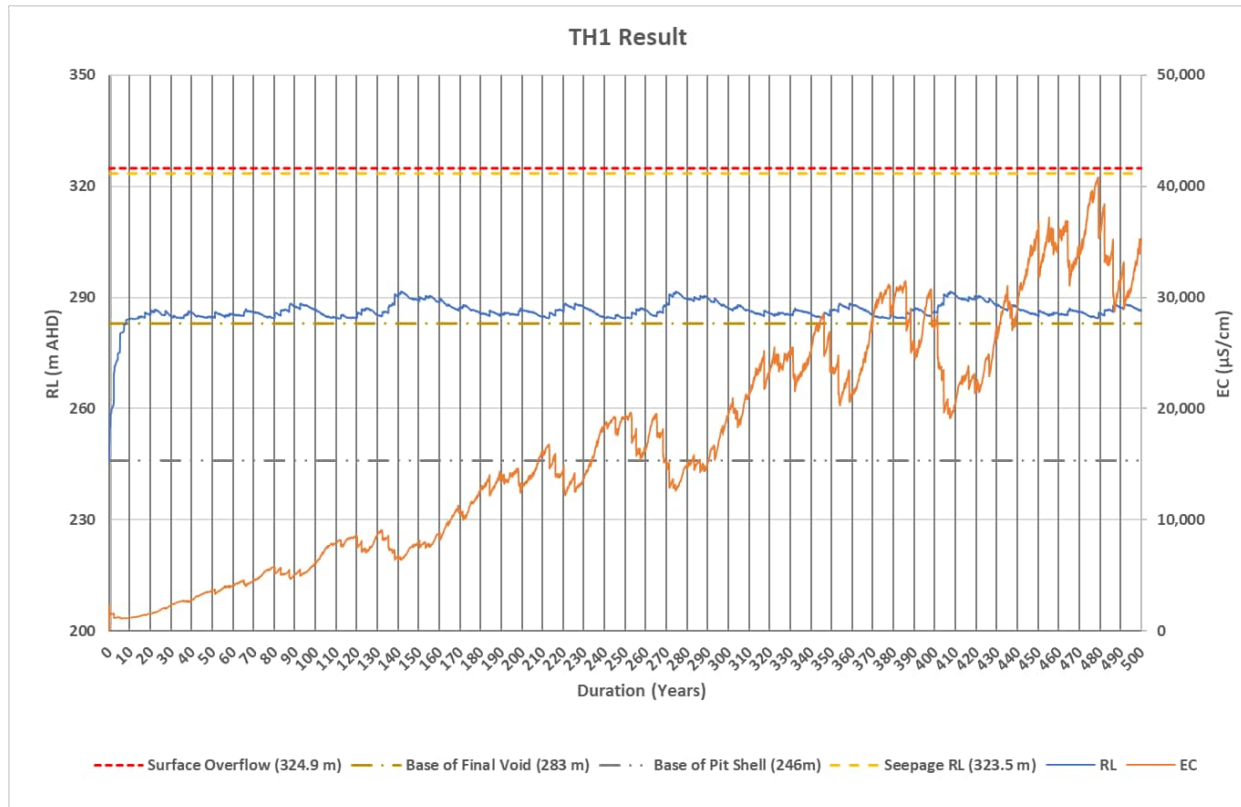


Figure 4-7 Water Balance Result – TH1

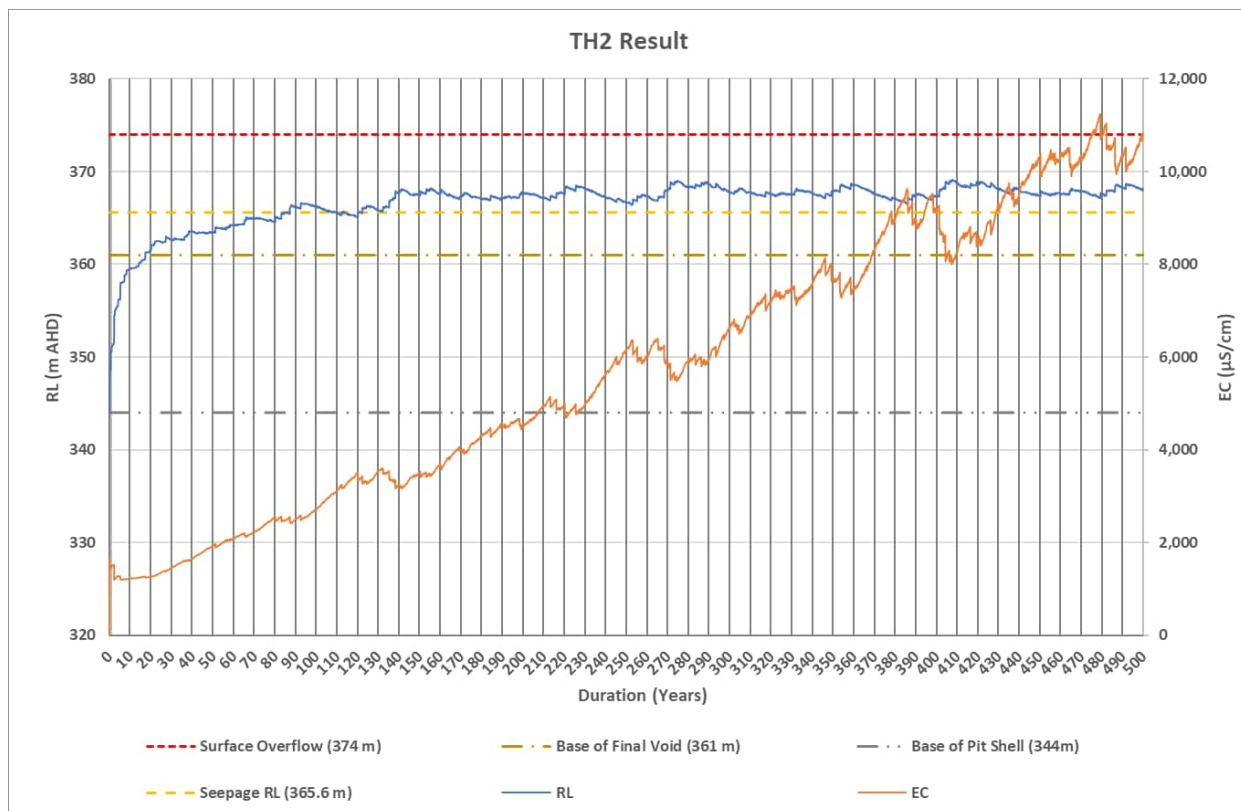


Figure 4-8 Water Balance Result – TH2

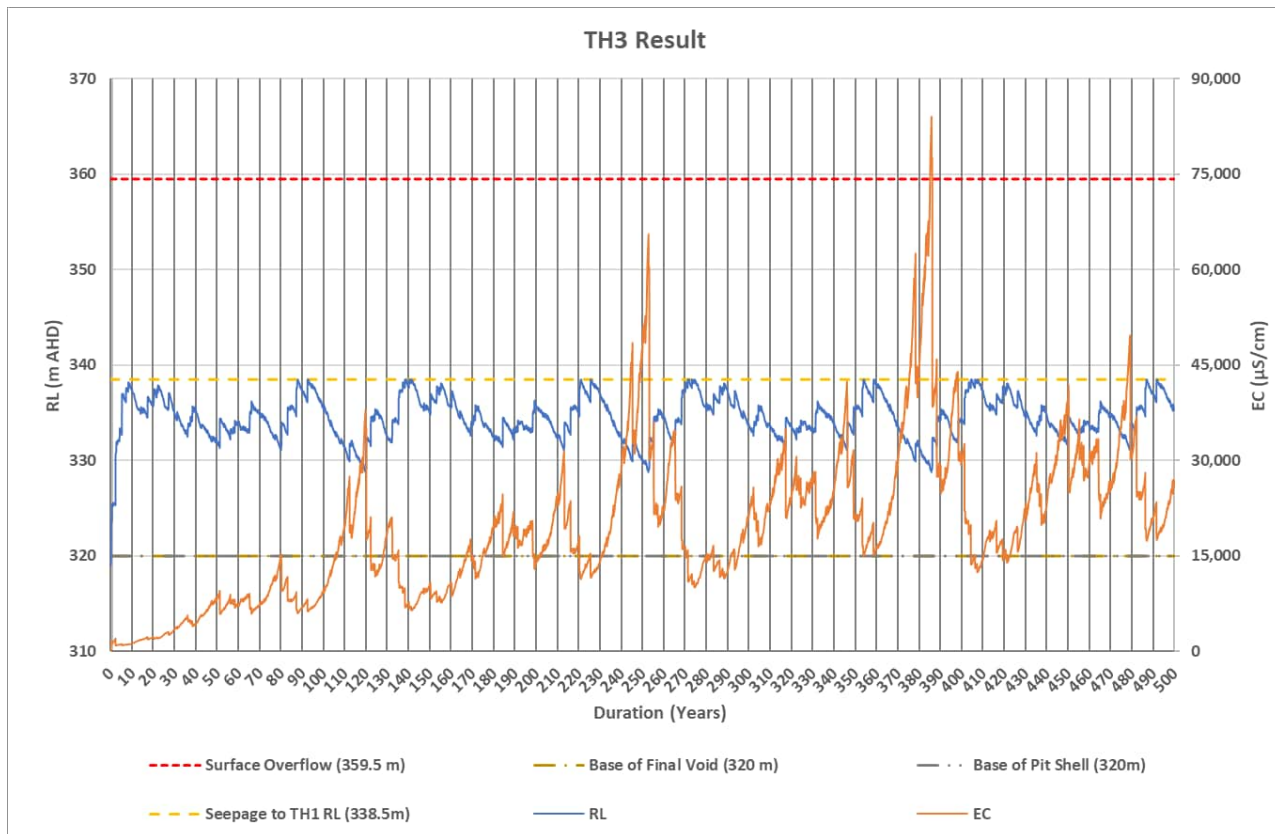


Figure 4-9 Water Balance Result – TH3

4.2 RUNOFF SENSITIVITY ASSESSMENT

In order to assess the sensitivity of estimated final void equilibrium water levels the AWBM parameters for the rehabilitated spoil landuse were adjusted to give a mean runoff coefficient of 10%, i.e., a 100% increase to the base case (5%). Table 4-2 to Table 4-4 and Figure 4-10 to Figure 4-17 show the results of the runoff sensitivity assessment.

Containment risk

- Minimum freeboard for all final voids reduces as a result of the additional inflow resulting from the increased level of runoff from rehabilitated spoil catchments.
- For all Boundary Hill voids a positive minimum freeboard is maintained (Table 4-2) with the runoff sensitivity however for BH2, 4, 5 the estimated residual freeboard of 0.2m is marginal. It is noted however that this is the minimum freeboard and that freeboard to the mean water level is 1.7m.
- As a result of the additional runoff inflow the maximum water level for Trap Gully is 17.9 m above the seepage RL. The mean water level is 11.4 m above the seepage RL. From Figure 4-13 it can also be seen that it is estimated that the seepage RL will not be exceeded for approximately 320 years.
- Dunn Creek (DC1/2 maintains a positive minimum freeboard of 6.8 m (Table 4-3 and Figure 4-14) with the additional runoff inflow.
- The maximum water level at TH2 increases 6.5 m above the seepage RL with the increased runoff scenario although this still remains 1.9 m below the surface overflow RL.

Estimated time to fill to equilibrium level

Estimated times to fill are typically reduced or not materially changed by the increased runoff sensitivity.

Final void lake water quality

Water quality plots for the runoff sensitivity are shown in Appendix B (Figure 7-15 to Figure 7-22) and indicate that final void EC is lower for all final voids as a result of increased runoff. This results from the increased dilutionary impact the additional runoff inflow provides.

Summary

The conservative sensitivity of increasing the assumed effective spoil runoff from 5% to 10% indicates that there is a low risk of material change from the basecase result and therefore that the individual containment risk of each final void remains similar to the basecase.

Table 4-2 Rehabilitated Spoil Runoff Sensitivity Results - Boundary Hill

Statistic	Units	BH1			BH2, 4, 5			BH3		
		5% Runoff (Base Case)	10% Runoff	Change	5% Runoff (Base Case)	10% Runoff	Change	5% Runoff (Base Case)	10% Runoff	Change
Mean water level	m AHD	233.6	235.8	2.2	192	202.3	10.3	162.7	165.8	3.1
Min water Level	m AHD	230.2	230.3	0.1	189.6	199.8	10.2	159.8	163.2	3.4
Max water Level	m AHD	240.3	242.3	2	193.7	203.8	10.1	164.9	167.7	2.8
Time to reach mean water level	Years	2	3	1	359	353.8	-5.2	403	353.8	-49.2
Min. freeboard to lowest critical RL	m	17.5	15.5	-2.0	10.3	0.2	-10.1	55.1	52.3	-2.8
Lowest critical RL		Seepage	Seepage		Seepage	Seepage		Seepage	Seepage	

Table 4-3 Rehabilitated Spoil Runoff Sensitivity Results – Trap Gully and Dunn Creek

Statistic	Units	TG1			DC1/2		
		5% Runoff (Base Case)	10% Runoff	Change	5% Runoff (Base Case)	10% Runoff	Change
Mean water level	m AHD	210.8	233.1	22.3	287	294.9	7.9
Min water Level	m AHD	205.5	226.3	20.8	283.2	291.4	8.2
Max water Level	m AHD	215.7	239.6	23.9	290	297.2	7.2
Time to reach mean water level	Years	406	407	1	404	403	-1
Min. freeboard to lowest critical RL	m	6	-17.9	-23.9	14	6.8	-7.2
Lowest critical RL		Seepage	Seepage		Seepage	Seepage	

Table 4-4 Rehabilitated Spoil Runoff Sensitivity Results – The Hut

Statistic	Units	TH1			TH2			TH3		
		5% Runoff (Base Case)	10% Runoff	Change	5% Runoff (Base Case)	10% Runoff	Change	5% Runoff (Base Case)	10% Runoff	Change
Mean water level	m AHD	286.8	292.4	5.6	367.9	370.6	2.7	334.5	336	1.5
Min water Level	m AHD	284.3	287.8	3.5	366.5	369	2.5	328.8	330.7	1.9
Max water Level	m AHD	291.6	296.8	5.2	369.1	372.1	3	338.5 ¹	338.5 ¹	0
Time to reach mean water level	Years	22	88.1	66	138	138.4	0	17	5.3	-12
Min. freeboard to lowest critical RL	m	31.9	26.7	-5.2	-3.5	-6.5	-3	21	21	0
Lowest critical RL		Seepage	Seepage		Seepage	Seepage		Surface overflow	Surface overflow	

¹ Max water level for TH3 is governed by the assumed seepage RL to TH1 at 338.5 m AHD (all water above this RL is assumed to enter TH1 via seepage through spoil)

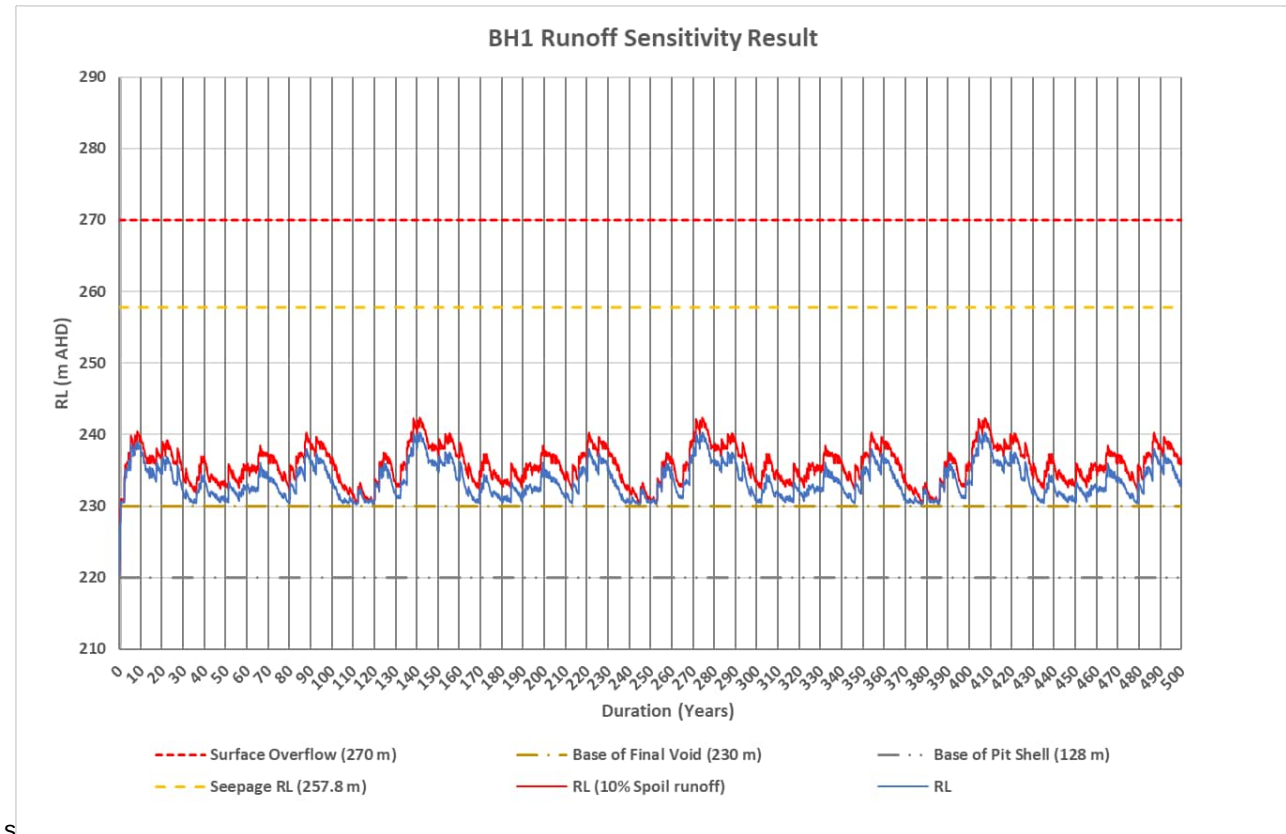


Figure 4-10 Runoff Sensitivity Result - BH1

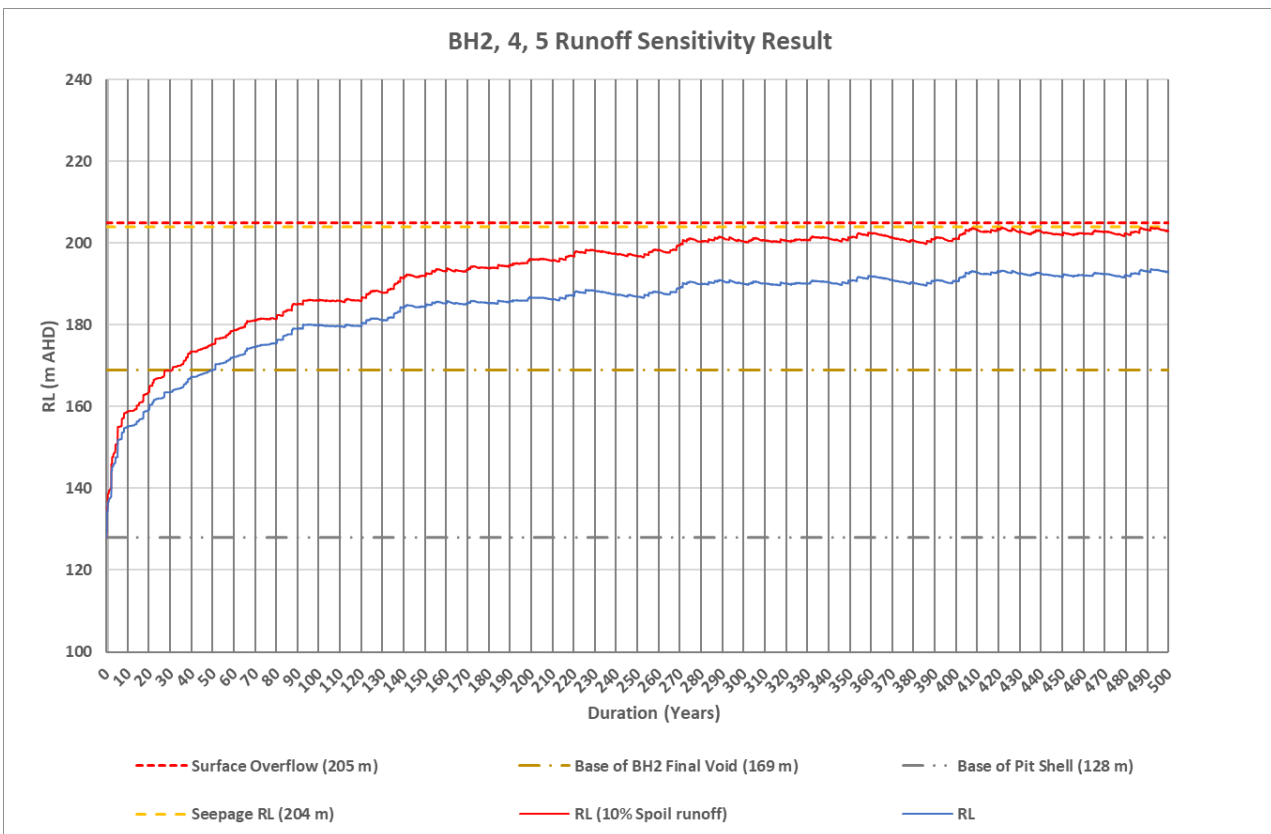


Figure 4-11 Runoff Sensitivity Result - BH2, 4, 5

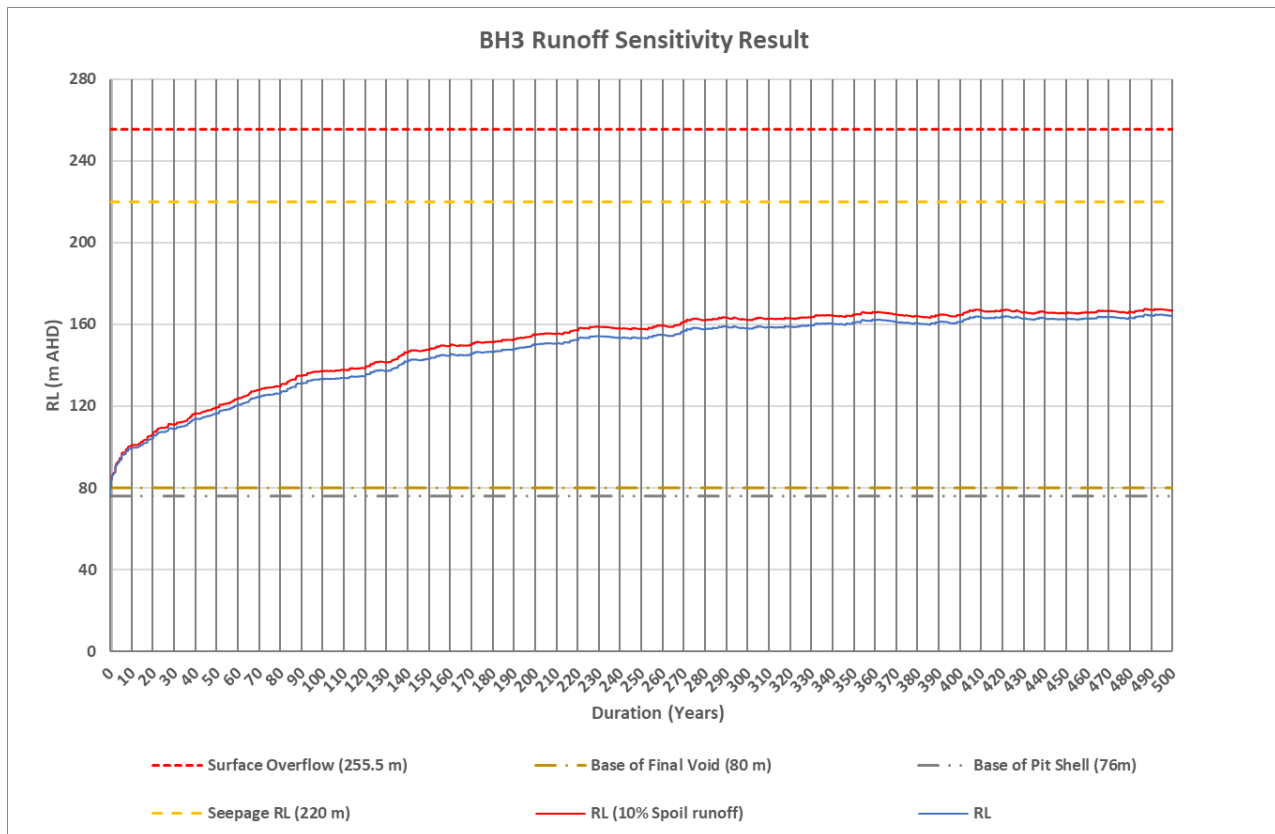


Figure 4-12 Runoff Sensitivity Result - BH3

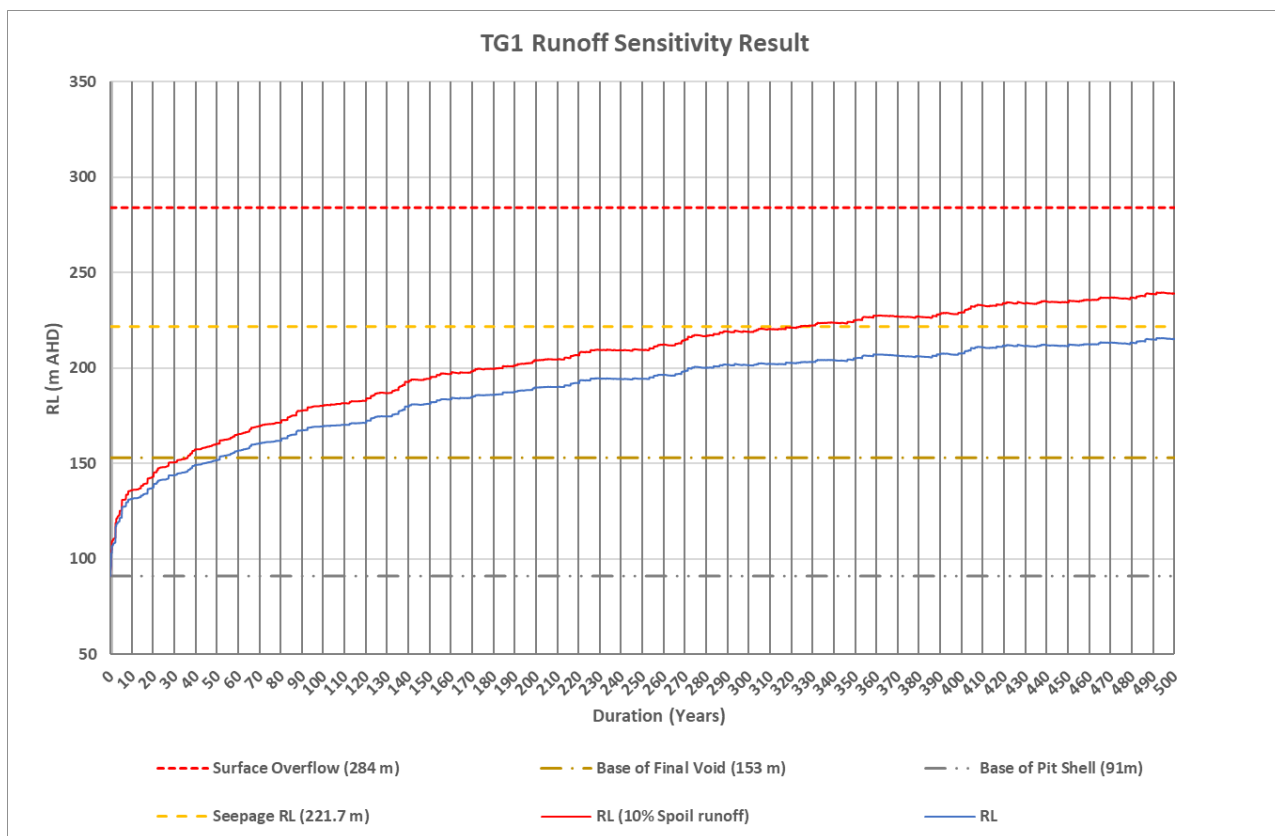


Figure 4-13 Runoff Sensitivity Result – TG1

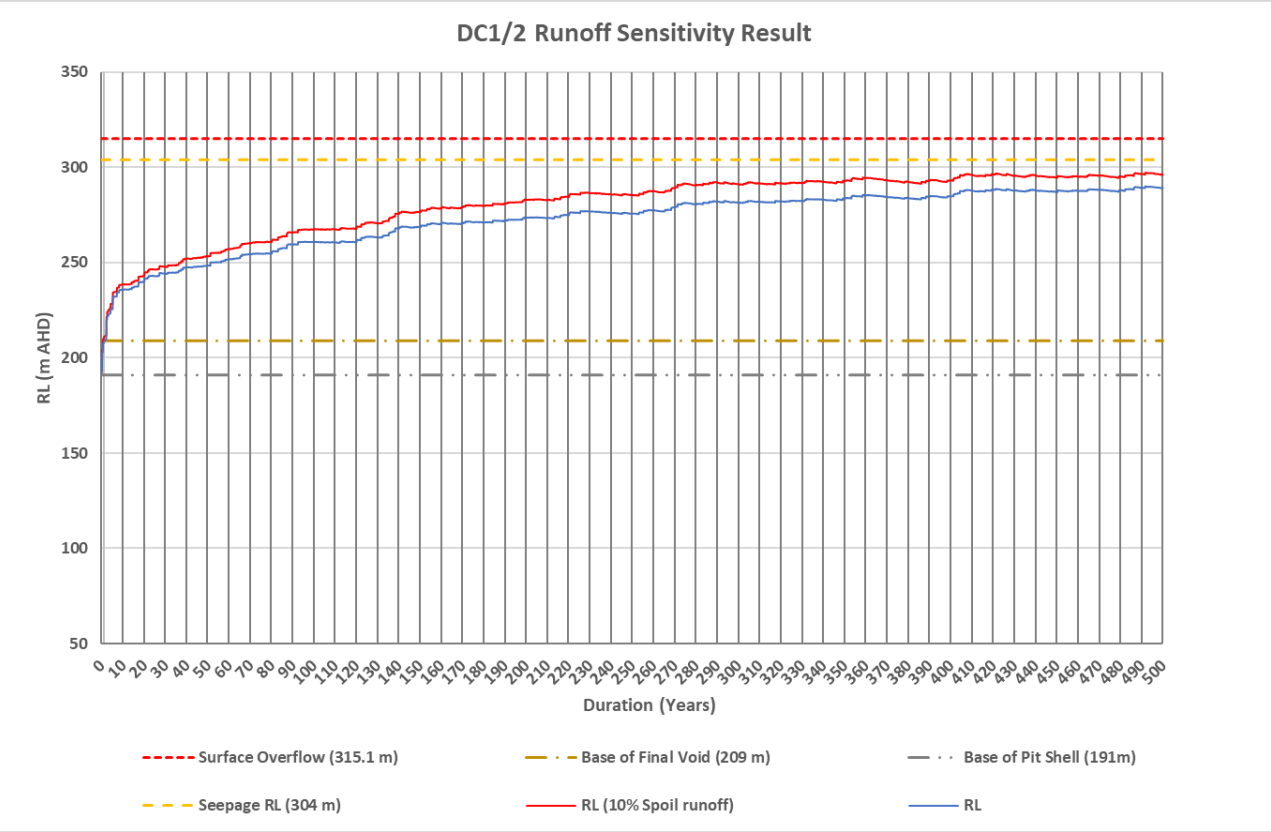


Figure 4-14 Runoff Sensitivity Result – DC1/2

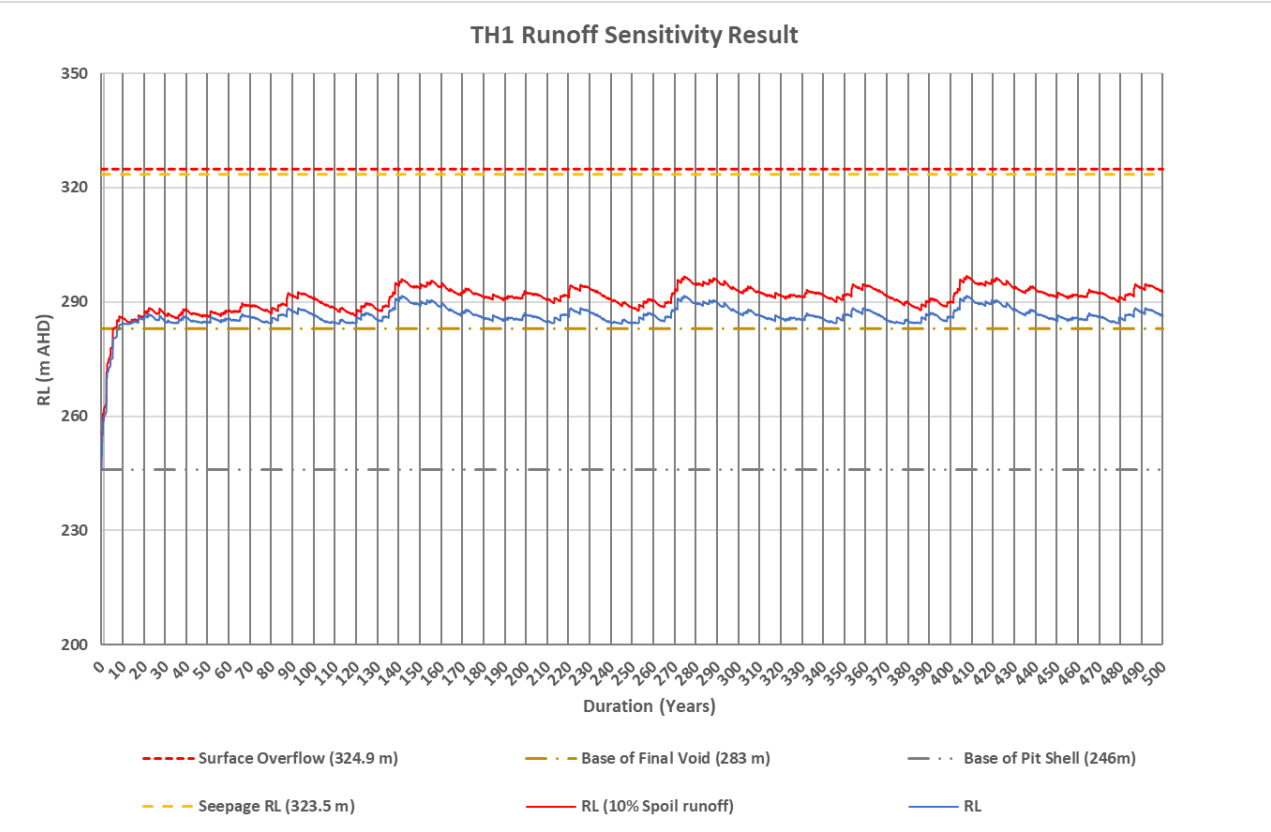


Figure 4-15 Runoff Sensitivity Result – TH1

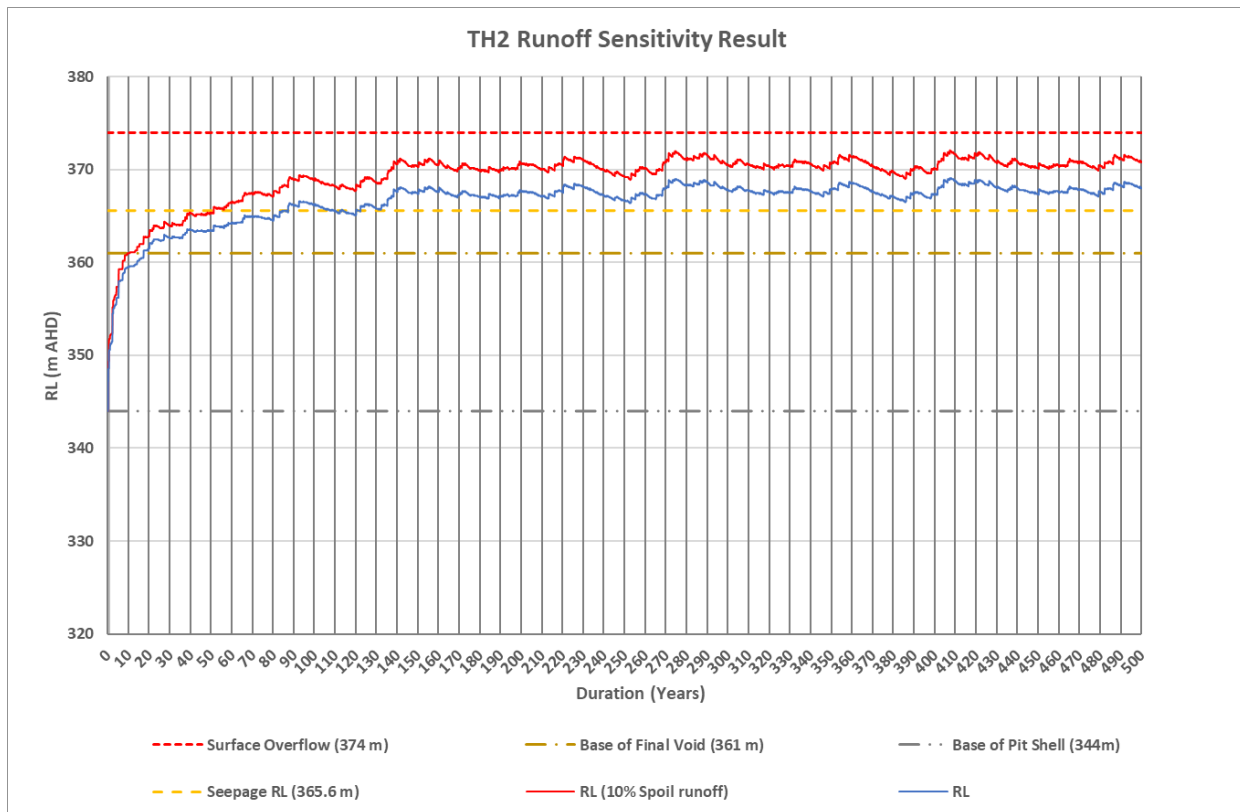


Figure 4-16 Runoff Sensitivity Result – TH2

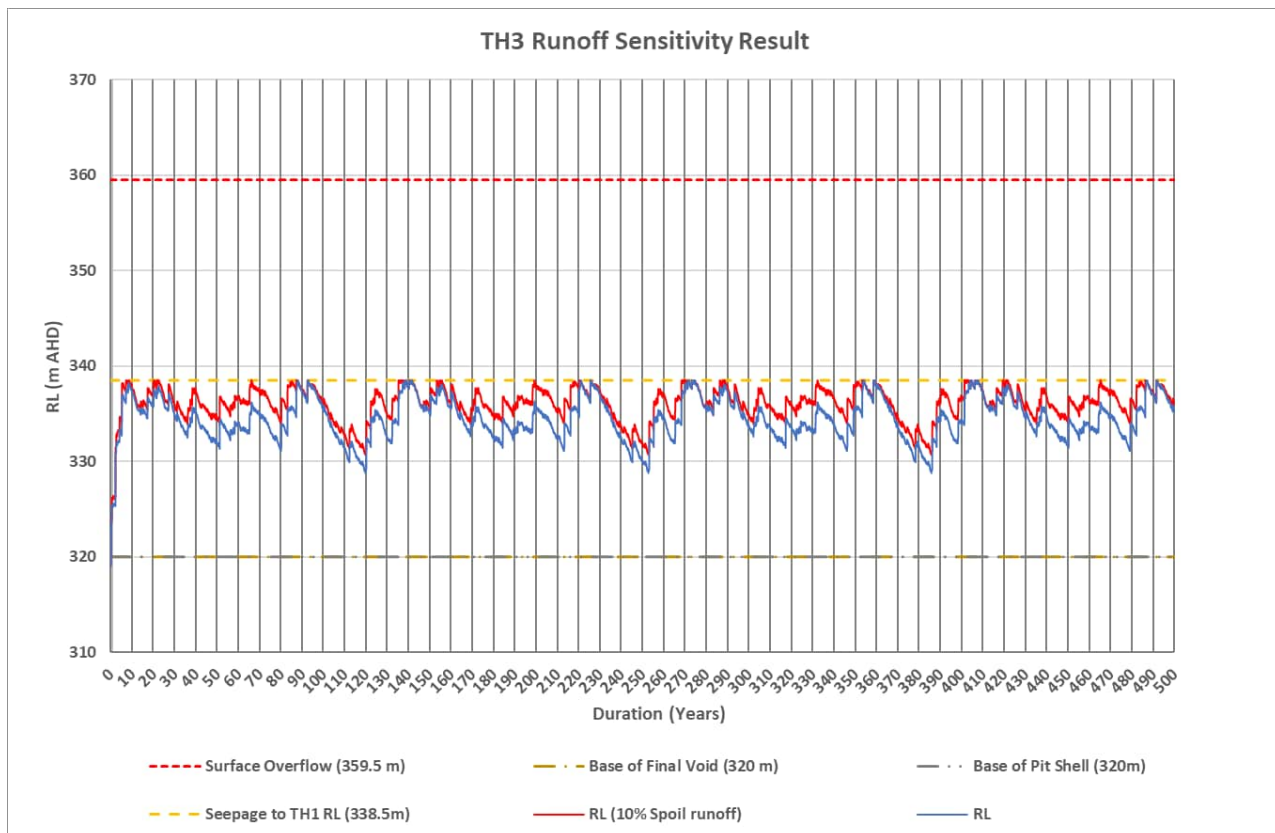


Figure 4-17 Runoff Sensitivity Result – TH3

5 CONCLUSIONS

The Callide Mine PRCP residual void hydrology assessment has been completed to assess potential containment risk arising from the proposed final void landforms. Final void configurations have been reviewed to determine drainage catchments and, where feasible final landform drainage diversions to manage void catchments have been identified. Water balance (using GoldSim) assessment has been completed to estimate void containment risk and to identify changes to storage volumes, water quality, equilibrium status and filling times.

Key findings of the assessment are that:

- Under both base case conditions and a runoff sensitivity assessment no final voids were found to lose containment via surface overflow (the surface overflow RL was not exceeded for any final void)
- Under base case conditions all final voids, except for The Hut final void TH2, equilibrate at a water level that does not exceed any critical RLs
 - The estimated equilibrium level for Trap Gully void (TG1) was initially found to exceed the seepage RL however by assuming diversion of 456 Ha of natural catchment, the final equilibrium was reduced to below the seepage RL.
- The equilibrium water level for TH2 has been found to exceed the seepage RL by a maximum depth of 3.5 m however containment risk could potentially be mitigated through the use of a levee structure across the pit entry ramp.
- Under a runoff sensitivity assessment that considered a 100% increase to rehabilitated spoil catchment runoff Trap Gully (TG1) final void was found to exceed the seepage RL however this was estimated not to occur for approximately 320 years after closure and final landform shaping.
- Estimated water quality for most final void lakes range from around 2,300 $\mu\text{S}/\text{cm}$ to 11,000 $\mu\text{S}/\text{cm}$ however for BH1, TH1 and TH3 estimated EC levels are much higher due to greater rates of evapo-concentration. Due to the partially intermittent nature of the BH1 void lake the potential for hyper saline conditions is possible.
- Estimated filling times vary greatly and range from 2 years to over 400 years and is, in part a function of the spoil water storage potential within each final void.

6 QUALIFICATIONS

- a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.
- b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.
- c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:
 - i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or
 - ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.
- d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.
- e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.
- f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.
- g) This Report does not provide legal advice.

7 REFERENCES

- Boughton, W. C. (1993). *A Hydrograph-Based Model for Estimating the Water Yield of Ungauged Catchments*.
- CSIRO. (2000). *On-farm and community-scale salt disposal basins on the riverine plain - Evaluating basin leakage rate, disposal capacity and plume development*. CSIRO Land and Water technical report 17/00.
- Qld Government. (2022). *SILO*. Retrieved from Long Paddock: <https://www.longpaddock.qld.gov.au/silo/>

Appendix A:

[Water Balance Input Data]

A.1 GROUNDWATER RECOVERY CURVES

Note that the data reflects estimated groundwater inflows *prior* to application of a 40% loss factor

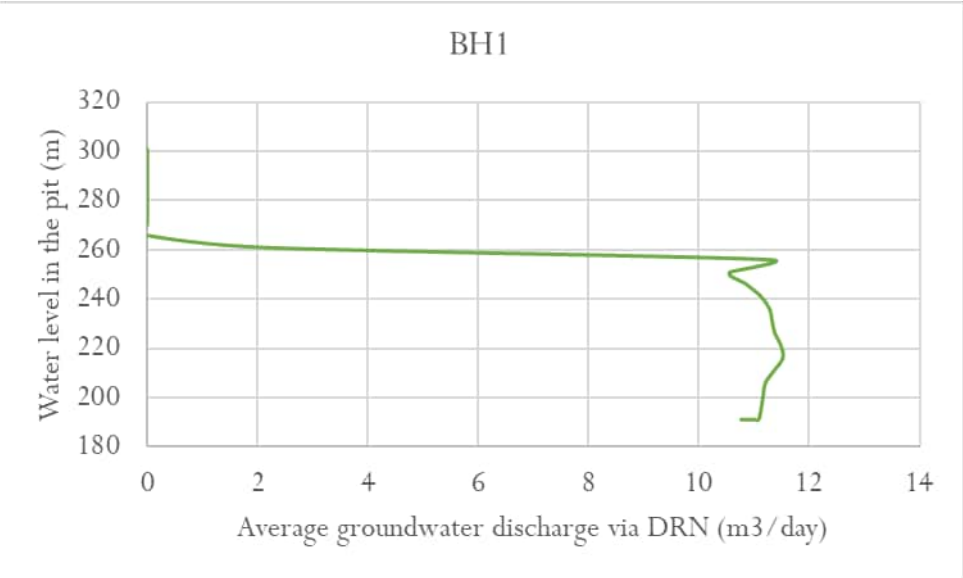


Figure 7-1 Groundwater Recovery Curve - BH1

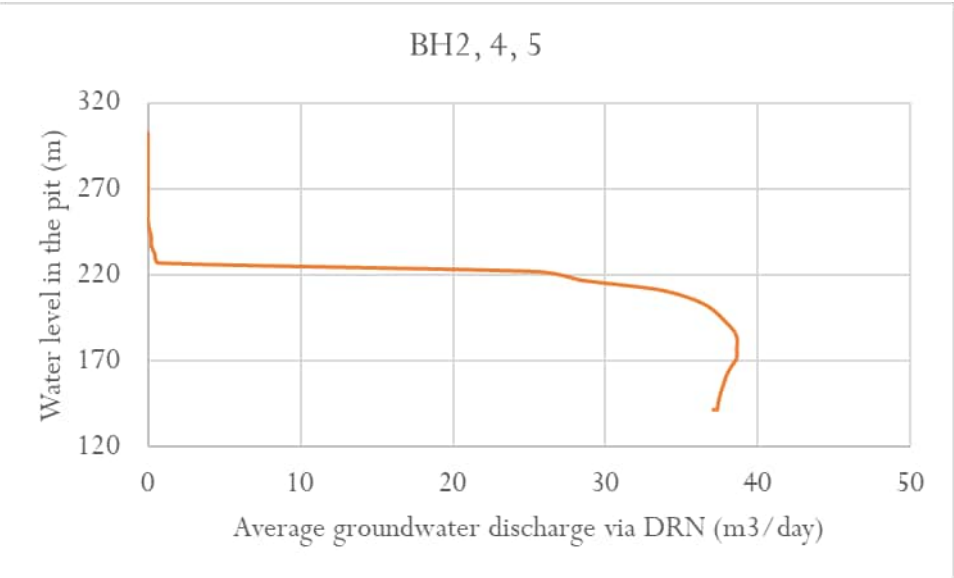


Figure 7-2 Groundwater Recovery Curve - BH2, 4, 5

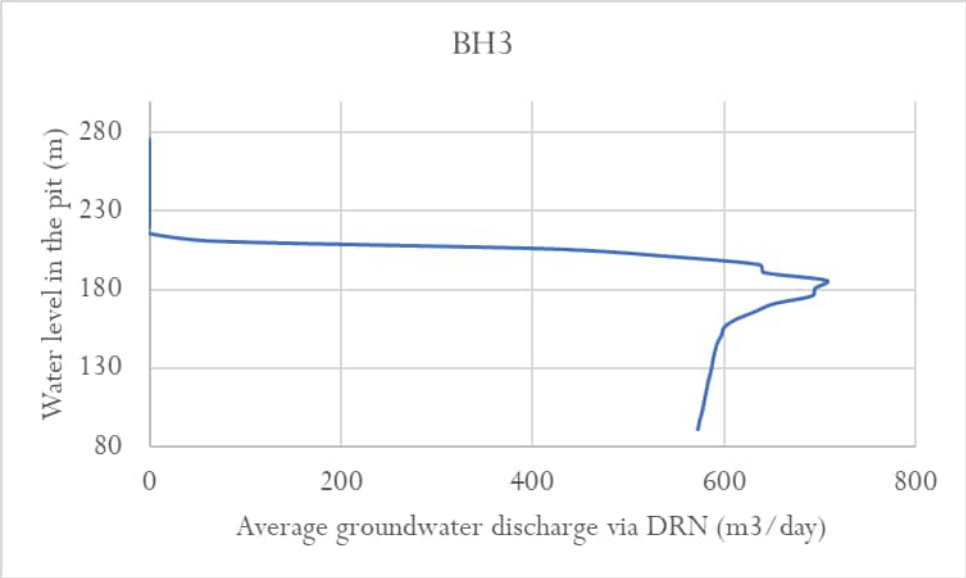


Figure 7-3 Groundwater Recovery Curve - BH3

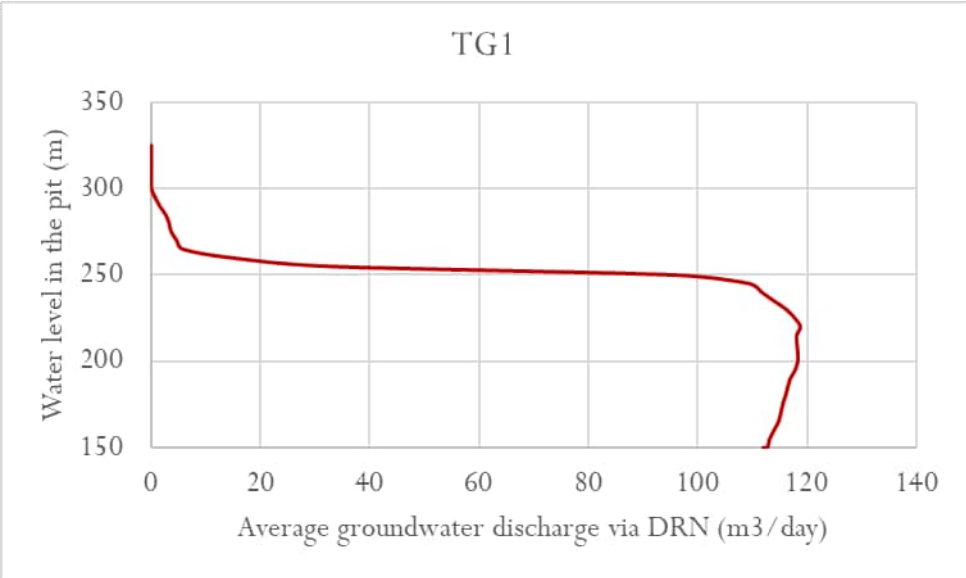


Figure 7-4 Groundwater Recovery Curve - TG1

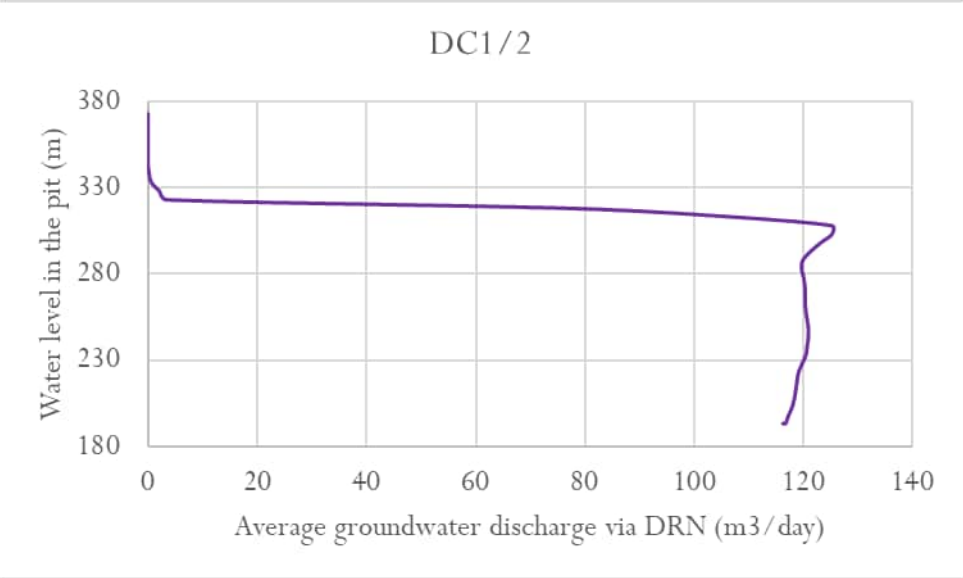


Figure 7-5 Groundwater Recovery Curve - DC1/2

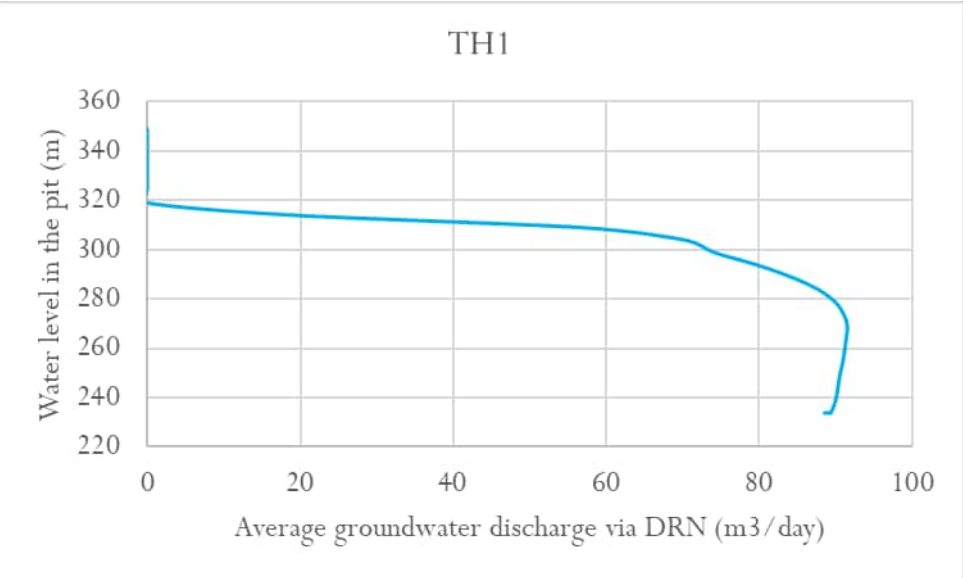


Figure 7-6 Groundwater Recovery Curve - TH1

A.2 FINAL VOID STORAGE CURVES

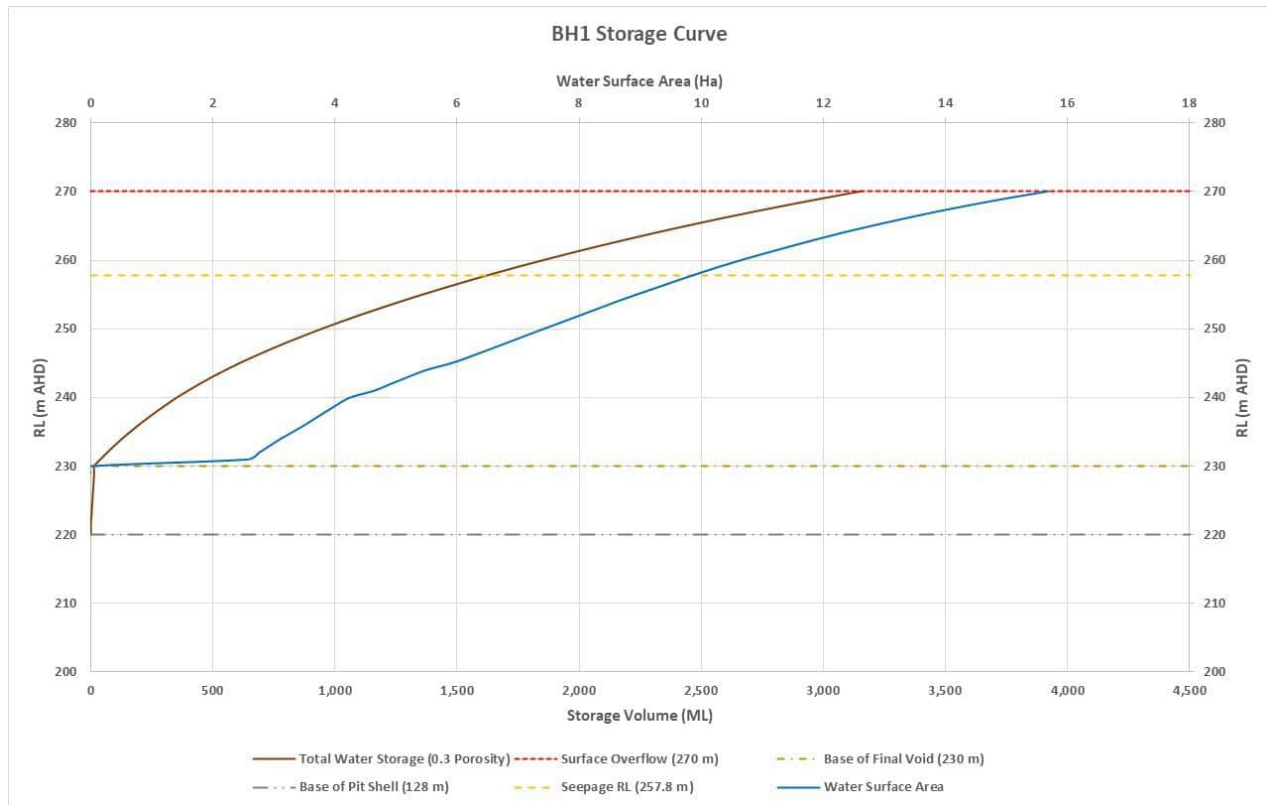


Figure 7-7 Storage Curve - BH1

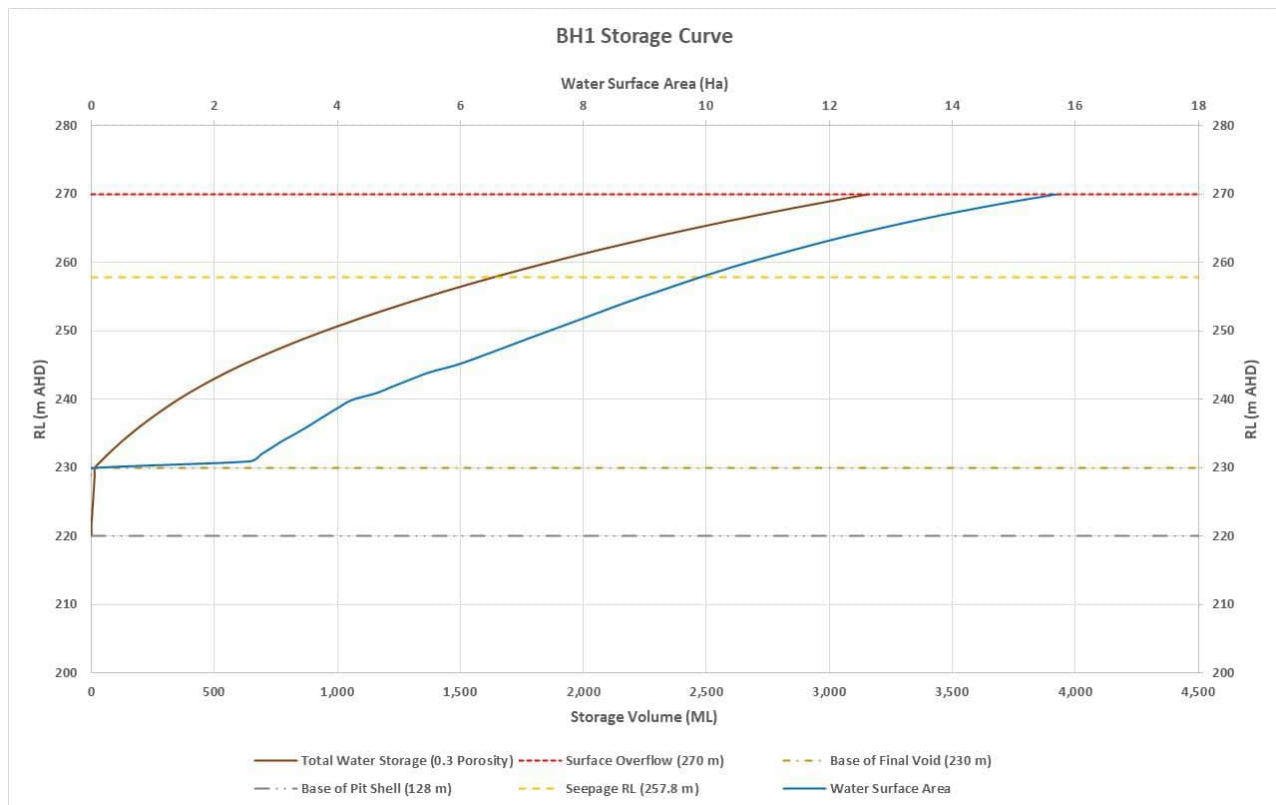


Figure 7-8 Combined Storage Curve – BH2, BH4 and BH5

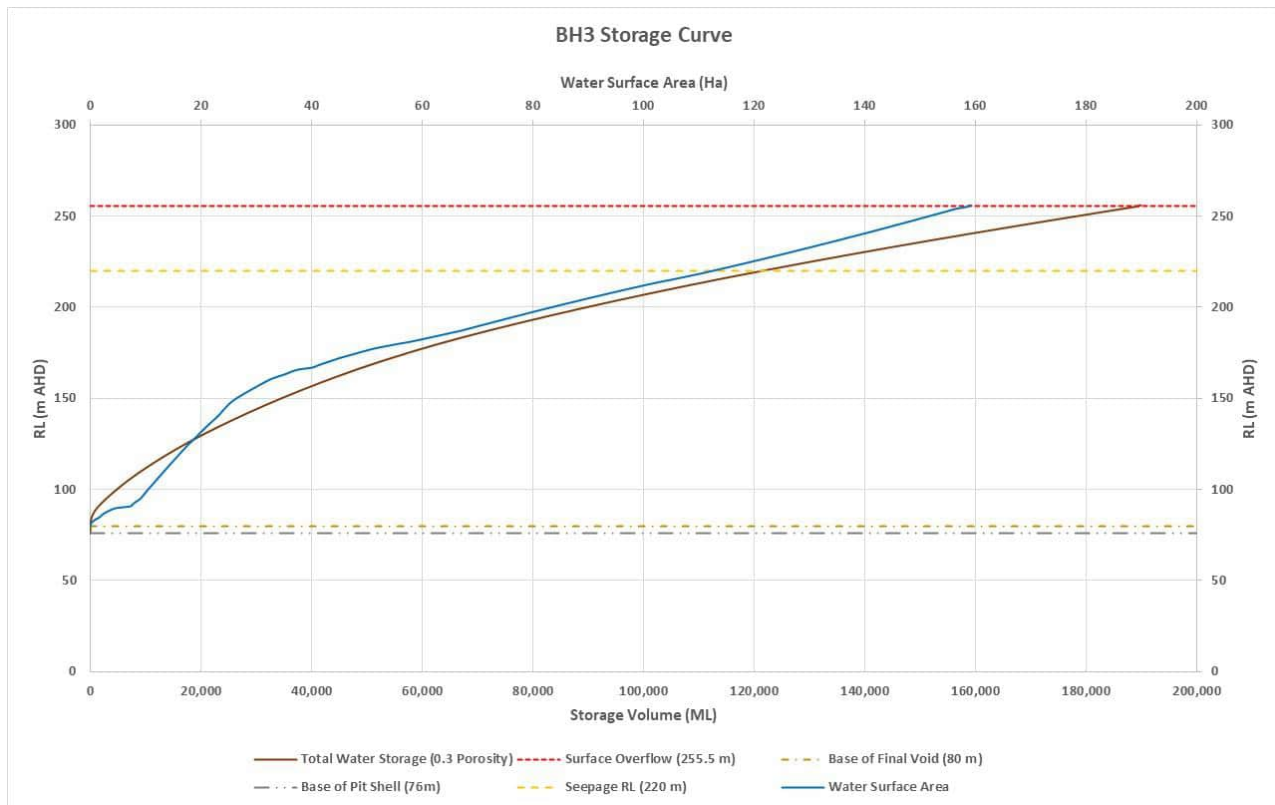


Figure 7-9 Storage Curve – BH3

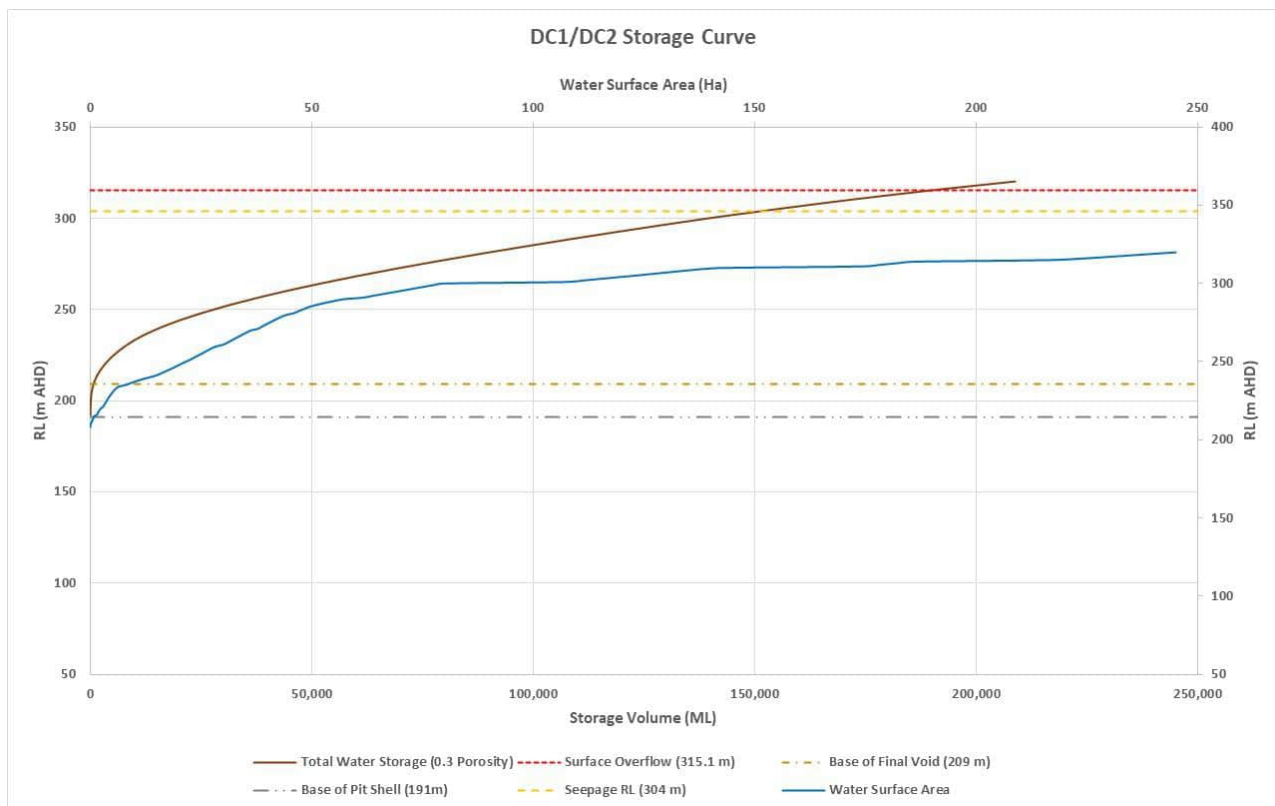


Figure 7-10 Combined Storage Curve – DC1, DC2

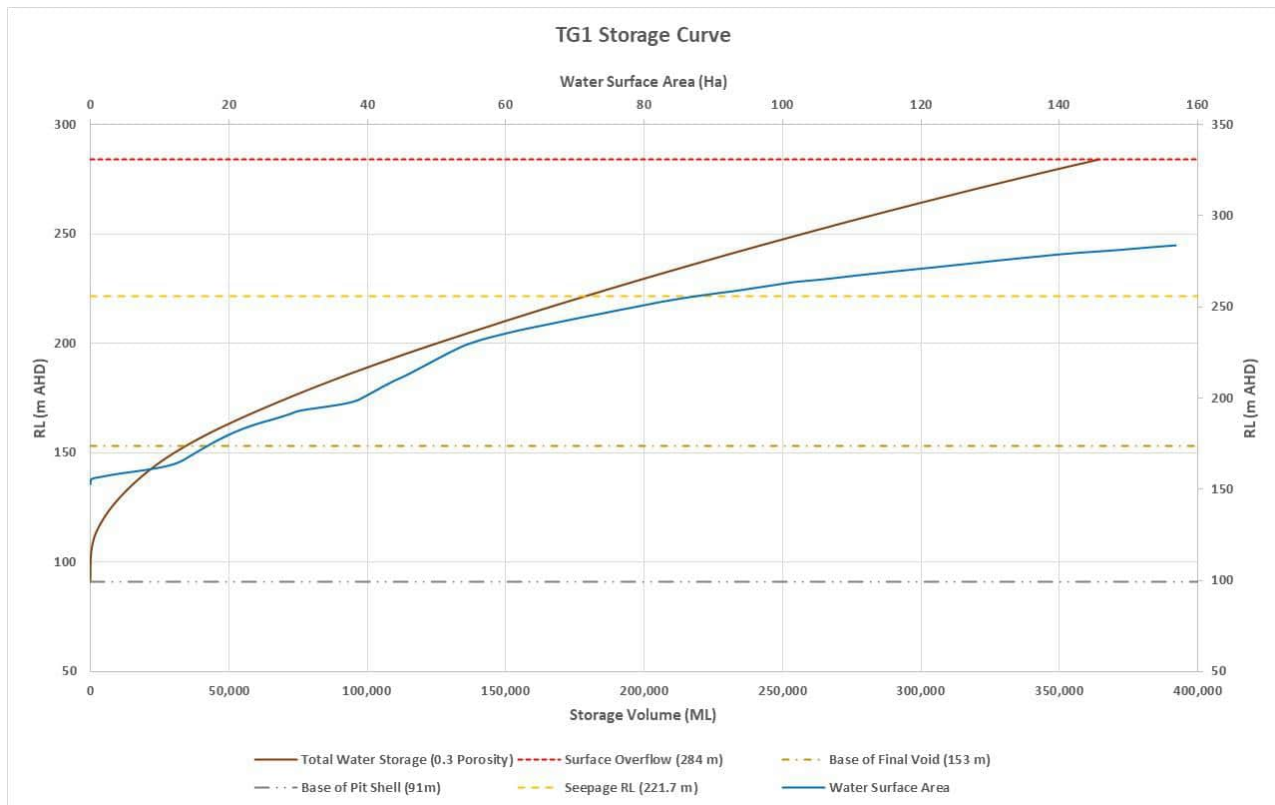


Figure 7-11 Storage Curve – TG1

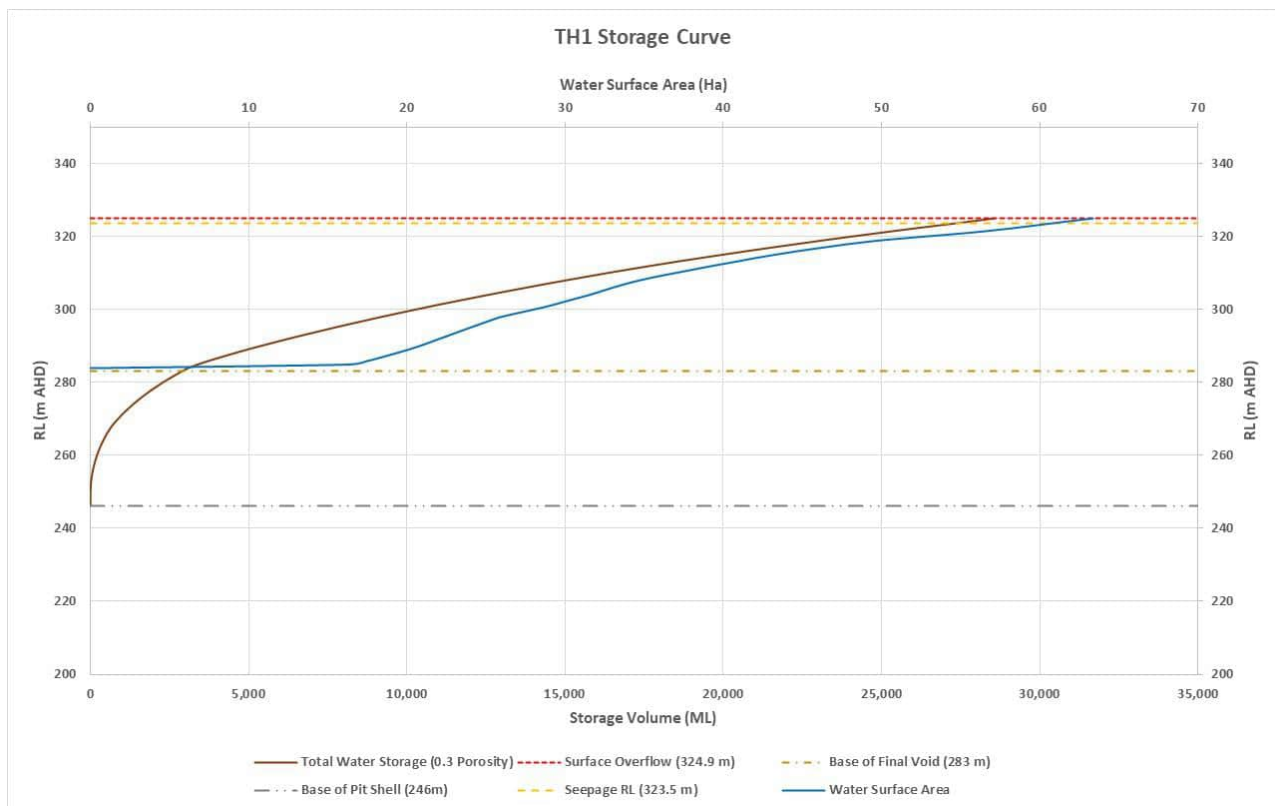


Figure 7-12 Storage Curve – TH1

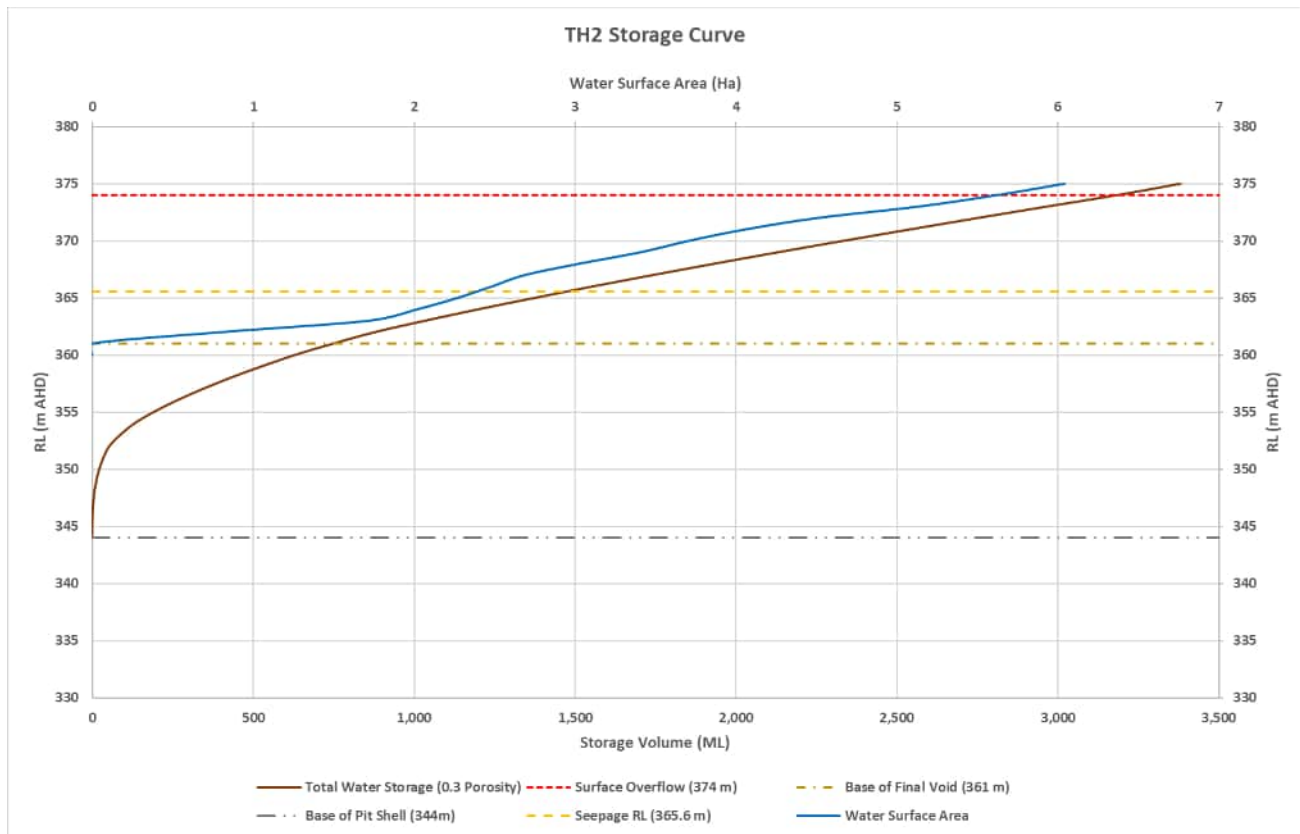


Figure 7-13 Storage Curve – TH2

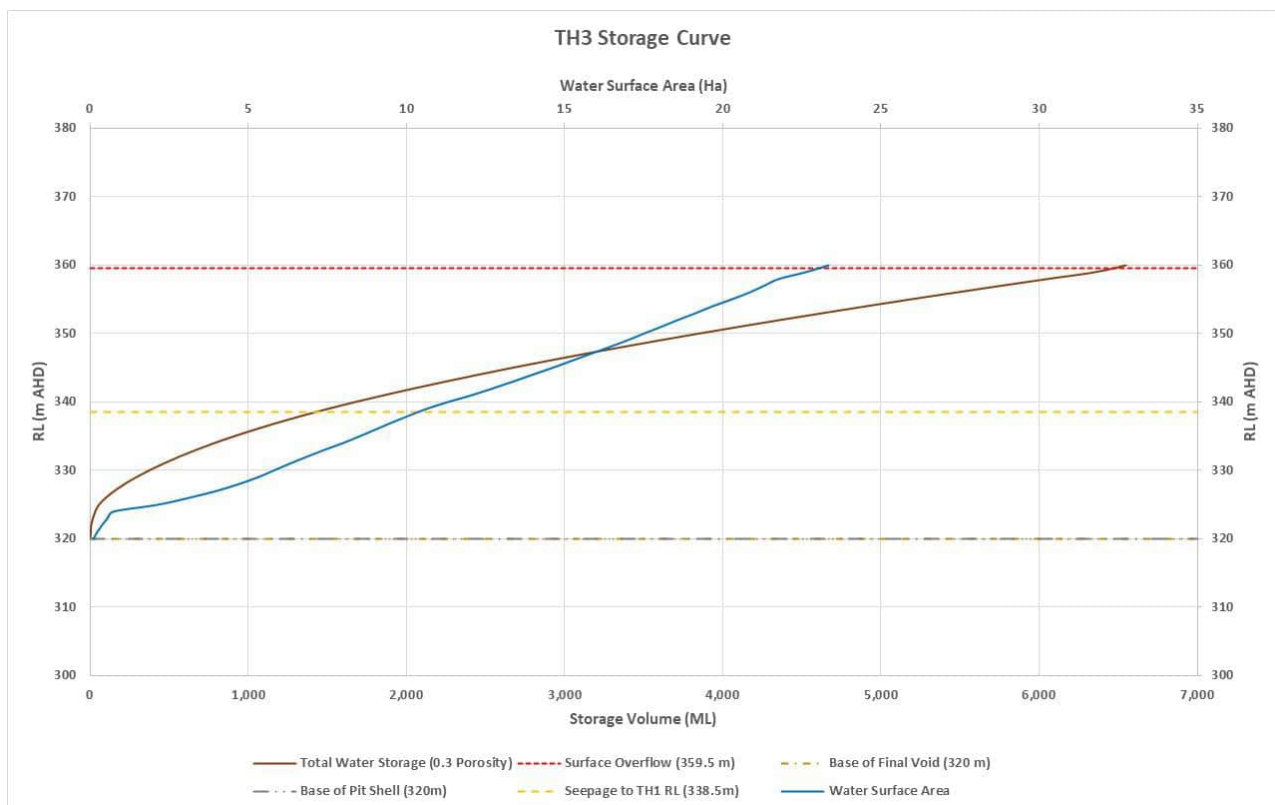


Figure 7-14 Storage Curve – TH3

Appendix B:

[Runoff Sensitivity – Water Quality Results]

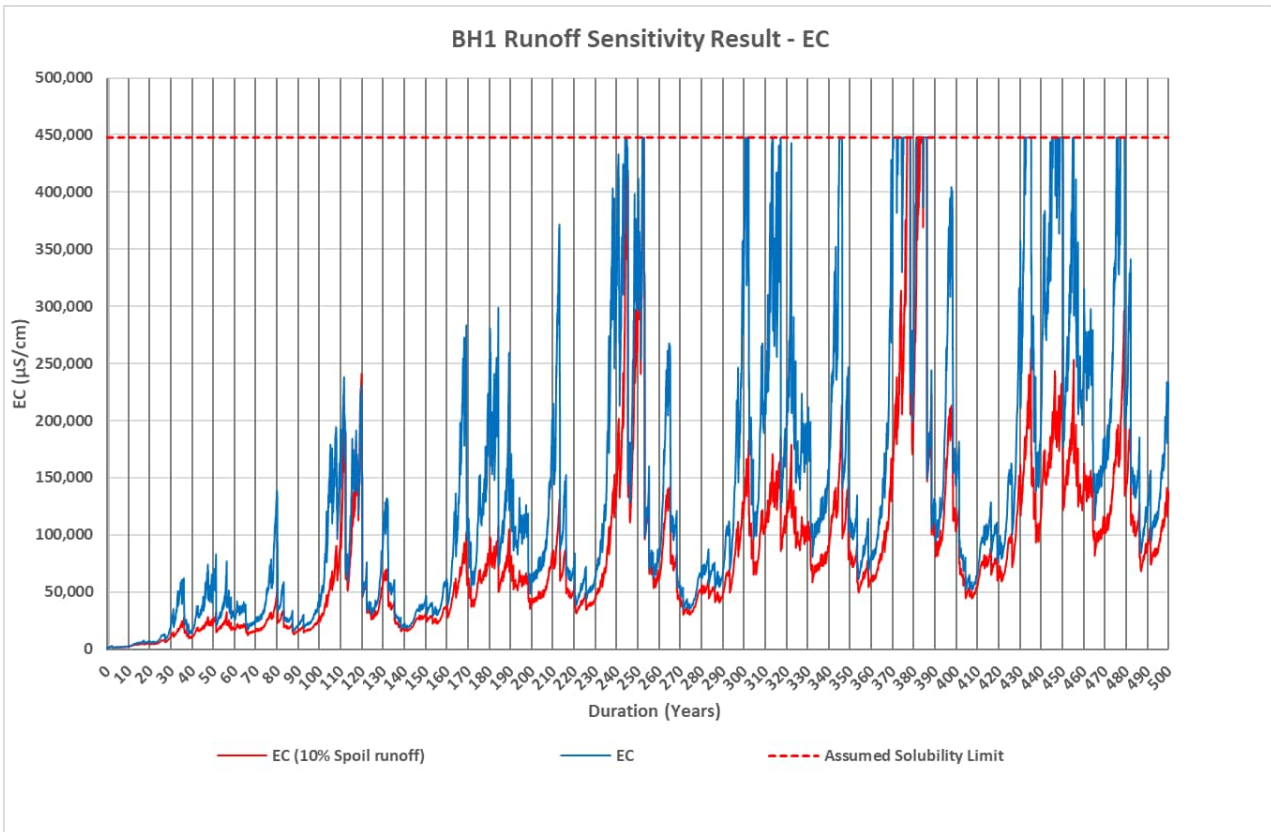


Figure 7-15 Runoff Sensitivity Result - BH1 EC

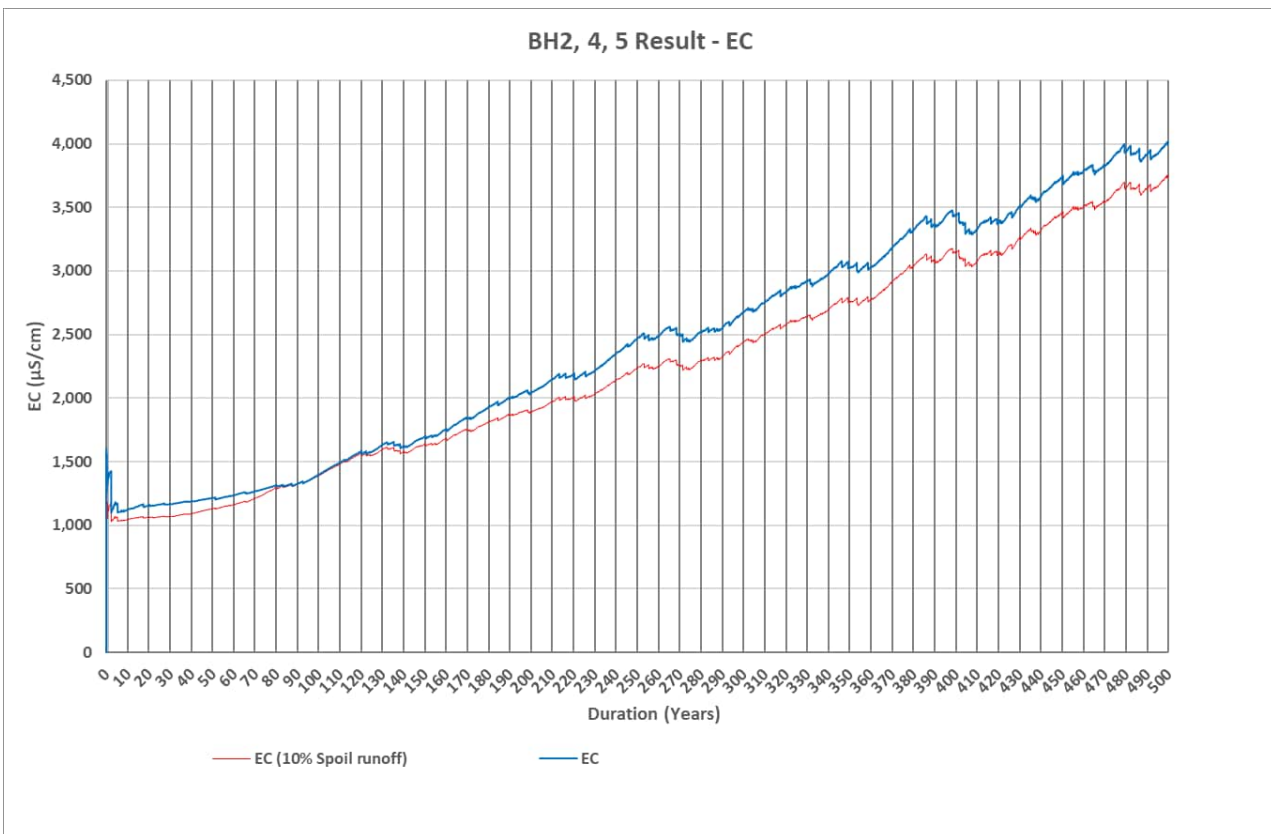


Figure 7-16 Runoff Sensitivity Result - BH2, 4, 5 EC

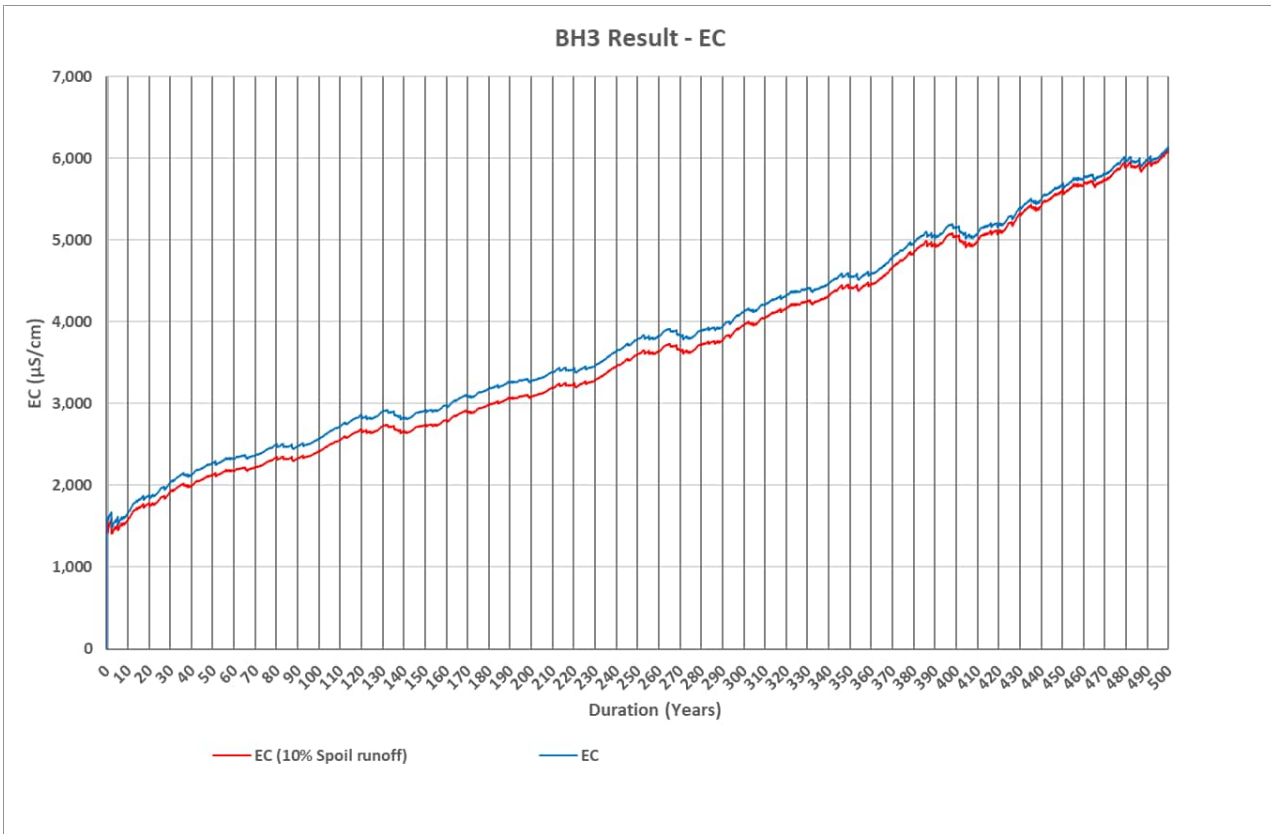


Figure 7-17 Runoff Sensitivity Result - BH3 EC

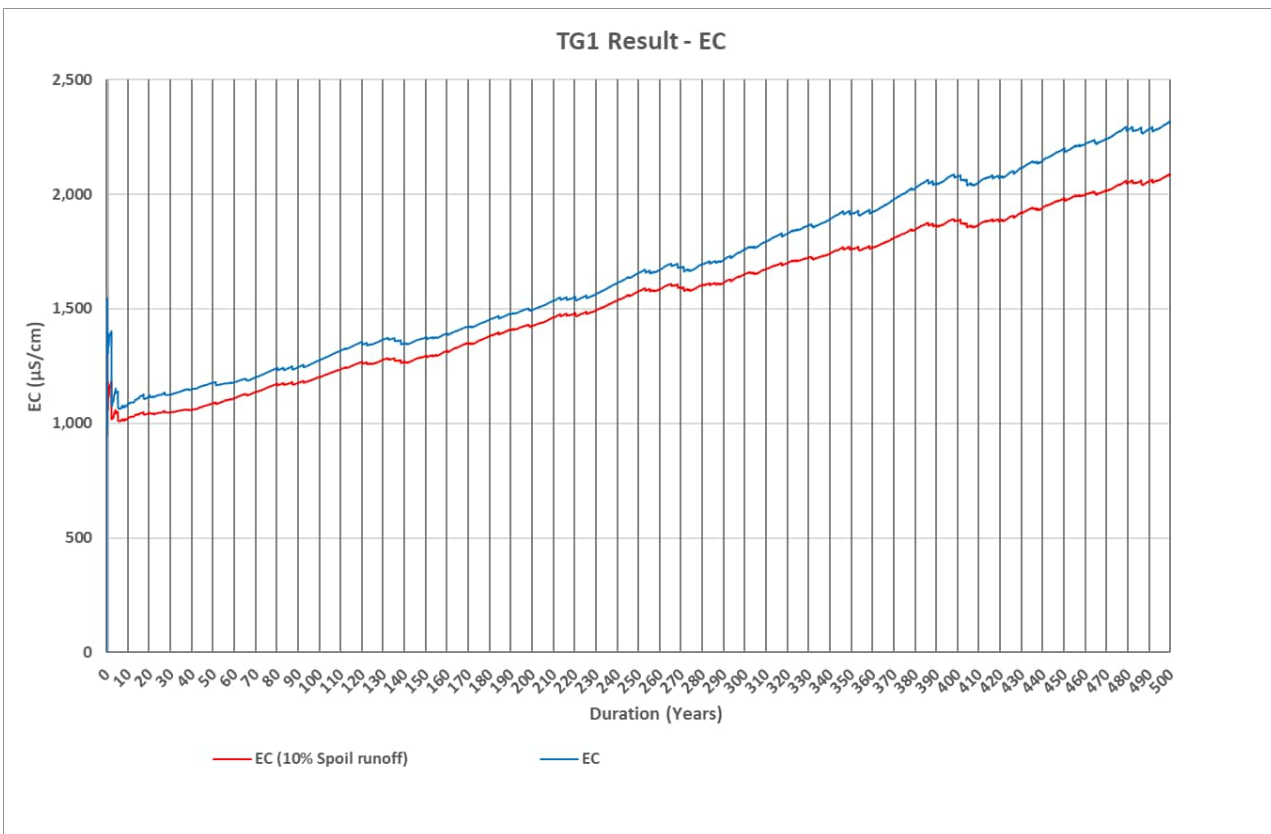


Figure 7-18 Runoff Sensitivity Result – TG1 EC

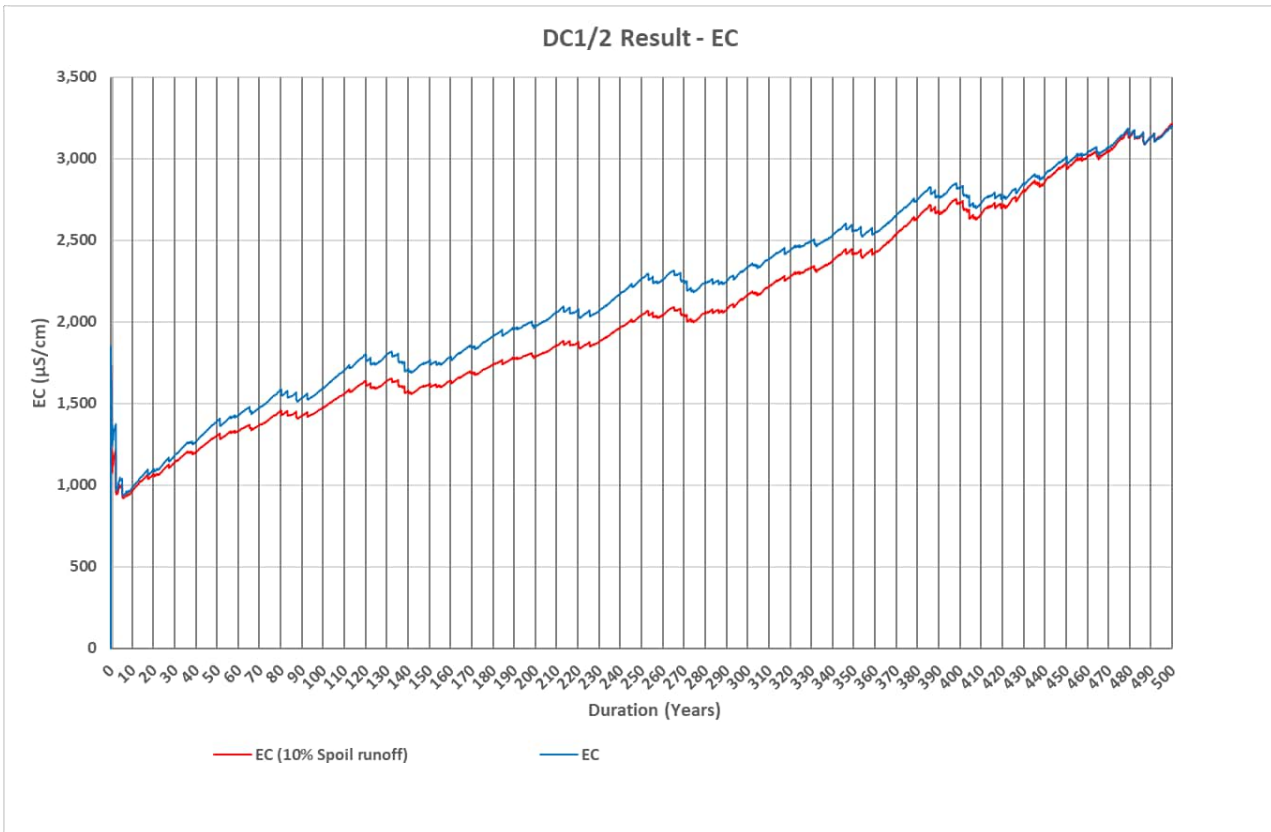


Figure 7-19 Runoff Sensitivity Result – DC1/2 EC

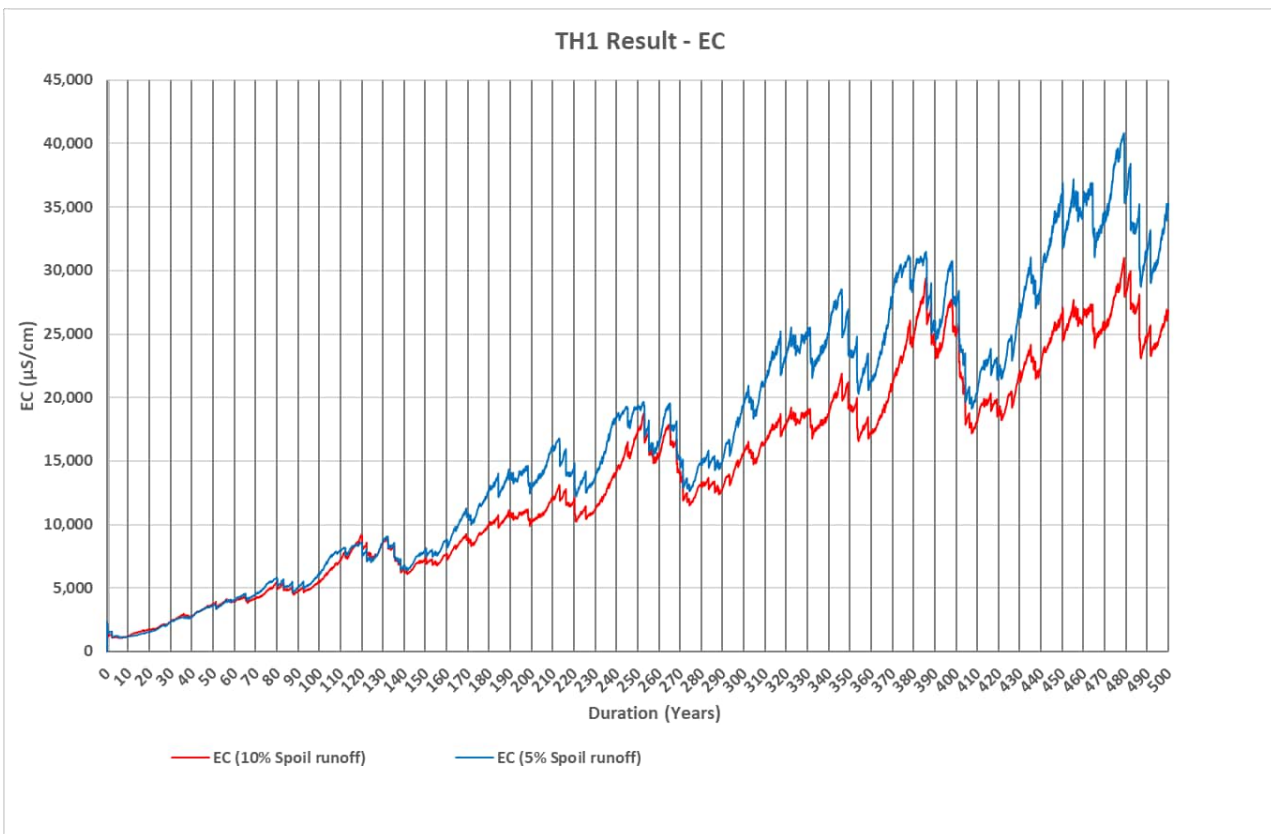


Figure 7-20 Runoff Sensitivity Result – TH1 EC

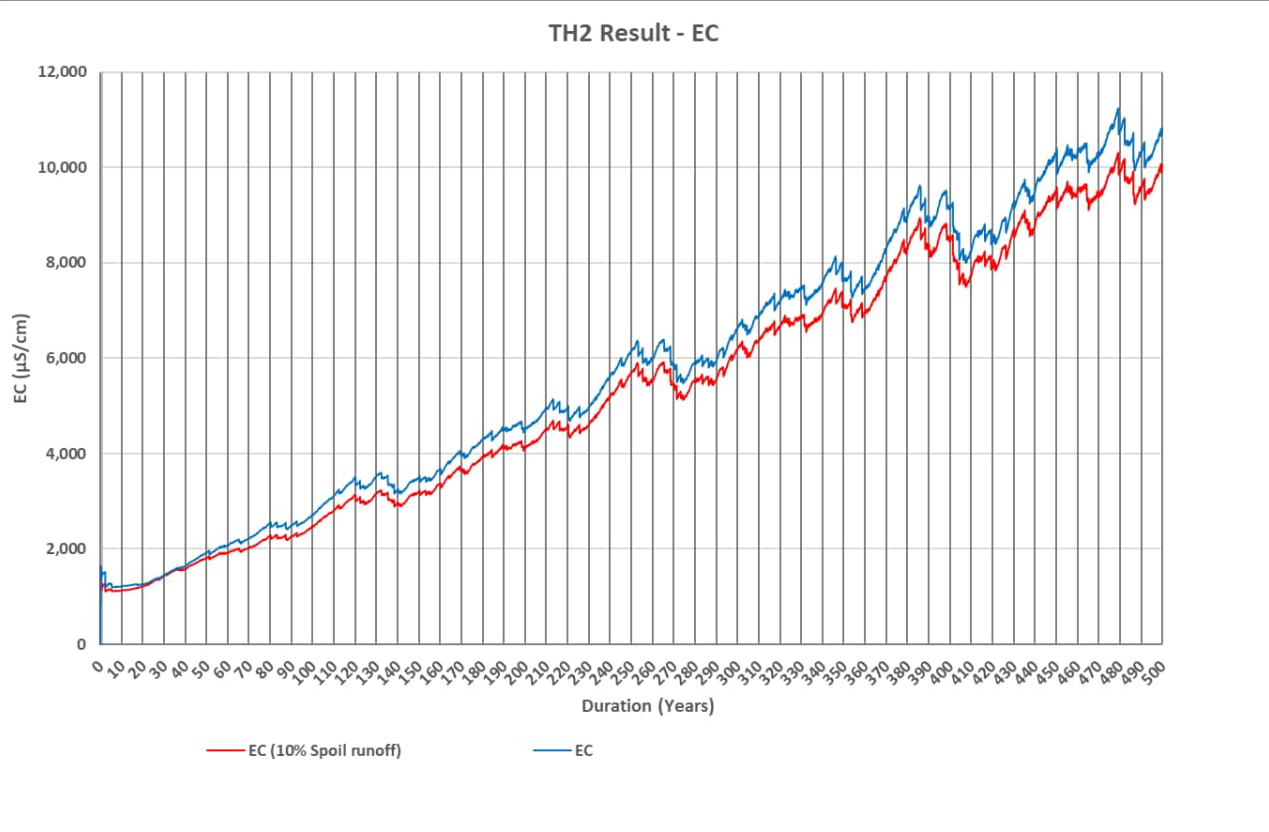


Figure 7-21 Runoff Sensitivity Result – TH2 EC

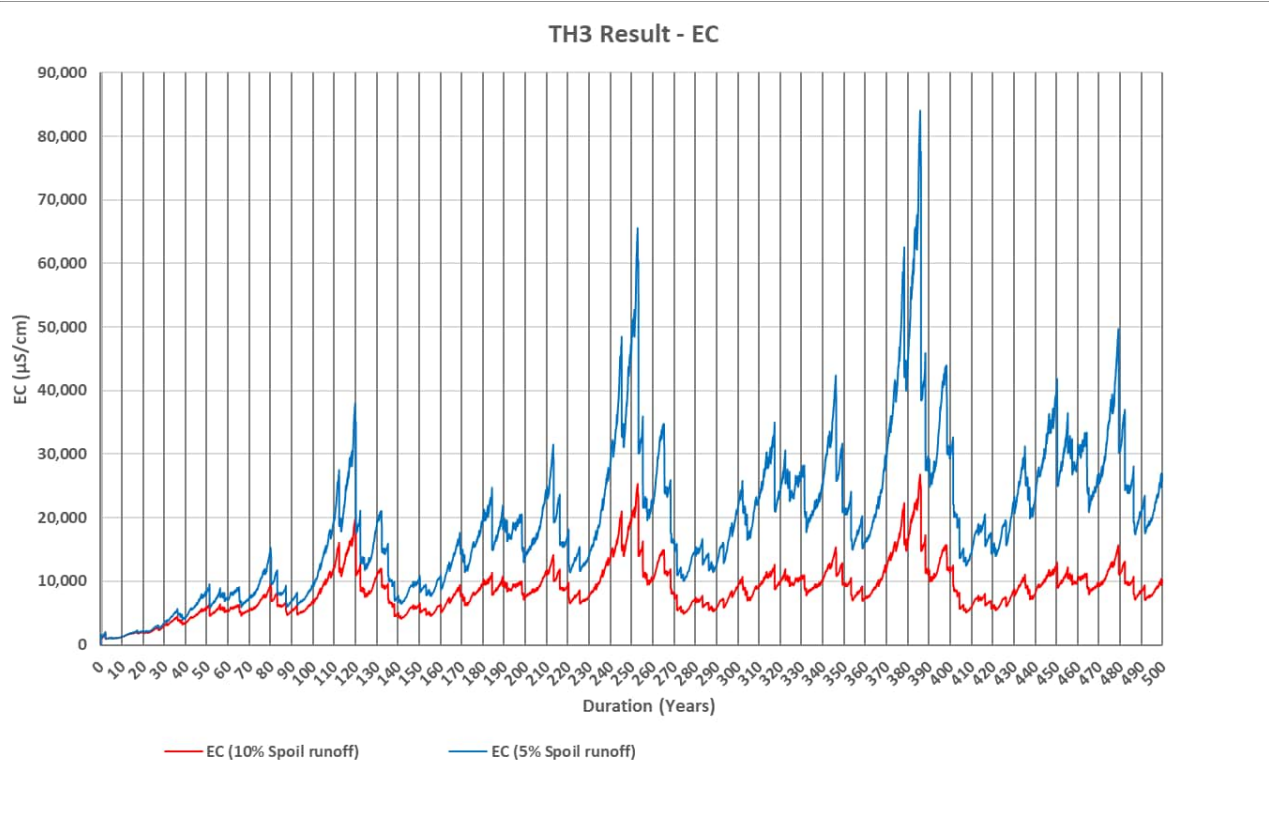


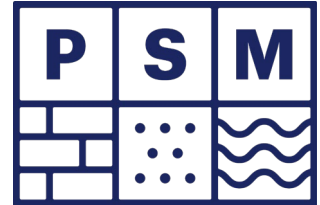
Figure 7-22 Runoff Sensitivity Result – TH3 EC



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Appendix F

Final Landform Slope Assessment



Our Ref: PSM3412-122L

28 March 2023

Manager - Environment and Community
Batchfire Resources Pty Ltd
Callide Mine
Coal Road
BILOELA QLD 4715

Joseph.Hughes@batchfire.com.au

Attention: Joseph Hughes

Dear Joseph,

Level 6, 500 Queen Street
Brisbane QLD 4000

P +61 7 3220 8300

E mailbox@psm.com.au

www.psm.com.au

RE: CALLIDE PCRP CLOSURE - GEOTECHNICAL ASSESSMENT

1. Introduction

This letter by Pells Sullivan Meynink (PSM) provides an assessment to assist with the Progressive Rehabilitation and Closure Plan (PRCP) of the Callide Coal Mine, for Batchfire Resources Pty Ltd (Batchfire). The study has focused on the requirements as set out in "Callide Environmental Authority EPML00720413 Table F3", provided below as Inset 1. Owing to the requirements set out in Table F3, the assessment has encompassed a geometric check of the proposed final landforms, dated 1 April 2022, as provided by Joseph Hughes of Batchfire.

**Table F3 - Residual void design outcomes
(Boundary Hill, Dunn Creek, Trap Gully, The Hut and The Bluff Mining Areas)**

Void Identification	Configuration
High wall	75° slope angle. Safety bunds will be constructed along the top of the high walls and along the crest of the pre-strip benches. The pre-strip benches will be shaped to shed runoff over the high wall at several locations to limit erosion.
Low wall	Generally at angle of repose.
Ramp Spoil	Generally at angle of repose.

Inset 1: Table F3 of Callide Environmental Authority EPML00720413, detailing closure requirements for final landform slopes for Callide Coal Mine.

2. Approach

The approach to the geometric assessment has been as follows:

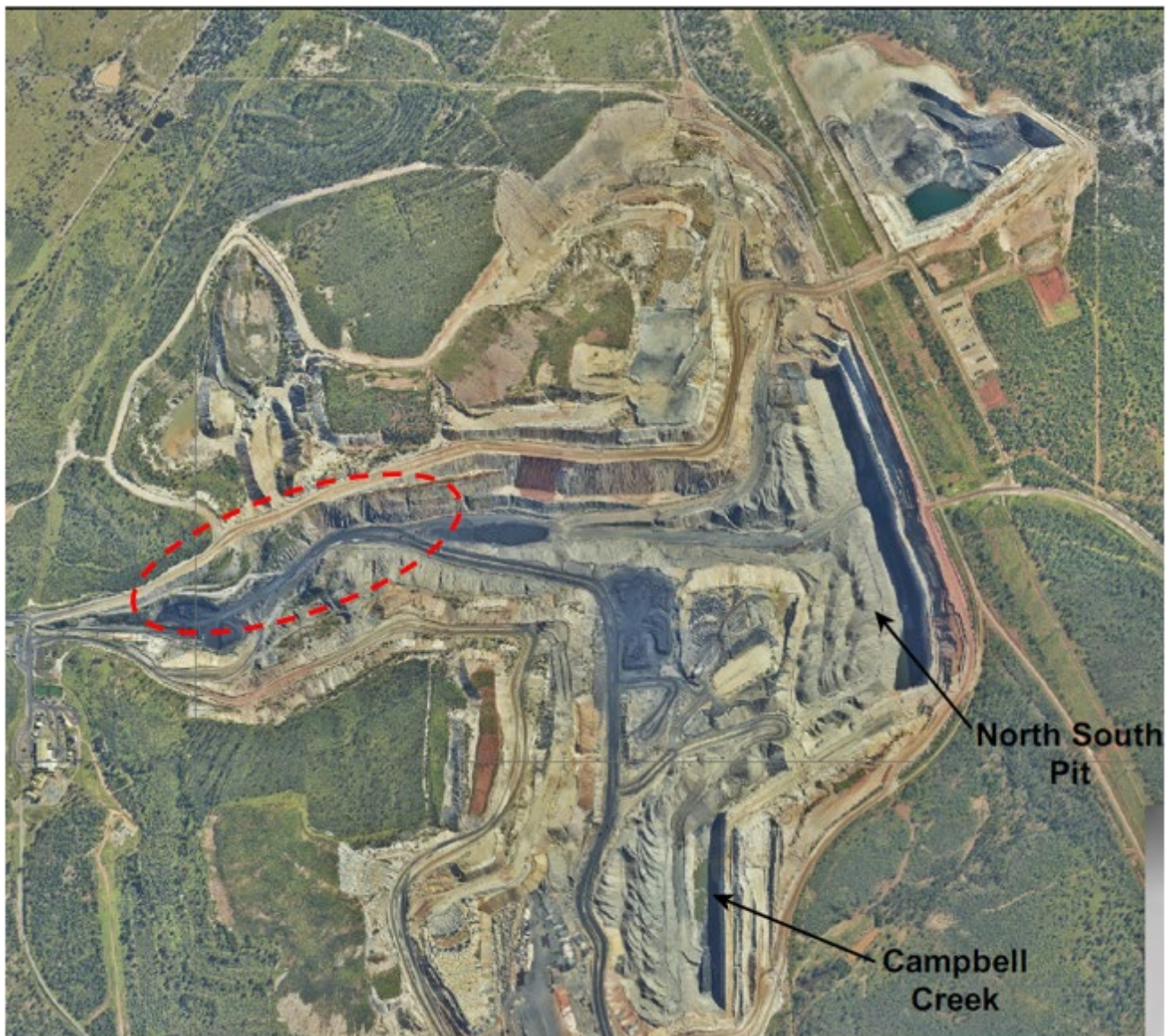
- Utilise a GIS package to import final landforms, with contours of the final landforms presented in Figures 1 to 8 for the four mining areas:
 - Boundary Hill Mining Area, Figure 1 and 2
 - The Hut Mining Area, Figure 3 and 4
 - Dunn Creek Mining Area, Figure 5 and 6, and
 - Trap Gully Mining Area, Figure 7 and 8.
- Utilise the defined disturbance extents to limit the extent of geometric checks
- Utilising aerial photographs and site knowledge (interacting with Batchfire where clarification was required), subdivide the extents of each of the four pit areas into two areas
 - firstly, where the final landform will leave a highwall
 - secondly, remaining area and which covers low wall and ramps.
- For the highwall areas, utilise the GIS package to query the landform and flag any areas where the slope angle exceeds 75°, as defined in Table F3. Figures 1, 3, 5 and 7 presents the results for this assessment for each of the above mining areas
- For the low wall and ramp areas, utilise the GIS package to query the landform and flag any areas where the slope angle exceeds the 40°. Figures 2, 4, 6 and 8 presents the results for this assessment for each of the above mining areas. While Table F3 defines low wall and ramp areas configured at “Generally at angle of repose”, experience indicates the angle of repose for sedimentary rocks often ranges from 35 to 38°. As such, and to avoid minor issues with the landform geometry, PSM have utilised 40° to ensure the highlighted areas of potential concern are appropriate. In practice, any regrading of existing final landform slopes of up to 40° would be likely to create more slope instability than a marginal exceedance of the design slope angle. In addition, any future final landform slopes will be constructed at angle of response, regardless of any design artifacts in the PRCP final landform plans.

3. Highwall

Figures 1, 3, 5 and 7 present the results for the highwall assessment, with the green outline providing the areas queried in the assessment. The following comments are provided:

- For Boundary Hill Mining Area, which includes open pits Boundary Hill South (BHS), Boundary Hill North (BHN), and Boundary Hill East (BHE), there are two areas where the highwall angles exceed 75°, Figure 1
 - One minor area is highlighted at the northern end of the future BHS pit final void. Batchfire have confirmed that this minor slope area is an artifact of the mine planning software used in the production of the final landform plans and the constructed slope in this area will be less than 75°
 - A more extensive area is indicated in the BHN pit final void in Figure 1. A portion of this area is an existing highwall. Figure 9 presents cross-sections through the final void highwall and indicates that only minor components of the lowest batter exceed 75° and the overall angle of the lower batter meets the requirement set out in Table F3.
- For the Hut Mining Area, there is one area where the highwall angle in the Eastern Hillside pit final void exceeds 75°, Figure 3. Representative cross-sections are presented in Figure 10. Similar to the steep section of highwall slopes in the BHN pit final void, only minor components of the lower highwall batter exceed 75° and the overall angle of the lower highwall batter meets the requirement set out in Table F3

- For Dunn Creek (DC) mining there is one area where the highwall angle in the Bluff pit final void exceeds 75° , Figure 5. This is in an area of an existing highwall that has a slope failure. As shown in the Inset in Figure 5, a localised, relatively short section along strike of the upper part of the slope constitutes a scarp to the failure and where the slope angle exceeds 75° , Figure 11. It is understood that Batchfire is proposing to place windrows to restrict access to the area including the failure and the pre-strip benches immediately above. The failure material has buttressed the area and bunding on the pit bench also limits further access to the short scarp area. It is understood that Batchfire will continue to monitor this area and, if necessary, will consider remediation measures to stabilise the area
- For the Trap Gully (TG) mining area, there are isolated occurrences where the design end wall slope angle exceeds 75° , Figure 7. PSM highlight these areas are yet to be mined. PSM understands that these areas are design artifacts and Batchfire will ensure the constructed slope meets the criteria set out in Table F3.



Inset 2: Boundary Hill North Mining Area showing area where ramp batters have minor exceedances of 40°

4. Low wall and Ramps

Figures 2, 4, 6 and 8 present the results for the assessment of low wall and ramps. The following comments are provided:

- For the Boundary Hill mining area, there are numerous small areas where the low wall spoil and ramp angle exceeds 40°, Figure 2. For Boundary Hill North, there are two significant areas, one near the entrance ramp into the pit void Inset 2 and Figure 2, and the other associated with the existing low wall Figure 2. These are largely existing landforms within the mining footprint and represent small areas where erosive processes have over-steepened a portion of an overall batter/slope. In view that the overall batter is near angle of repose, PSM consider no mitigation of the areas are required as any slope regrading work is likely to create unnecessary instability
- PSM have noted areas in Boundary Hill South, south and east of above areas, where minor areas of the final landform appears to be overly steep, Figure 2. Batchfire have confirmed that this is due to a minor issue with the landform design geometry, and which will be addressed during construction to achieve a design slope in keeping with Table F3
- For the Hut mining area, there are numerous small areas where the low wall spoil and ramp angle exceeds 40°, Figure 4. Comments made in the above two bullet points (inclusive of an area where there is an issue with the design) are equally appropriate
- For Dunn Creek (DC) mining area, there are numerous small areas where the low wall spoil and ramp angle exceeds 40°, Figure 6. Batchfire have confirmed that this is due to a minor issue with the landform design geometry. Furthermore, Batchfire have confirmed that the actual final slopes will be constructed in keeping with Table F3
- For Trap Gully (TG) mining area, there are no areas identified where low wall spoil or ramp angles exceed 40°, other than design artefacts that will be addressed during construction (Figure 8).

5. Outcomes & Recommendations

The PSM review of the final landforms has concluded:

- There are localised areas in Boundary Hill North, Eastern Hillside and The Bluff pits where existing final highwall batters exceed 75°. In the Boundary Hill North and Eastern Hillside pits, cross-sections through the highwall indicate that only minor components of the lowest highwall batter exceed 75°, and the overall angle of the lower highwall batter meets the closure requirements set out in Table F3. In The Bluff pit, a section of the highwall batter angle exceeds 75° in an area associated with an existing highwall failure. It is understood that Batchfire will continue to monitor this area and, if necessary, will consider remediation measures to stabilise the area
- With the exception of Trap Gully, all mining areas have isolated occurrences of low wall and ramps where angle exceeds 40°. These areas are largely existing landforms within the mining footprint and representing small areas where erosive processes have over-steepened portions of an overall batter/slope. Elsewhere, where the area is a proposed slope, steeper portions of the batter appear to be a design artifact issue and Batchfire have confirmed that the actual final slopes will be constructed in keeping with Table F3
- There are minor areas where the landform design for future slopes, yet to be constructed, needs revision, as indicated in Figures 2, 4, 6 and 7. It is understood these design issues would be addressed by Batchfire during creation of detailed designs prior to construction.

Yours Sincerely

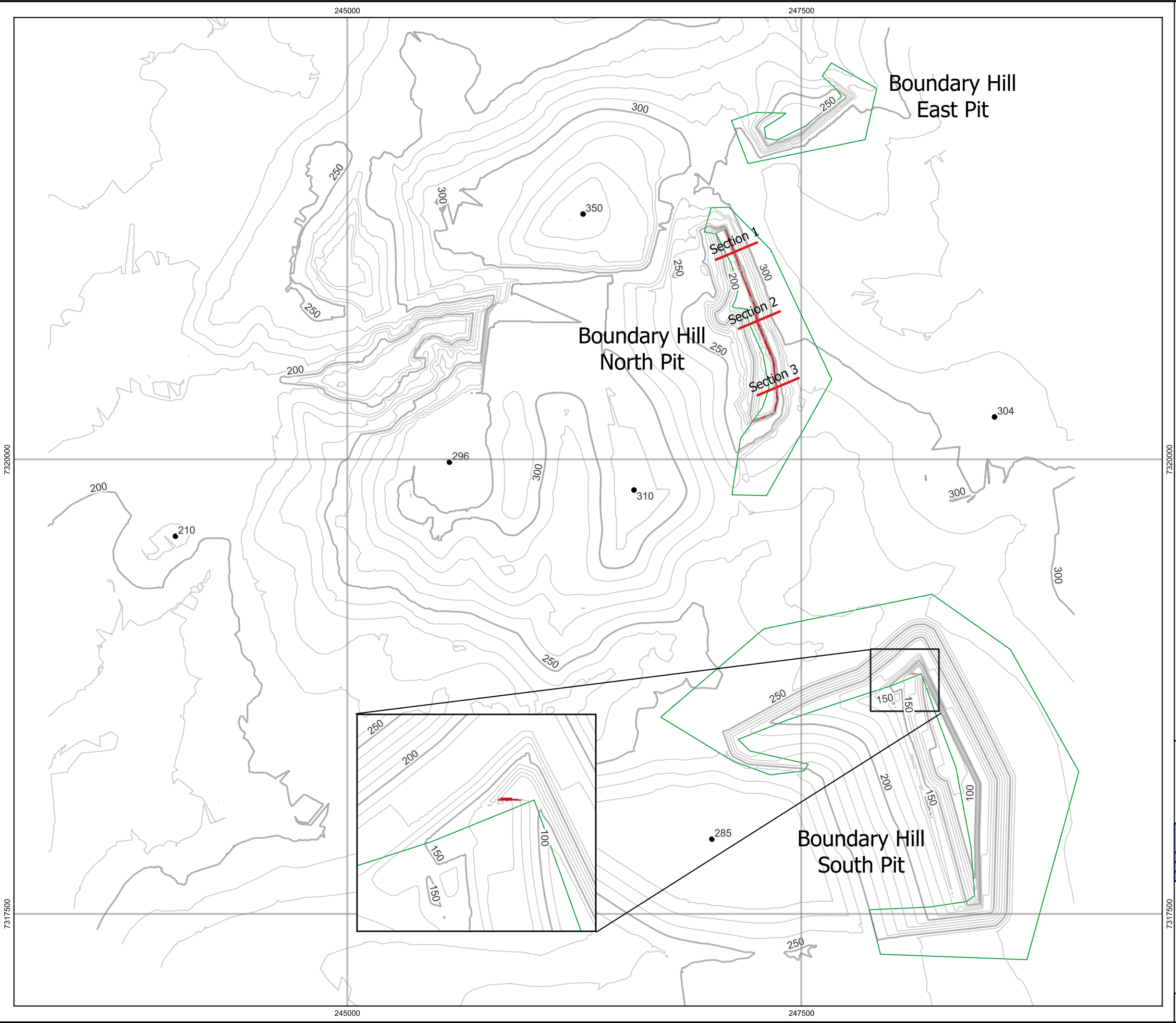
A handwritten signature in black ink, appearing to read "Alex Duran".

ALEX DURAN
PRINCIPAL
RPEQ 10461

A handwritten signature in black ink, appearing to read "Greg Kennedy".

GREG KENNEDY
PRINCIPAL

C:\Users\leleizja\OneDrive\Documents\GIS - PSM341202_Workspace\01_MXD\PSM341202_Callide_Closure_Study_Figures\qgz_LayOut_BHS Final High Wall above 75 Slope Map



Legend

High Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 75

Boundary Hill Sections - Figure 9

N

0

1 km

Scale 1:20,000

Map Projection:
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Created By:

PSM

Revision:

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Date:

15 Mar 2023

Paper Size:

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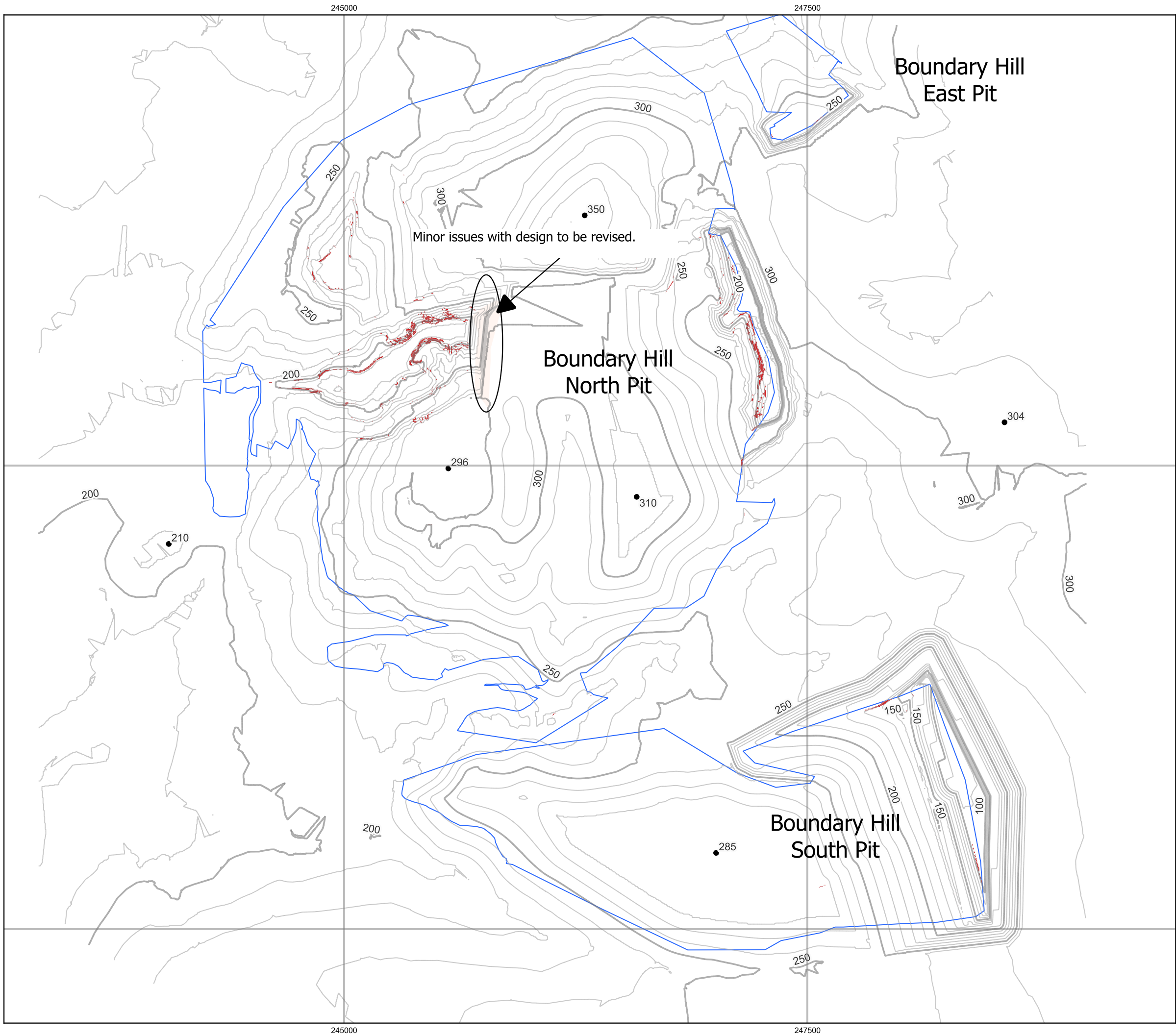
Callide Coal Mine
PRCP Mine Closure

Boundary Hill Mine
Final Landform
Slope Map (High Wall)

PSM3412-122L

Figure No 1

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Legend

Low Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 40

N

0

1 km

Scale 1:20,000

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Created By:
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Date:
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Revision:
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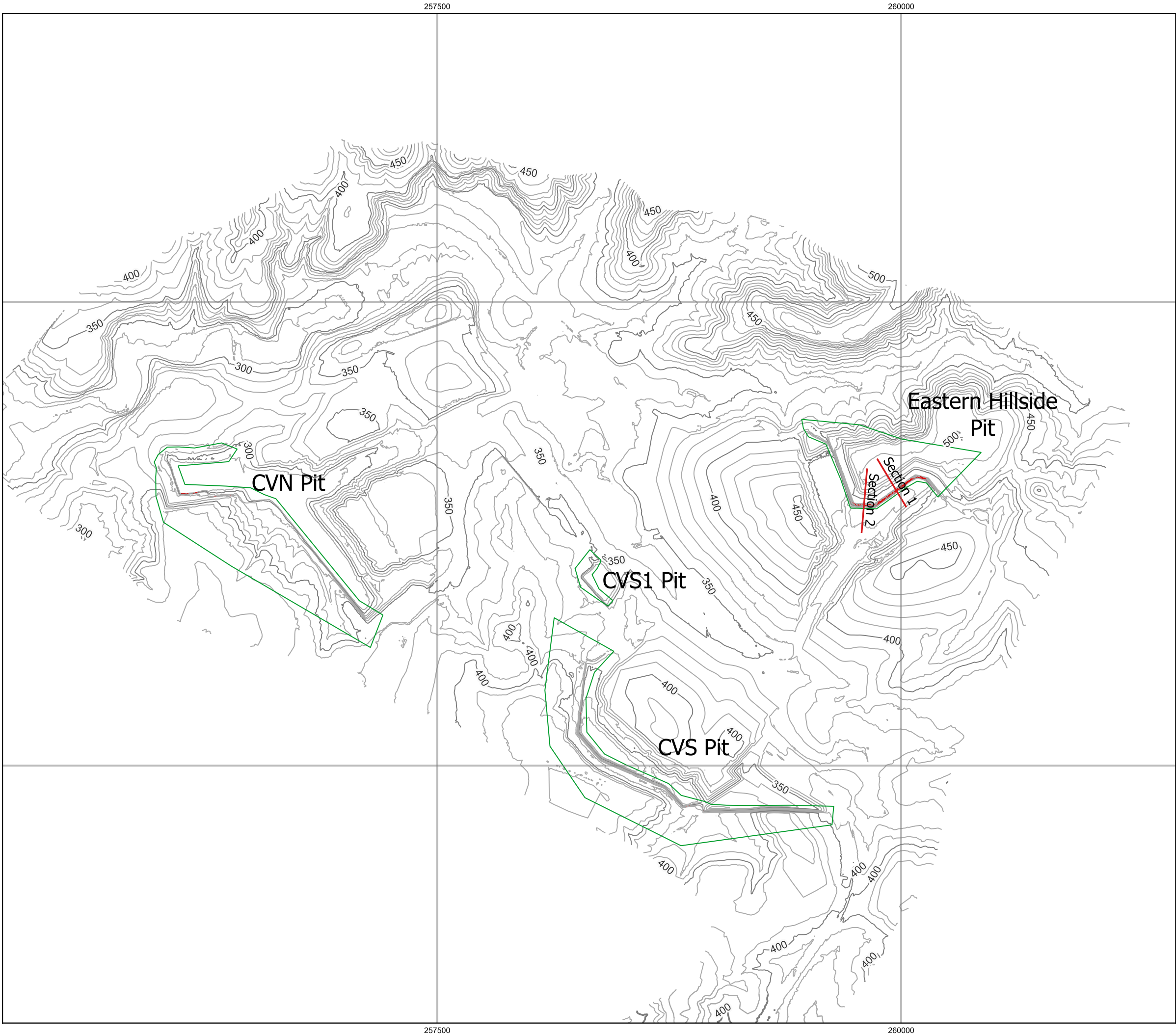
Callide Coal Mine
PRCP Mine Closure

Boundary Hill Mine
Final Landform
Slope Map (Low Wall & Ramps)

PSM3412-122L

Figure No 2

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Legend

High Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 75

The Hut Sections

N

0

1 km

Map Projection:
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Created By:

PSM

Revision:

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Date:

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Paper Size:

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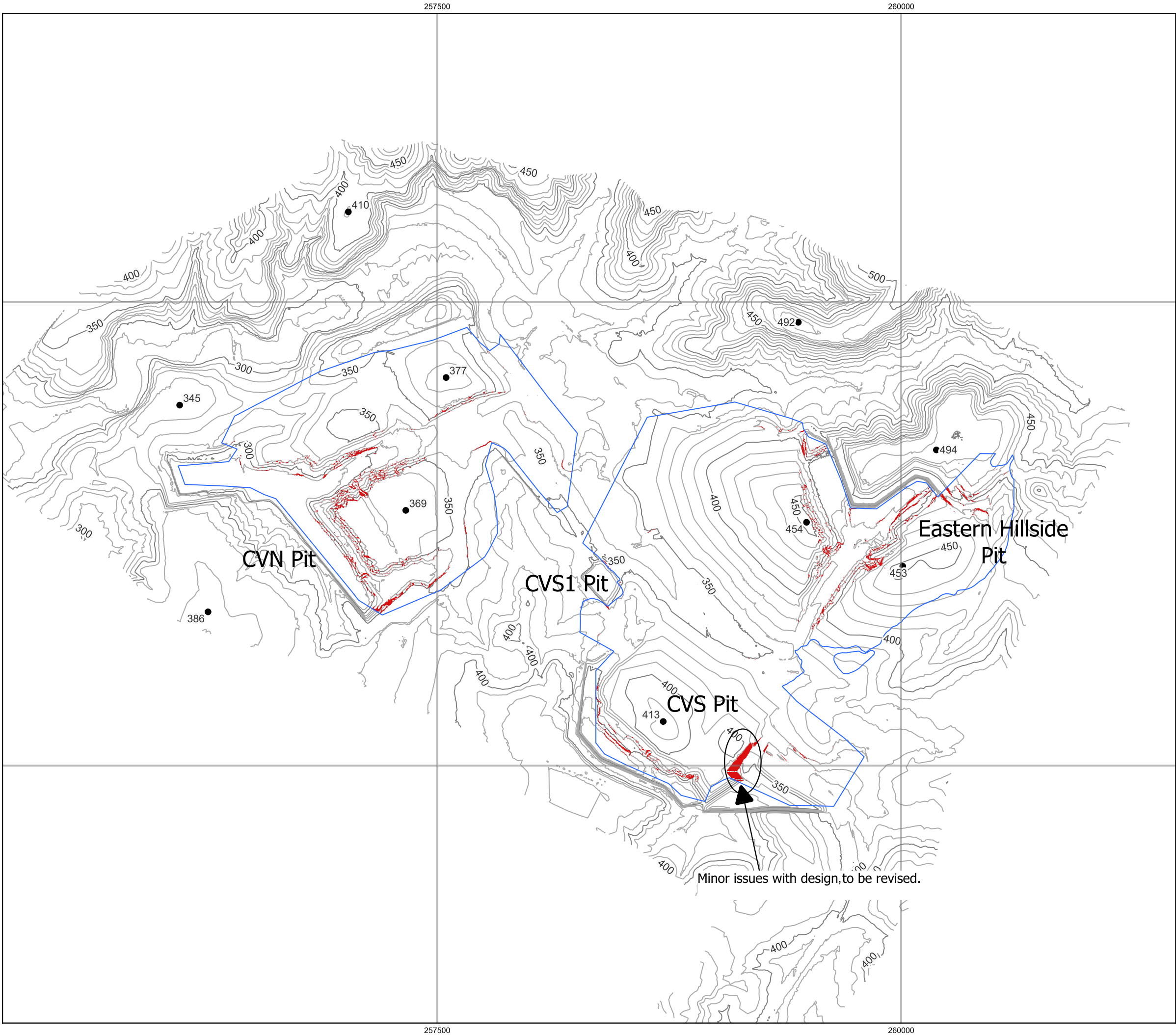
Callide Coal Mine
PRCP Mine Closure

The Hut Mine
Final Landform
Slope Map (High Wall)

PSM3412-122L

Figure No 3

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Legend

Low Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 40

N

0

1 km

Scale 1:20,000

Map Projection:
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Grid: EPSG:20356

Created By:

PSM

Revision:

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Date:

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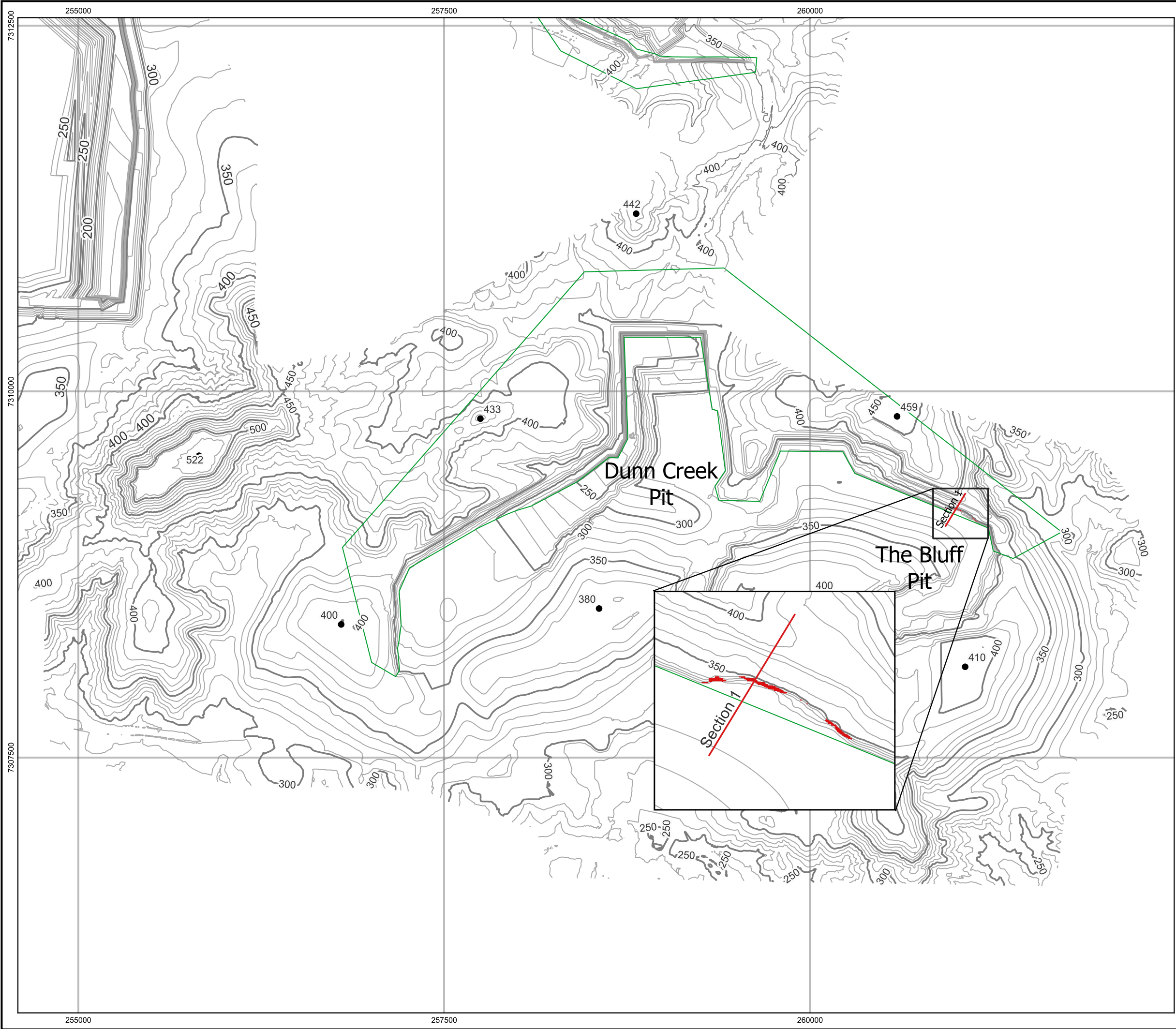
Callide Coal Mine
PRCP Mine Closure

The Hut Mine
Final Landform
Slope Map (Low Wall & Ramps)

PSM3412-122L

Figure No 4

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Legend

High Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 75

Dunn Creek High Wall Section

N

0

1 km

Scale

1:25,000

Map Projection:

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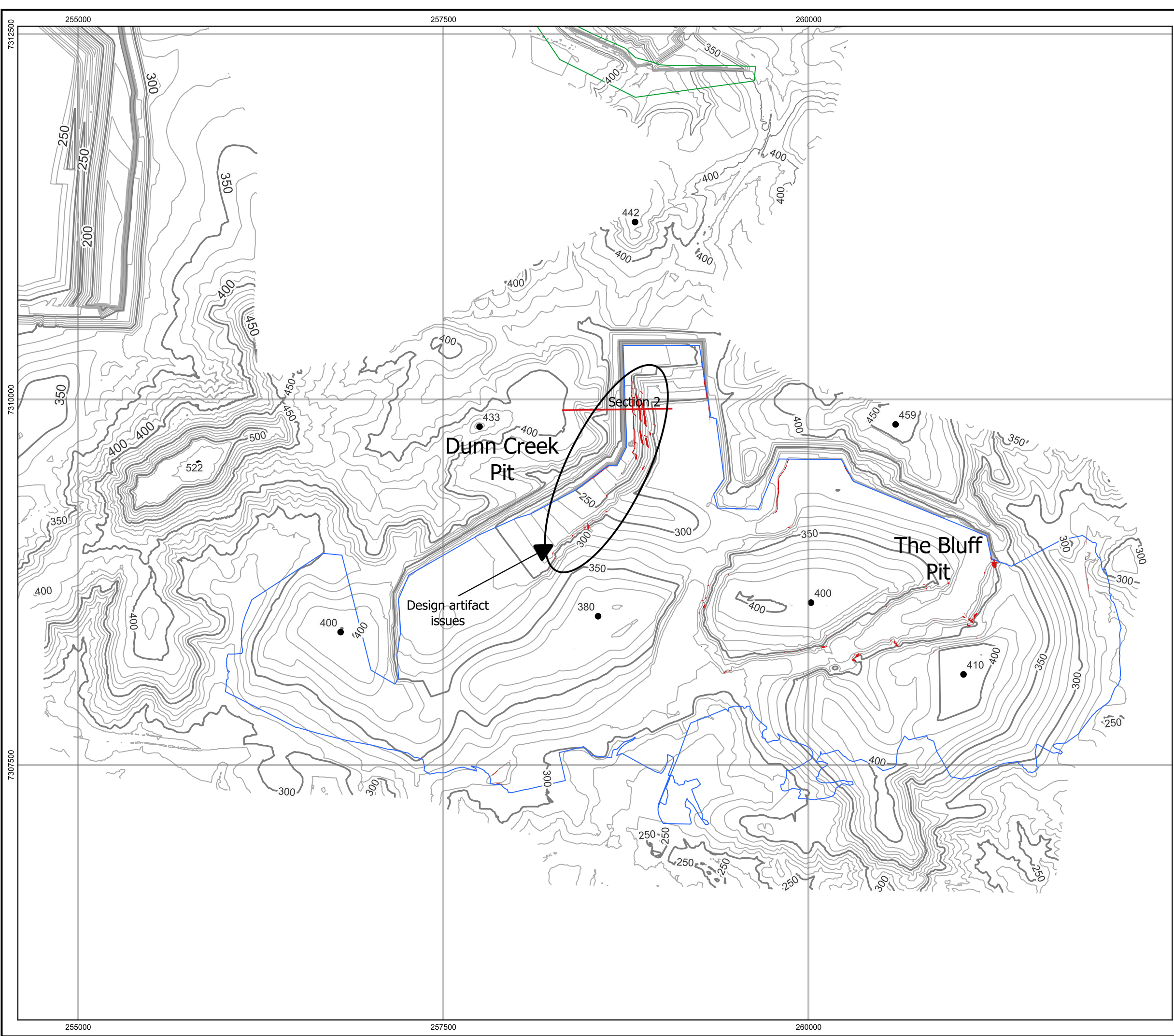
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	Date:	08 Mar 2023	Paper Size:	A3

Callide Coal Mine
PRCP Mine Closure

Dunn Creek Mine
Final Landform
Slope Map (High Wall)

PSM3412-122L	Figure No 5
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Legend

Low Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 40

Dunn Creek Low Wall Section

N

0

1 km

Map Projection:
Horizontal Datum: AGD84 / AMG
zone 56
Grid: EPSG:20356

Created By:

PSM

Revision:

A

Date:

08 Mar 2023

Paper Size:

A3

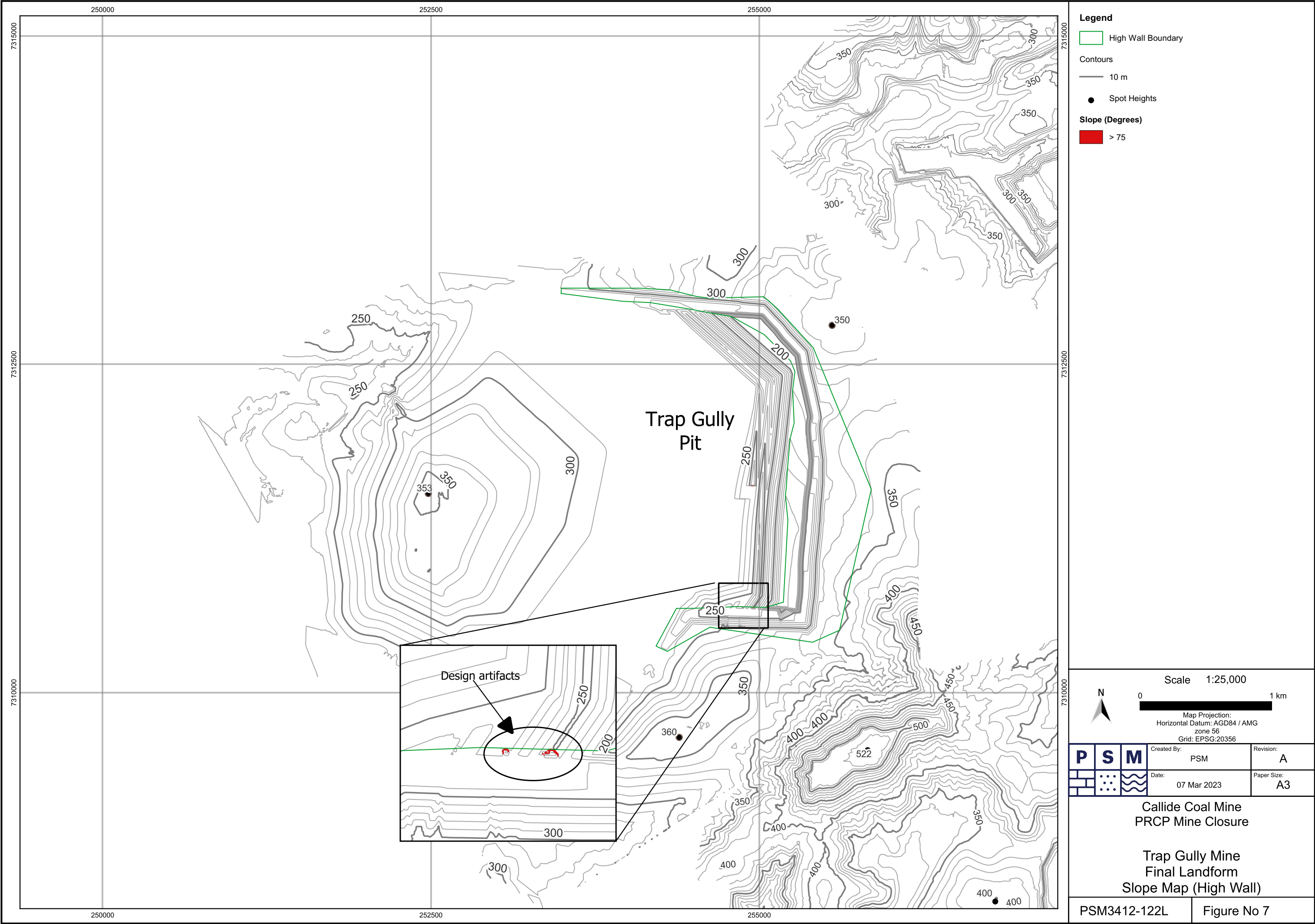
Callide Coal Mine
PRCP Mine Closure

Dunn Creek Mine
Final Landform
Slope Map (Low Wall & Ramps)

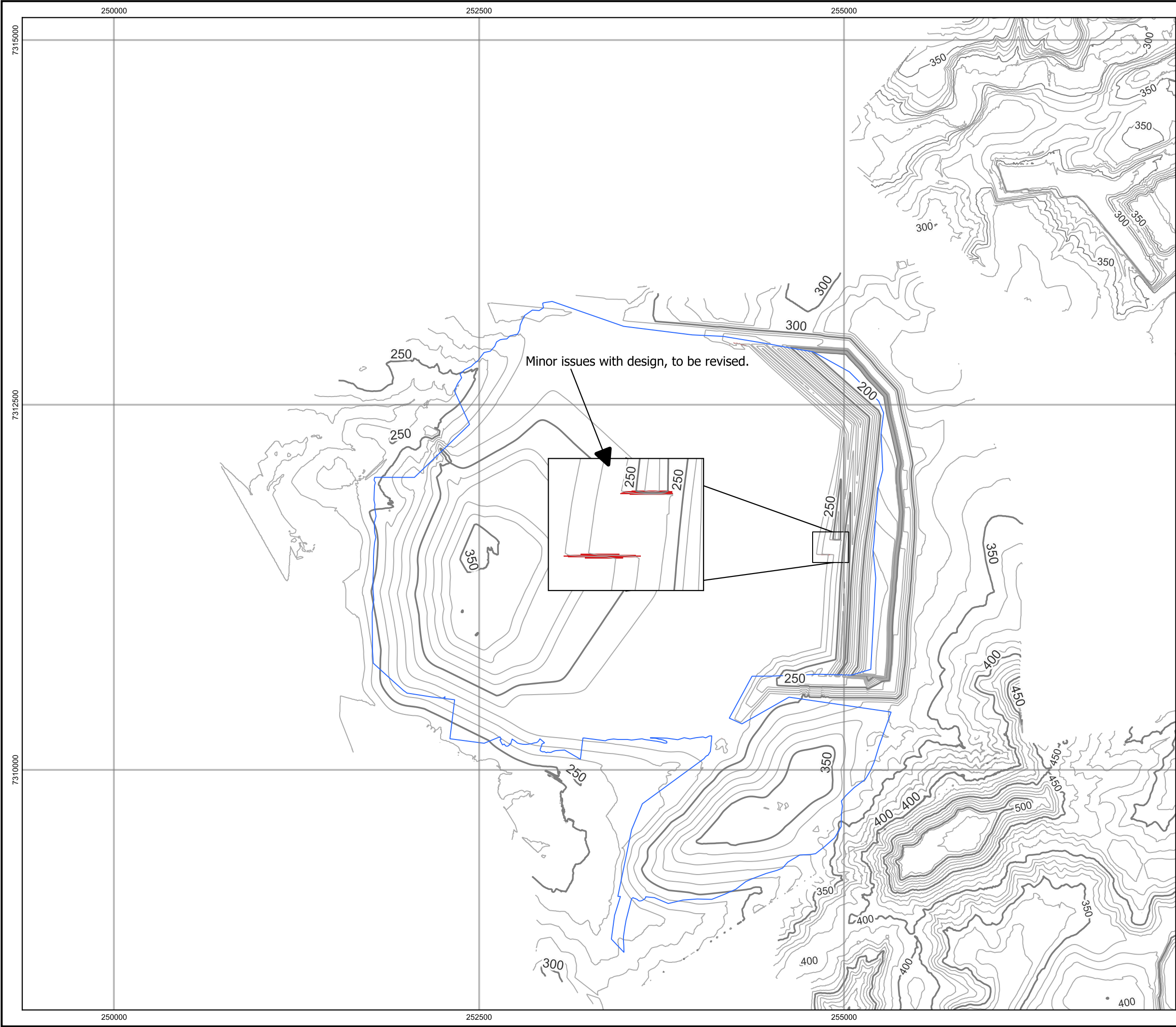
PSM3412-122L

Figure No 6

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Legend

Low Wall Boundary

Contours

10 m

Spot Heights

Slope (Degrees)

> 40

Scale 1:25,000

0 1 km

Map Projection:
Horizontal Datum: AGD84 / AMG
zone 56
Grid: EPSG:20356

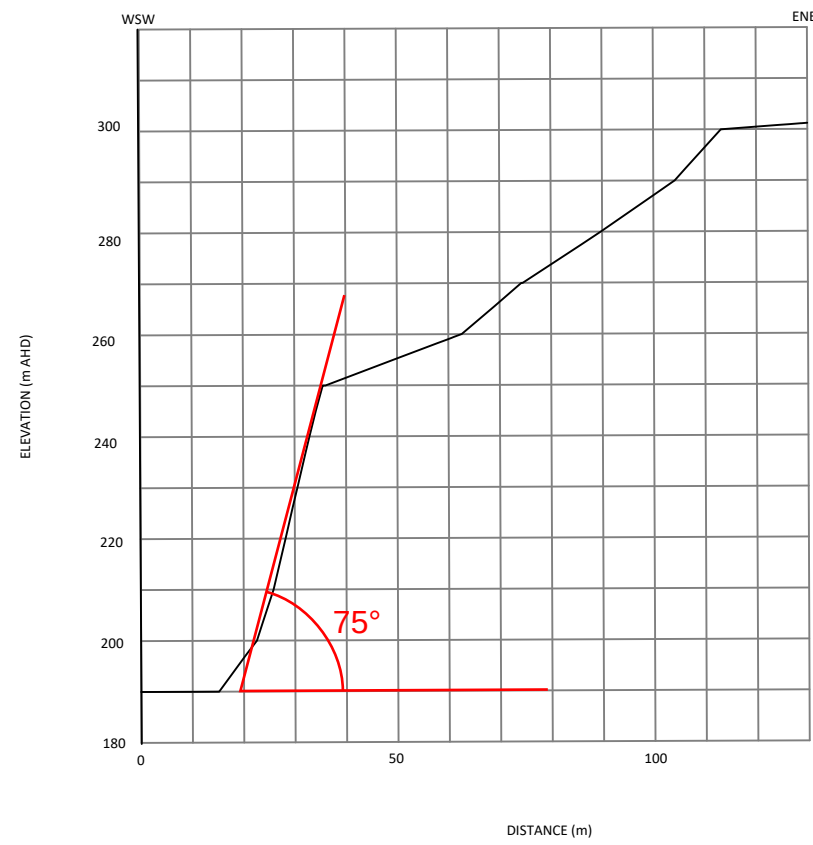
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	Date: 07 Mar 2023	Paper Size: A3

Callide Coal Mine
PRCP Mine Closure

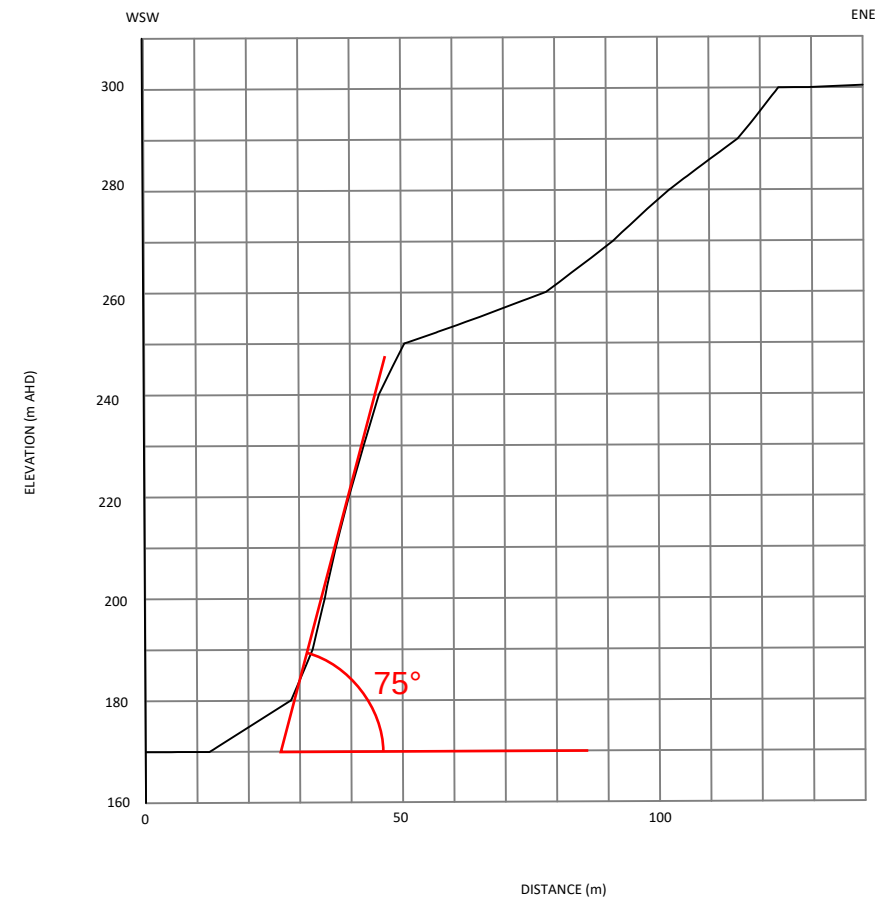
Trap Gully Mine
Final Landform
Slope Map (Low Wall & Ramps)

PSM3412-122L	Figure No 8
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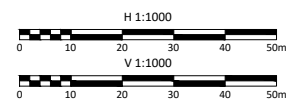
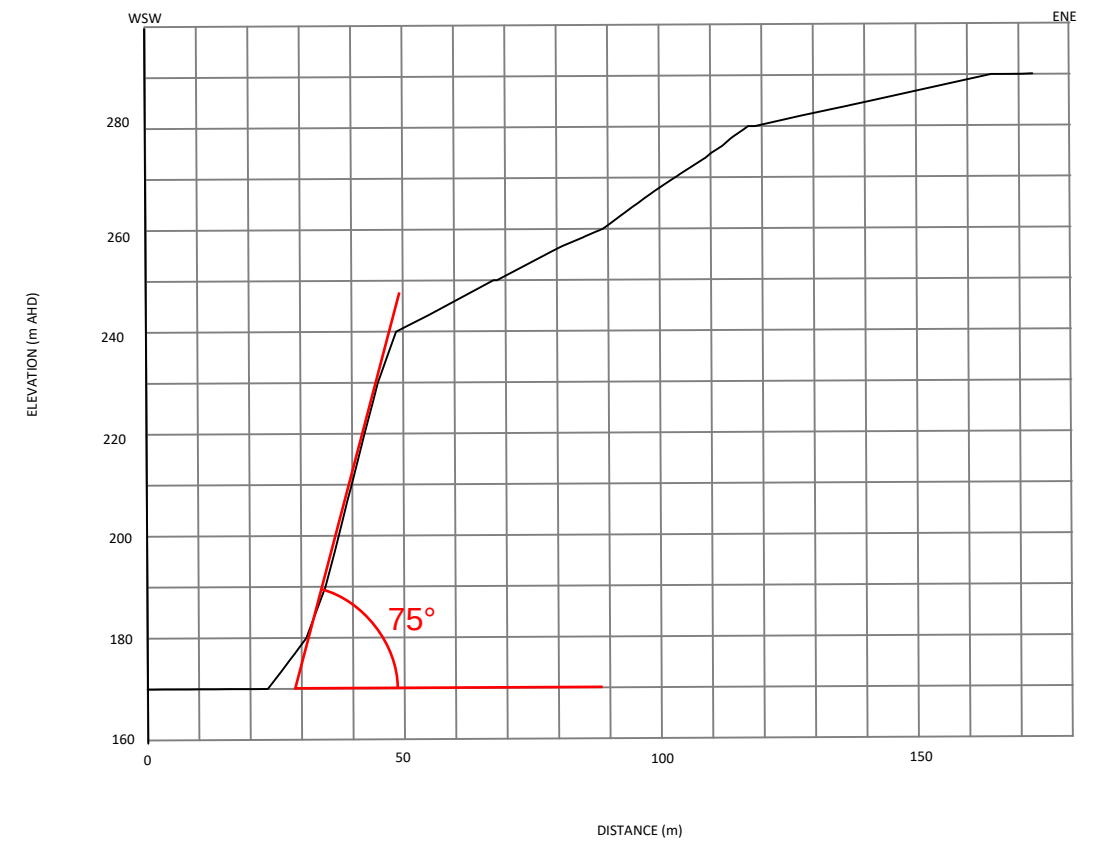
Section 1



Section 2



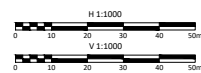
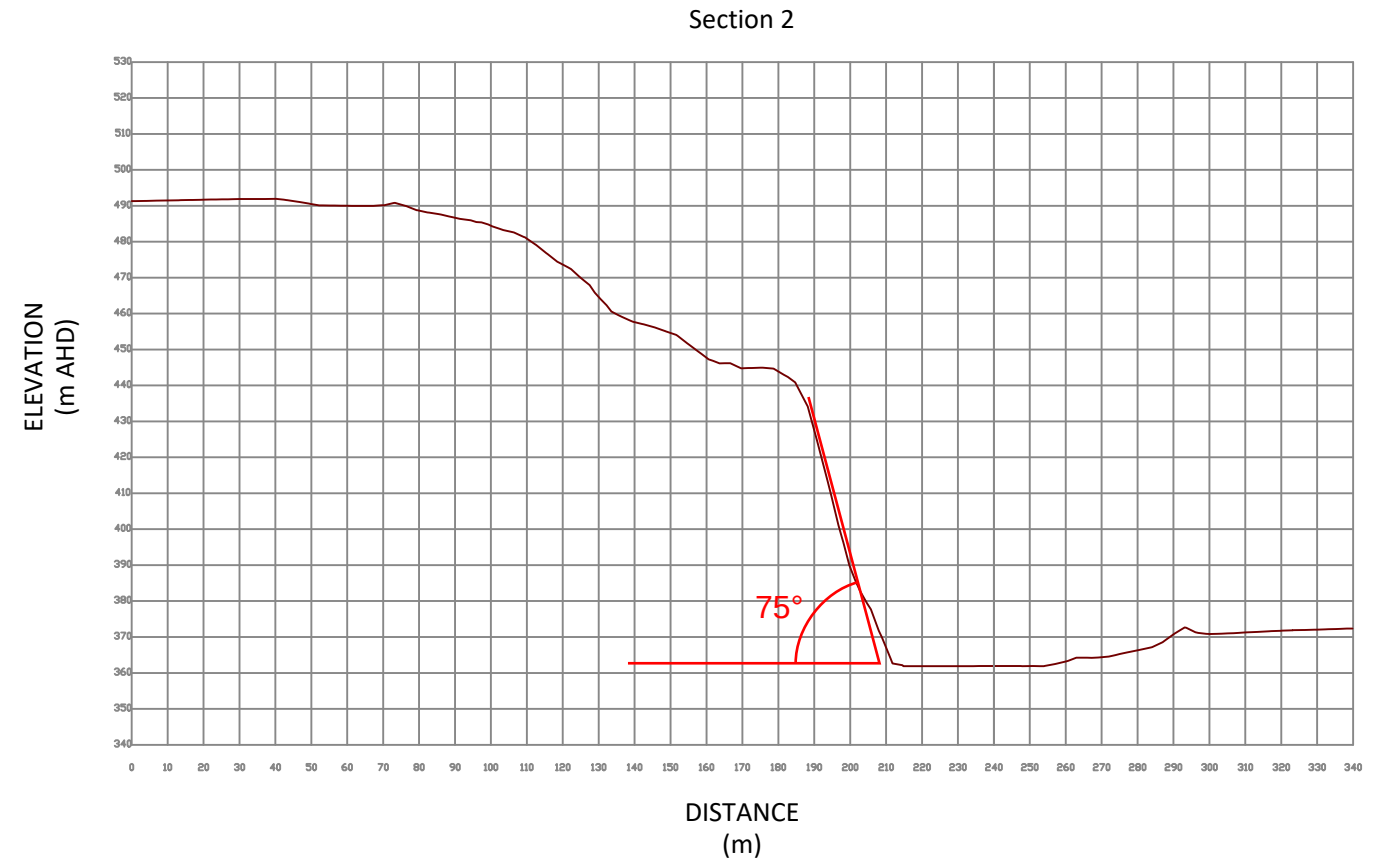
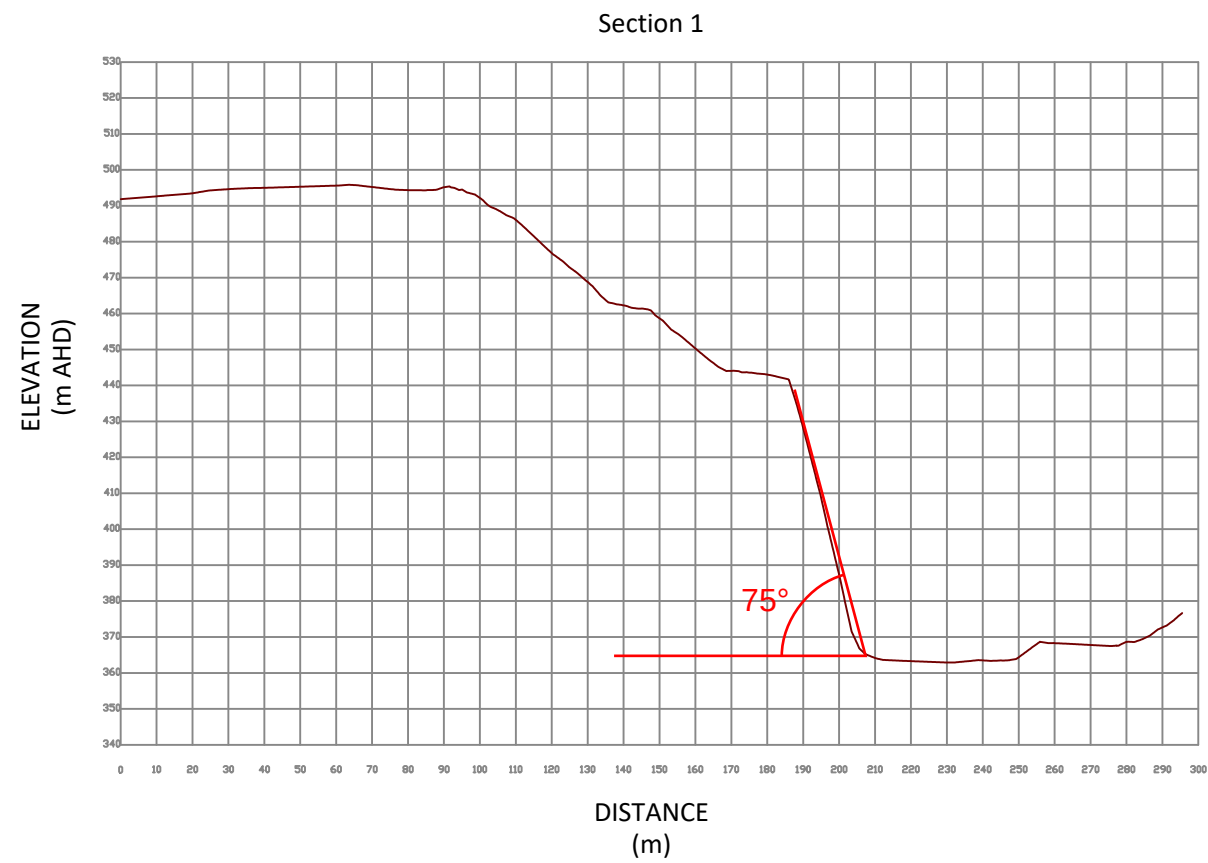
Section 3



Refer to Figure 1 for section locations

Callide Coal Mine
PRCP Mine Closure
Boundary Hill Pit Sections
(High Wall)

DRAWN	PSM	
CHECKED	PSM	DATE 10/10/2022
SCALE H 1:1000 V 1:1000		SIZE A3
PROJECT No PSM3412-122L		FIGURE No 9

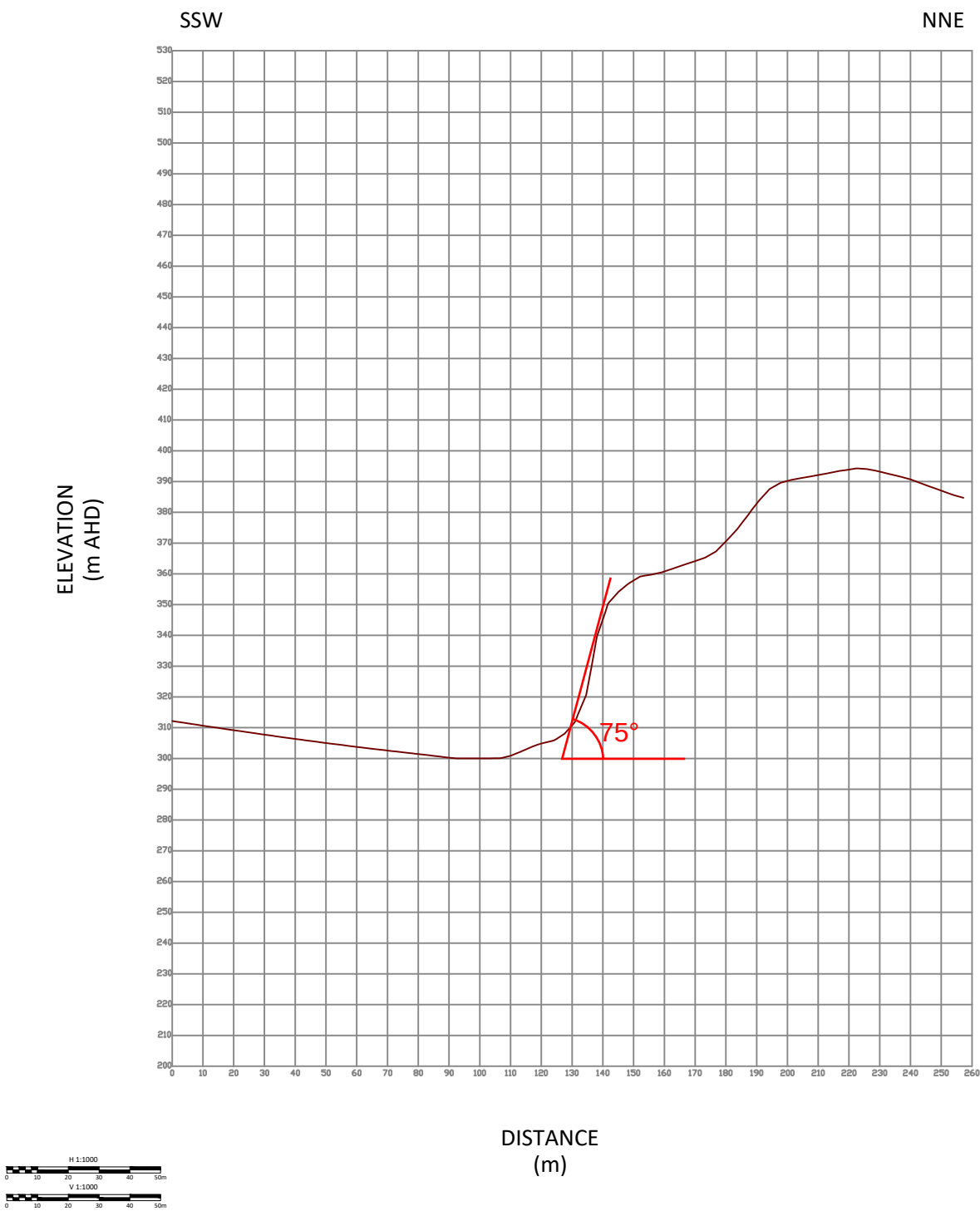


Refer to Figure 3 for section location

Callide Coal Mine PRCP
Mine Closure
The Hut Pit Sections
(High Wall)

DRAWN	PSM	
CHECKED	PSM	DATE 10/10/2022
SCALE H 1:1000 V 1:1000		SIZE A3
PROJECT No PSM3412-122L		FIGURE No 10

Section 1



Refer to Figure 5 for section location

Callide Coal Mine
PRCP Mine Closure
Dunn Creek Pit Section
(High Wall)

DRAWN	PSM	
CHECKED	PSM	DATE 10/10/2022
SCALE H 1:1000 V 1:1000		SIZE A3
PROJECT No PSM3412-122L		FIGURE No 11

Appendix G

Risk Assessment

ID	Rehabilitation Area	Risk Event	Hazard	Cause	Potential Consequences	Existing Controls	Initial Risk				Proposed Treatment/Control	Residual risk			
							Consequence	Likelihood	Risk Rating	Risk Level		Consequence	Likelihood	Risk Rating	Risk Level
1	Waste Rock Landforms (RA1, RA2, RA3)	Does not achieve safe and stable for humans and wildlife, able to sustain vegetation, non-polluting condition (EA - F1).	Steep waste rock landforms causing erosion.	Legacy issue of overdumping of waste rock landforms.	High erosion and sedimentation.	Dump Design Checklist / E&C approval Rock lined drains Contour drains Rock mulch on steeper slopes Overburden rehabilitation reshape designed by appropriately qualified person. Active ESCP Mine Planning	3	2	9	M	Final landform drainage designed by an appropriately qualified person. Final landform standard. Erosion gullies reshaped repaired as required Additional overburden and soil characterisation (erosion).	3	1	6	M
1a			Poor soil condition-nutrient and biota deficiencies-physical (e.g. structure/particle size, organics) and chemical (e.g. pH, EC, ESP) deficiencies	Long term stockpiling, soil type.	Poor vegetation germination, increased erosion/compaction.	Mine Planning	3	2	9	M	Ameliorisation (soil additives) Additional soil characterisation on stockpiled topsoil, treatment of soil with gypsum prior to stripping, progressing placement of stripped topsoil to reshape waste rock area, 'Final landform drainage designed by an appropriately qualified person including advice on treatment of topsoil with lime to improve structure.	3	1	6	M
1b			Soil loss	High rainfall events - erosion	Excessive loss of topsoil resulting in poor vegetation germination/cover	Rehabilitation schedule Landform design (Outer slopes generally 15% slope angle; steeper slopes are rock mulched at Dunn Ck) Drainage design (contour drains) Ripping, topsoil and seeding	2	2	5	L	Final landform drainage designed by an appropriately qualified person	2	2	5	L
2		Spoil dumps do not reach stable condition consistent with selected PMLU	Deficiency of competent rock material (i.e. mulch, drain lining)	Low stocks of competent rock material	Insufficient quantity available for rehabilitation area Delays in rock application/rehabilitation completion	Rehabilitation Schedule. Rock screening of basalt rock stockpiles at S Cut. Communications within Mine Plan to mine and haul rock where available. Optimising landform shape to reduce rock requirements Basalt stockpiles surveyed and suitability assessed.	3	2	9	M	PRCP LOM Plan Rehabilitation schedule (long term planning) Additional characterisation Optimising landform shape to reduce rock requirements	2	2	5	L
2a			Deficiency of topsoil/growth media.	Insufficient historic stockpiling.	Poor vegetation germination Long haul from alternative sources (The Hut). Application of alternative growth media	Spread topsoil at 15cm Topsoil stockpile surveys Topsoil Balance for Dunn Creek negative based on PRCP rehabilitation schedule (Cover Material Assessment Report, SLR 2022)	3	3	13	S	Characterisation of suitable topsoil substitute - weathered basalt which is stockpiled at Dunn Creek (Cover Material Assessment Report, SLR 2022). Compost	3	1	6	M
2b			Seed mix and/or ameliorant unavailable	Supply issues	Delayed rehabilitation completion Poor vegetation germination	Scoping potential suppliers. Seed mix developed from monitoring and research. Use seed that suppliers have instock that match to native species to meet rehabilitation criteria. Obtain quotes from multiple suppliers.	2	3	8	M	Obtain quotes from suppliers well in advance of PRCP rehabilitation schedule.	2	2	5	L

ID	Rehabilitation Area	Risk Event	Hazard	Cause	Potential Consequences	Existing Controls	Initial Risk				Proposed Treatment/Control	Residual risk			
							Consequence	Likelihood	Risk Rating	Risk Level		Consequence	Likelihood	Risk Rating	Risk Level
2c			Poor vegetation germination	Lack of maintenance during establishment period. Poor selection and placement of growth material. Low quality seed used. Water used for establishment inappropriate. Drought or extreme weather conditions. Lack of available seed suitable for revegetation. Influx of pest and weed species impacting native species growth. Unauthorised disturbance by personnel, equipment or stock.	Self-sustaining ecosystem not achieved Soil erosion	Landform design (Outer slopes generally 15% slope angle; steeper slopes are rock mulched at Dunn Ck) Drainage design (contour drains) Ripping, topsoil and seeding Seed mix developed from monitoring and research Reseed as required.	3	2	9	M	Additional topsoil characterisation and gypsum application and potentially lime application. Final landform drainage designed by an appropriately qualified person Erosion gullies reshaped repaired as required	3	1	6	M
2d			Surface spoil characterisation unsuitable for vegetation	Final dumped material has acidic/saline characterisation, includes partings, coal fines, ash etc	Poor vegetation germination	Reshape spoil to cap unsuitable material with more benign material. Reshape to avoid water infiltration areas within final profile.	2	3	8	M	Spoil characterisation of potentially erosive, saline and carbonaceous material for the purposes of germination or erosion control. Tailor specific final rehabilitation treatment for identified problem areas.	2	2	5	L
2e			Influx of pest and weed species impacting native species growth	Introduction of weed seeds to rehabilitation Poor vegetation establishment and % cover of rehabilitated landforms/areas	Spread of weeds across rehabilitation, inhibiting growth and re-germination of seeded species Spread of weeds offsite.	Implementation of Weed management plan and Topsoil Management Plan. Regular identification and control by land management contractor. Permit to Disturb, Rehabilitation monitoring	2	3	8	M		2	3	8	M
2f			Residual ramps undermine stability of surrounding reshape	High erosion in unshaped spoil	Erosion head cuts into reshaped surface and undermines long term stability	Drains/bunds installed to redirect runoff away from high flow points. ESCP implementation.	3	3	13	S	Detailed design for drainage and construction as well as desilting of erosion and sediment control structures.	2	2	5	L
2g			PMLU establishment and maintenance impacted by livestock	Loss of vegetative cover due to grazing by livestock	Poor vegetation establishment and % cover of rehabilitated landforms/areas Increased surface runoff and potential for erosive effects	Fencing - no livestock on existing rehabilitation.	2	2	5	L	Grazing could be used as a management tool only on rehabilitation areas (waste rock landforms) for fire management and to improve diversity of vegetation.	2	2	5	L
2h			PMLU establishment and maintenance impacted by bushfire	Lightning Arson	Loss of vegetation cover Soil Erosion PMLU degradation	Fire breaks and annual maintenance Fire management plan ERT response	2	2	5	L		2	2	5	L

ID	Rehabilitation Area	Risk Event	Hazard	Cause	Potential Consequences	Existing Controls	Initial Risk				Proposed Treatment/Control	Residual risk			
							Consequence	Likelihood	Risk Rating	Risk Level		Consequence	Likelihood	Risk Rating	Risk Level
3	Waste Rock dumps (RA3) and Infrastructure Areas (RA4, RA5)	Water quality does not meet acceptance criteria	Catchment shedding dirty water	Inadequate erosion and sediment control Inappropriate surface treatemtns that increase runoff and degrade water quality	Discharge of poor water quality into the greater environment	Desilting of sediment dams Erosion and sediment control plan Water Management Plan Progressive rehabilitation Water quality monitoring Receiving Environmental Monitoring Program	2	3	8	M	'Final landform drainage designed by an appropriately qualified person and review of legacy sediment and erosion control structures (Sediment dams). Post closure care and maintenance and monitoring.	2	2	5	L
4		Contaminated land resulting in presence and potential migration of contaminants in soil, surface water and groundwater	Contamination of soil, surface water and groundwater above selected thresholds/guidelines Migration of contaminants from source to sensitive receptors	Erosional instability of waste landforms resulting in sediment mobilisation Unsuitable materials used in rehabilitation or as capping Potential contamination sources not adequately investigated and/or remediated	Potential contaminants onsite and offsite.	Surface drainage to minimise/exclude offsite water discharge in accordance with Environmental Authority. Preliminary and Detailed site investigation reports completed for PFAS by appropriately qualified person. Ongoing monitoring according to requirements of EEO	2	3	8	M	Ongoing identification, investigation and remediation of potentially contaminating activities and sources Potentially contaminated areas to be assessed and specific remediation plan developed by appropriately qualified person for at risk areas. Remediation Plan to be developed in accordance with EEO Contaminated land investigations and potential remedial options impleneted (if required) for hydrocarbon storage and depots.	2	1	3	L
5	Creek Diversion (RA6)	Failure of creek diversions to meet closure criteria	Diversion unable to be relinquished	Inadequate erosion and sediment control during construction Insufficient construction methods Failure to rehabilitate areas in accordance with milestone and closure criteria Failure of landforms adjacent to drainage features Inadequate design Insufficient monitoring and maintenance	Erosion Sedimentation Loss of ecological function	Ongoing monitoring and completion of any maintenance/repairs in accordance with Water Licence #105184	2	3	8	M	Completion of any maintenance/repairs and ongoing monitoring/maintenance requirements Oakly Creek Diversion satisfies completion criteria specified in the Water Licences design criteria Submission of a Water Licence Relinquishment application for the Oakly Creek Diversion, supported by a Final Monitoring and Evaluation Report that is certified by an RPEQ	2	2	5	L
6	Dunn Creek Nature Reserve	Mount Murchison Nature Refuge adversely impacted by mining and does not meet MMNR Nature agreement conditions.	Clearing of nature reserve	Mining operations	Destruction of vegetation	Permit to Disturb system. LOM Plan and final landform design not impacting on Nature Reserve Signage Fencing MMNR Conservation Agreement and Conditions Site wide toolbox talks on environmental awareness. No access to public	4	1	10	M		4	1	10	M
6a			Bushfire	Lightning Arson	Burning of sensitive vegetation	Fire breaks and annual maintenance Fire management plan ERT response	2	2	5	L		2	2	5	L

ID	Rehabilitation Area	Risk Event	Hazard	Cause	Potential Consequences	Existing Controls	Initial Risk				Proposed Treatment/Control	Residual risk			
							Consequence	Likelihood	Risk Rating	Risk Level		Consequence	Likelihood	Risk Rating	Risk Level
6b			Invasive species	Weed infestation	Habitat degradation	MMNR Agreement: land management and pest control clauses Weed management plan. Regular identification and control by land management contractor. Permit to Disturb	2	3	8	M		2	3	8	M
7	Residual Voids (IA1)	NUMA does not achieve safe, structurally stable condition or causes environmental harm	Highwall failure - does not achieve geotechnical stability	75 degree highwall angle not achieved	Wall collapse	Operational inspections and controls. Geotechnical investigations by appropriately qualified person (operational).	3	4	17	S	Geotechnical investigation by appropriately qualified person to ensure highwall stability post closure to improve Factor of Safety. Identify the maximum potential failure in critical sections of the wall. Construct closure bund to block access post closure. Encourage habitat in the failure Safety bund to prevent public access.	3	1	6	M
7a				Excessive stormwater runoff over highwall	Wall collapse	Safety bunds and water management constructed along top of walls and pre-strip bench crests to divert stormwater for operational purposes.	3	2	9	M	Post closure drainage design by appropriately qualified person. Post closure stability assessment to be completed by appropriately qualified person	3	1	9	M
7b			Poor void water quality adversely impacting on PMLU	Acid and metaliferous drainage	Increased salinity Low/high pH Increased metals present	Geochemical characterisation of waste rock Water monitoring over life of mining Groundwater studies (inflow of clean water)	3	1	6	M	Post-closure void water quality model update	3	1	6	M
7c			Flood	Significant rainfall event	Residual void overtopping to surrounding environment resulting in environmental harm	Residual void hydrogeoloical modelling to determine overtopping risk and salinity risk. Water Management Plan Water Balance Water quality moinitoring	2	1	3	L	Updated residual void flood modelling by appropriately qualified person based on PRCP final landform. Final landform drainage design	2	1	3	L

Appendix H

Topsoil Management Plan (2025)



EMS_06

Topsoil Management Plan

Document Owner – Environment & Community Superintendent	Date	Signature
Leeanne Pattinson	18/03/2025	
General Manager – ESG & Development	Date	Signature
Stuart Schmidt	29 April 2025	

APPROVED DOCUMENT IS UNCONTROLLED WHEN PRINTED

Title: EMS_06 Topsoil Management Plan		
Document ID: EMS_06	Version Number: 2	
Last Review: 18/03/2025	Next Review: 18/03/2030	Page 1 of 9

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4.4	Topsoil Placement	7
5	Appointments, Authorisations and Competencies.....	8
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Title: EMS_06 Topsoil Management Plan		
Document ID: EMS_06	Owner: Leeanne Pattinson	Version Number: 2
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1 Purpose and Scope

This Topsoil Management Plan specifies the management measures applied to the stripping, stockpiling and respreading of topsoil at Callide Mine. The purpose of this plan is to ensure the optimum management of the topsoil resource in order to maximise the success of mine rehabilitation.

2 Definitions

Term	Definition
Condition	Condition within the EA
EA	Callide Mine Environmental Authority EPML007201413
Topsoil	The uppermost horizon (or A Horizon) of the soil profile which usually contains the organic matter, biota, and a concentration of nutrients
Stripping	The process of removing topsoil from its original in-situ location
Stockpiling	The process of relocating topsoil to a storage pile
Re-spreading	The process of reapplying the topsoil to the new slope for rehabilitation purposes
Rehabilitation	The process of treating mine affected land and returning to safe, stable and non-polluting landform
RMP	Rehabilitation Management Plan
Should	Indicates a direction is a recommendation
Shall	Indicates a direction is mandatory
WRAC	Workplace Risk and Control
PTD	Permit to Disturb

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3 Overview of mining activities

Callide Mine is located approximately 20 km north of Biloela in Central Queensland. Callide Mine is an open cut coal mine with an annual production rate of approximately 10.5 Million tonnes per annum of product coal. Mining commenced at Callide Mine in 1944. The mine produces low-sulphur, sub-bituminous thermal coal that is used to supply the adjacent Callide Power Station and for export to overseas customers.

Callide Mine involves open cut mining in four discrete mining areas. An overview of each mining area is as follows:

- **Dunn Creek mining area.** Dunn Creek was the original mining area at Callide Mine with mining operations commencing in 1944. There are currently two operating pits within the Dunn Creek mining area, known as the Dunn Creek Pit (the western pit) and The Bluff Pit (the eastern pit). Mining operations involve a dragline and truck and shovel pre-stripping. The primary infrastructure area for Callide Mine is located at the Dunn Creek mining area and includes a CHP, coal stockpiles, conveyor and train loading facilities, administration buildings and offices, and workshops and maintenance facilities. ROM coal is hauled to the Dunn Creek CHP. Once crushed in the CHP, coal is either conveyed to the nearby Callide Power Station or loaded onto trains and transported to Gladstone.
- **Trap Gully mining area.** Open cut mining commenced in 1981 at the Trap Gully mining area. Mining occurs in a single open cut pit using truck and shovel mining methods. ROM coal from Trap Gully is hauled to the Dunn Creek CHP for crushing and transport from site.
- **The Hut mining area.** Mining in The Hut mining area commenced in 2001 and has been undertaken in three pits using truck and shovel mining methods. ROM coal is hauled to the Dunn Creek CHP for crushing and transport from site. Recently, the western pit in The Hut mining area has been used as a water storage for mine affected water generated at the Trap Gully and Dunn Creek mining areas.
- **Boundary Hill mining area.** Open cut mining at the Boundary Hill mining area commenced in 1983. Boundary Hill operates independently of the other Callide Mine mining areas. Coal is currently mined in two pits using a dragline and truck and shovel fleet. Coal mining at the Boundary Hill South pit commenced in August 2018. Run-of-mine (ROM) coal is hauled from the pits to an in-pit Coal Handling Plant (CHP) for crushing. Crushed coal is then conveyed to the Boundary Hill train load out facility and transported to Gladstone. A mine infrastructure area is located at Boundary Hill including a crib room, administration building and workshops.

Current planning indicates that Callide Mine has a remaining mine life in excess of 20 years. The mine operates 24 hours a day, 7 days a week.

4 Topsoil Management Procedures

4.1 Soil Types

Soil field surveys and desktop assessments indicate that 14 soil types occur across the Callide Mine mining leases. These are shown in Table 1. An assessment of the suitability of soils for stripping and reuse in rehabilitation has previously been undertaken as part of various specialist soils assessments. Table 1 presents the approximate depth of topsoil that is available to be stripped and reused for each soil type.

Table 1 Soil types and depth of topsoil available for reuse

Soil Type	Approximate Depth of Topsoil Available (m)
Alluvial soils	0.30 to 1.00
Self-mulching basaltic soils	0.10 to 0.45
Brigalow supporting clay soils	0.20 to 0.40
Cracking clays	0.10 to 0.50

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Soil Type	Approximate Depth of Topsoil Available (m)
Non-cracking clays	0.20 to 0.30
Duplex soils	0.15 to 0.35
Escarpment soils	0.10 to 0.15
Gradational soils	0.25 to 0.40
High gravel content soils	0.10 to 0.25
Grey loamy sands	0.20 to 0.35
Red earths	0.30 to 0.50
Sandy loam to loamy sands	0.15 to 0.45
Silts	0.10 to 0.30
Soils on steep slopes	0.00 to 0.25

4.2 Topsoil Stripping

Disturbance areas are cleared progressively ahead of mining operations. Topsoil stripping commences immediately after the completion of vegetation clearing and is generally completed one week prior to mining operations commencing. Topsoil management measures adopted during stripping include:

- Estimated soil stripping depths are shown in Table 1, and are confirmed as part of EMS_07.2 Permit to Disturb to ensure that the quality of stripped soil is not reduced through contamination with unsuitable soils;
- Stripping limits (including areas of no recovery) are to be clearly delineated with survey pegs and adhered to during stripping operations;
- Topsoil is removed by conventional earthmoving plant, predominantly excavator and trucks;
- Earthmoving plant operators are trained and/or supervised to ensure that stripping operations are conducted in accordance with stripping plans and in-situ soil conditions; and
- Care is to be taken during topsoil stripping and stockpiling to avoid structural degradation of soil, particularly to avoid excessive compaction (i.e. avoiding re-handling and limit stripping activities in wet conditions).

4.3 Topsoil Stockpiling

Where possible, topsoil is placed directly onto areas ready for rehabilitation, as per the Rehabilitation Management Plan (EMS_07). If this is not possible, topsoil is stockpiled during the topsoil stripping activities. The following process for soil stockpiling will be followed to minimise degradation of stored soil and encourage nutrient stores.

4.3.1 Stockpiling Locations

Where practicable, stockpiles will be located:

- Adjacent to rehabilitation areas;
- Away from drainage lines, operational water;
- Away from operational areas; and
- Away from proposed disturbance areas.

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4.3.2 Stockpile Management

- The height of topsoil stockpiles shall be kept to a minimum in order to maintain viable soil biota and nutrients;
- Topsoil stockpiles shall be a maximum of 3 m in height. If long term (>24 months) stockpiling is required, approval for >3 m stockpile height must be obtained from Environment and Community Team;
- No stockpile will exceed 10 m in height;
- The surface of stockpiles shall be shaped in order to promote infiltration and minimise erosion until vegetation is established, thereby minimising the formation of anaerobic zones;
- All stockpiles shall be vegetated once their construction is completed;
- Topsoil shall be stored within delineated topsoil stockpile areas, or stockpiled within the footprint of the open cut mining area where required, in order to limit the disturbance footprint;
- Topsoil stockpiles should be clearly signposted for easy identification and to avoid any inadvertent losses; and
- An inventory of stockpiled topsoil, including soil types, and stockpile locations and volumes, shall be maintained to ensure adequate materials are available for planned rehabilitation activities in order to manage the topsoil resource.

4.3.2.1 Erosion and Sediment Control

All works are to be compliant with EMS_02 Erosion and Sediment Control Plan (ESCP). Freshly placed topsoil stockpiles should be seeded with a suitable cover crop. All stockpiles should be placed in a location that will not impact drainage lines and no stockpiled material should pose a risk to offsite watercourses.

4.3.2.2 Weed Management

Establishment of weeds on the stockpiles should be monitored and controlled, in accordance with EMS_07.4 Weed Management Plan. Weed treatment is to focus on listed priority weeds. It has been found that species such as exotic perennial grasses are persistent, and treatment is not effective. Treatment should be specific to the types of weeds present on the stockpile and targeted. Broad chemical weed treatment should be avoided to limit residual chemicals in the stockpiles. Equipment should be the lightest specification possible to limit compaction, hand tools and backpack spray should be the first preference.

4.3.2.3 Topsoil stockpile dimensions and use

Where stockpiles need to be formed to heights exceeding 3 metres, the following approach should be applied:

- Stockpiles should be formed with a flat top and 1(V):4(H) batter slopes;
- Seeded with target vegetation species or cover crop;
- When topsoil recovery occurs, a 0.5 m to 1 m thick layer should be stripped/scalped from the surface of the stockpile, with the exposed soil then being lightly ripped, fertilised and seeded; and
- The revegetated layer should be left for a target of 2 years before removal of a further 0.5 m to 1 m depth of soil and further revegetation/remediation operations.

The topsoil inventory shall be maintained independently of the Topsoil Management Plan. The inventory shall be updated immediately following any topsoil stripping / stockpiling campaigns or after any re-use of stockpiled topsoil. The current stockpile locations and inventory are available on GIS at S:\04 Environment & Community\05 GIS\05 Data Export\02 Digital Files

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4.4 Topsoil Placement

Management measures to be adopted during re-spreading topsoil are outlined in the RMP, and include:

- Mine rehabilitation planning should include balancing the topsoil quantities required for each rehabilitation area against stored stockpile inventories and confirming the design topsoil replacement depth for each rehabilitation area;
- Topsoil shall be re-spread in even layers at a thickness appropriate for the intended land use of the area to be rehabilitated and volume of topsoil available, to the design thickness (typically an average thickness of 150 mm and a maximum thickness to 250 mm); and
- Topsoil shall be selectively placed, with any erodible topsoil being placed on more level areas to minimise potential for erosion.

Soil loss from rehabilitated areas shall be minimised through:

- Contour ripping to encourage rainfall infiltration and minimise runoff;
- Reseeding soon after re-spreading to establish a vegetation cover as early as possible;
- Installing slope drainage control to limit slope lengths and runoff velocities; and
- Installing collection drains and sediment dams to collect runoff and control suspended sediment.

Soil loss from rehabilitated areas is minimised through:

- Contour ripping to encourage rainfall infiltration and minimise runoff;
- Application of appropriate soil ameliorants to promote structural integrity of the soil and plant growth;
- Reseeding soon after re-spreading to establish a vegetation cover as early as possible;
- Installing slope drainage control to limit slope lengths and runoff velocities; and
- Installing collection drains and sediment dams to collect runoff and control suspended sediment.

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5 Appointments, Authorisations and Competencies

The following table identifies the parties responsible for ensuring management actions are carried out in accordance with this Topsoil Management Plan:

Roles requiring appointments	Roles requiring authorisation
All Coal Mine Workers	Follow the protocols outlined in this Topsoil Management Plan
Mine Planning – Mid Term	- Preparing an annual disturbance plan and provide to scheduling - Plan for direct placement of topsoil to rehabilitation from stripping works - Ensure topsoil stockpiling locations will not require rehandling of material
Mine Planning – Scheduling (short-term)	- Liaise with site Environment & Community team to commence the PTD process (Permit Originator) for mining related clearing and topsoil stripping work - Ensure topsoil is only to be removed at a maximum of one strip ahead of mining, minimizing disturbance
Environment and Community Superintendent	- Ensure adequate resources are allocated to enable the training of staff - Document owner - Assess and approve any deviations from accepted practices, for instance operation of topsoil stripping during night-time hours
Environment Team	- Support Mine Planning in implementation of EMS_07.2 Permit to Disturb - Follow EMS_07 Rehabilitation Management Plan - Request surveys of topsoil stockpiles - Conduct sampling of topsoil as required - Verify topsoil depths to be stripped - Verify that topsoil stockpiles are compliant to this management plan - Conduct due diligence inspections prior to routine maintenance - Track topsoil stockpile volumes to ensure adequate volume for rehabilitation, i.e. maintain topsoil inventory - Implement improvement measures as required - Review of Topsoil Management Plan as required
Survey Department	- Peg the areas to be stripped according to PTD boundary - Survey of topsoil following stripping activities to validate appropriate volumes have been collected - Maintain annual topsoil volume tracking on site

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6 References

- *Environment Protection Act 1994*
- Callide Mine Environmental Authority EPML00720413
- EMS_07 Rehabilitation Management Plan
- EMS_02 Erosion and Sediment Control Plan
- EMS_07.2 Permit to Disturb
- EMS_07.4 Weed Management Plan

7 Document Control

V#	Date	Nature of change	Approved Superintendent	Date	Authorised GM ESG&D	Date
1	Mar 2019	Document created	Amy Warden	June 2018	-	-
2	Mar 2025	Review Update template	Leeanne Pattinson	18 March 2025	Stuart Schmidt	29 Apr 25

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Appendix I

Callide Coalfields – An Assessment of Overburden
Properties for Rehabilitation, (1991)

CALLIDE COALFIELDS
AN ASSESSMENT OF OVERBURDEN
PROPERTIES FOR REHABILITATION
April 1991

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CALLIDE COALFIELDS
AN ASSESSMENT OF OVERBURDEN
PROPERTIES FOR REHABILITATION

April 1991

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1.0 INTRODUCTION

Rehabilitation after opencut mining invariably requires the establishment of vegetation to stabilise the new land surface and to promote a desired postmining land use. This vegetation will be required to survive in either spoil, a soil mulch overlying spoil, or, a returned soil profile. The requirements for the use of topsoil will depend upon the properties of the spoil, the properties of available soil, the postmining landform, and the desired land use. The properties of overburden cannot only limit vegetation establishment and growth, it may also influence landform designs. If the spoil has the potential to produce acid mine drainage, not only will rehabilitation be jeopardised but the method of mining may even need to be changed to minimise acid production.

The surface zones of spoil and/or soil should ideally fulfil five broad requirements to allow revegetation to proceed in a satisfactory manner. They should:-

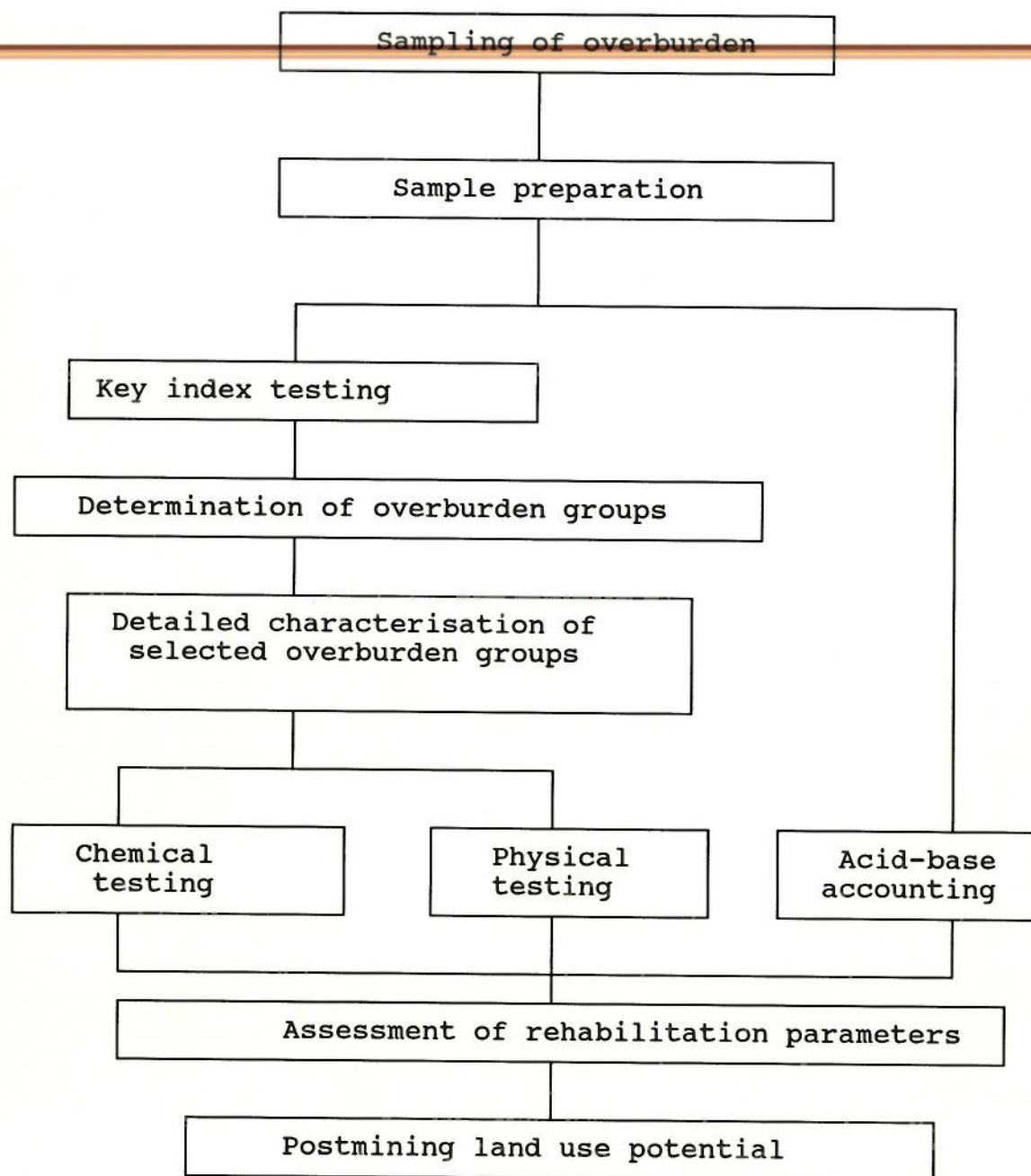
- (1) be non-toxic for plant growth;
- (2) have an erosion potential within acceptable limits for the particular landform and use;
- (3) provide an environment conducive to the emergence of seeds and propagules;
- (4) provide a rooting medium consisting of material capable of supporting sufficient plant growth to sustain the desired land use; and
- (5) provide an isolation zone between the rooting depth and run-of-mine spoil if such spoil has properties toxic to plant growth.

An assessment of the quality of overburden for the reconstruction of profiles after mining needs to take into account the factors that influence the above requirements. Only after this assessment has been undertaken can an objective and quantitative evaluation of the rehabilitation potential of the mining project be determined. Decisions can then be made as to the suitability of overburden to support the desired land use, the requirement for topsoil, landform constraints or the need for burial of toxic material.

The general procedure followed to characterise the overburden of the Callide Coalfields is outlined in Figure 1. This report details these procedures and the tests performed on overburden samples to identify the chemical and physical limitations to plant growth. From these results, assessments of erosion potential, use of spoil as an emergence zone, potential land capability and toxic properties are then described.

FIGURE 1

The process of overburden characterisation for rehabilitation planning



2.0 PREVIOUS OVERBURDEN STUDIES

Surveys of overburden had previously been commissioned by Callide Coalfields mining areas Boundary Hill (CSR Environmental Services, February 1984) and The Hut (Mark Evans & Associates, March 1987). Five drill holes provided 136 samples representing overburden from Boundary Hill and 37 samples were collected from 5 drill holes at The Hut.

Five overburden classes were identified as being present at Boundary Hill and 10 classes were defined for The Hut. A summary of the properties of these classes is presented in Tables 1 and 2.

TABLE 1

Properties of sampled overburden classes at Boundary Hill as determined during the 1984 Study

Class	% of Samples	Emergence rating	Limitation	Capability Rating	Limitation
1	54	Poor	available moisture	VIII	available moisture
2	7	Poor	available moisture sodicity	VI	sodicity pH
3	28	Poor	available moisture	VI	available moisture
4	4	Poor	pH salinity	VII	pH
5	7	Moderate	sodicity dispersion pH	IV	texture

TABLE 2

Properties of sampled overburden classes at The Hut determined during the 1987 Study

Class	% of Samples	Emergence rating	Limitation	Capability Rating	Limitation
1	24	Moderate	available moisture dispersion sodicity	VI	dispersion
2	19	Poor	available moisture dispersion pH	VII	dispersion
3	8	Poor	available moisture sodicity	VII	available moisture sodicity
4	5	Poor	available moisture sodicity	VII	available moisture sodicity
5	16	Poor	pH	VI	pH
6	3	Poor	dispersion sodicity	VII	dispersion
7	11	Poor	salinity sodicity	VIII	salinity
8	5	Moderate	salinity sodicity pH	VI	salinity
9	11	Unsuitable	nutrient toxicity	VIII	nutrient toxicity
10	3	Poor	salinity sodicity pH	VIII	salinity

3.0 SAMPLE COLLECTION

Samples were collected from 22 drill holes located in four mining areas during the 1990 Callide Coalfields exploration drilling programme. In all, 1653 samples were collected representing approximately 1700 metres of overburden. The samples

represent overburden from Dunn Creek, Trap Gully, Boundary Hill and The Hut, all being mining areas.

The coverage of each of the four mining areas is represented in Table 3. Samples were supplied at 1 metre intervals wherever possible.

TABLE 3
Location of the drill holes sampled

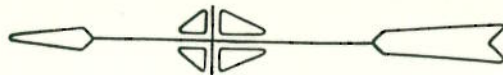
Mining Area	Hole number	Depth sampled (m)
Trap Gully	C1771	113
	R1772	90
	R1773	108
	R1774	50
Dunn Creek	C2462	132
	R2465	90
	C2466	124
	R2469	67
	C2473	133
	R2475	110
	R2476	108
	C2477	117
The Hut	C2650	21
	C2654	24
	R2665	20
	R2666	108
	R2667	43
Boundary Hill	R2858	71
	R2864	81
	C2866	65
	C2867	67

American investigations suggest that any given drill hole can be assumed to be representative of surrounding overburden up to a distance of 1000m in areas of low geological variability (Ralston and Wiram 1978, Abbott et al. 1982). As illustrated in Figure 1 and listed in Table 4, approximately 97% of the currently proposed mining areas have been surveyed assuming a 1000m predictive radius from each hole and including previously surveyed material.

TABLE 4

The proportion of the proposed mining area included in the overburden surveys

Location	% of mining area surveyed assuming a 1000m radius
Dunn Creek	97%
Trap Gully	100%
Boundary Hill	96%
The Hut	99%



E 62000

E 61000

E 60000

E 59000

E 58000

E 57000

E 56000

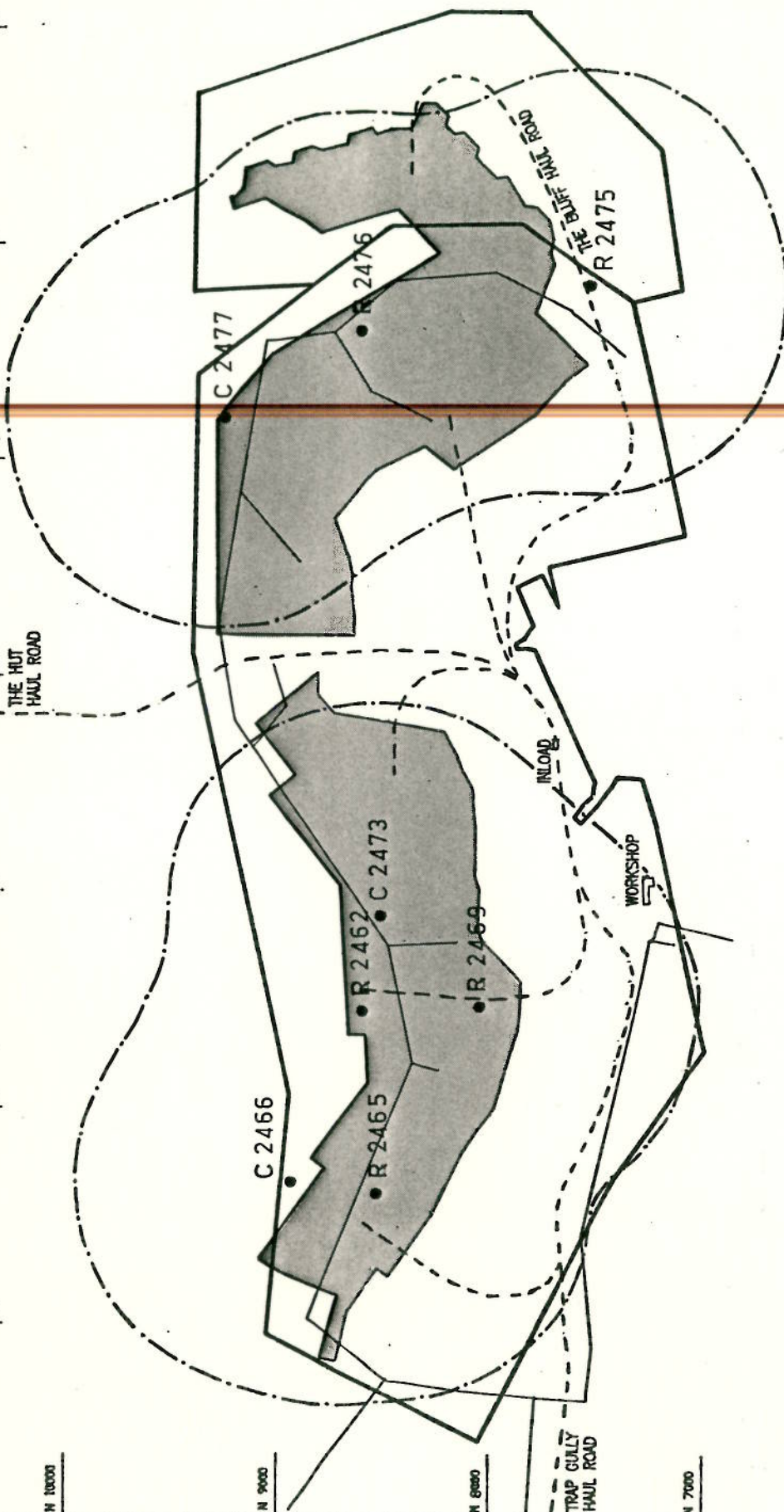
N 10000

N 9000

N 8000

N 7000

N 6000



- BOUNDARY OF LEASE
- OVERHEAD POWER LINES
- HAUL ROADS
- MINING AREA
- DRILL HOLE LOCATIONS
- EXTENT OF SURVEY

CALLIDE COALFIELDS DUNN CREEK EXTENT OF SURVEY

Scale 1:30000

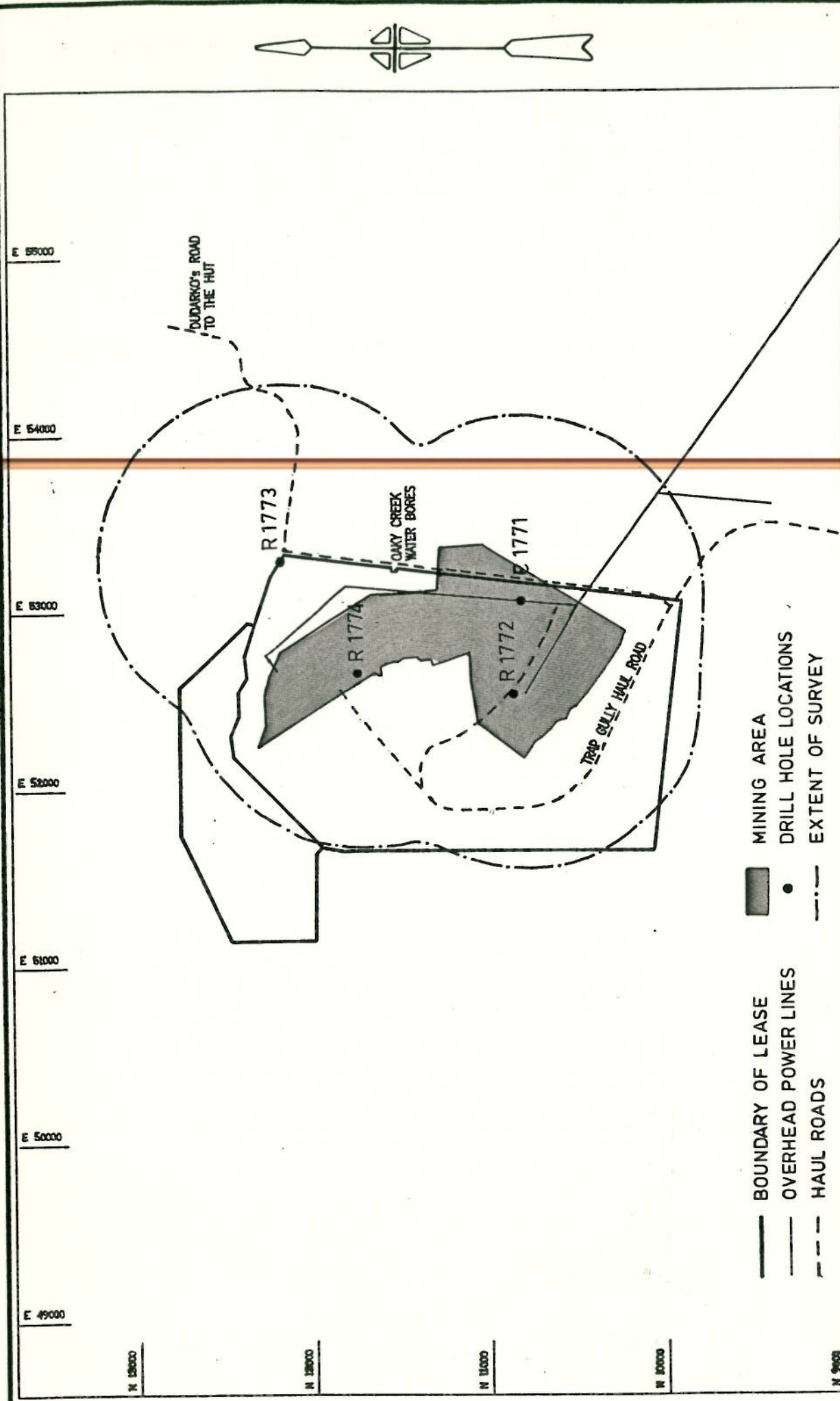
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FIGURE 1A

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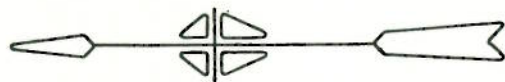
Scale 1:30 000
 Date -6-91
 FIGURE 1B

**CALLIDE COALFIELDS
 TRAP GULLY
 EXTENT OF SURVEY**



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247000E

246000E

245000E

244000E

7323000N

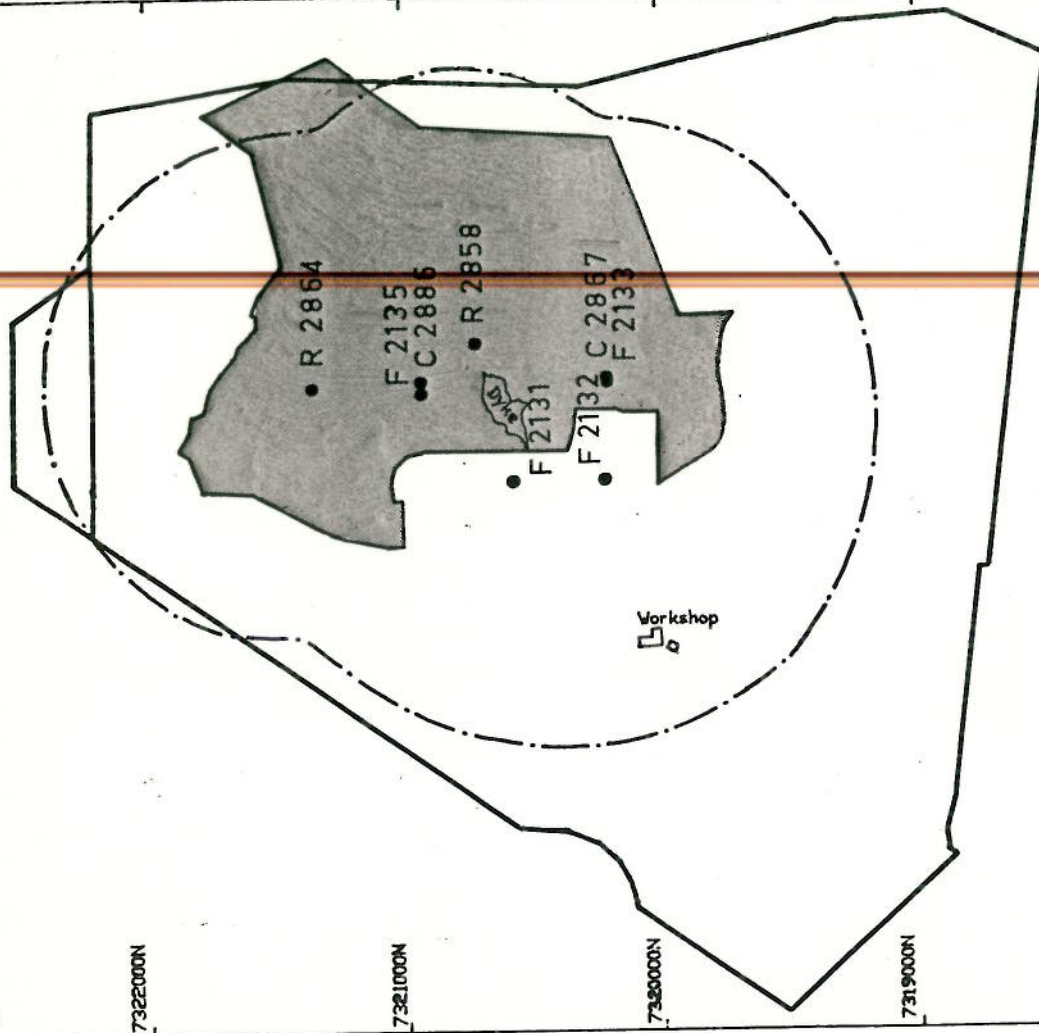
243000E

7322000N

7321000N

7320000N

7319000N



- BOUNDARY OF LEASE
- OVERHEAD POWER LINES
- - - HAUL ROADS
- MINING AREA
- DRILL HOLE LOCATIONS
- - - EXTENT OF SURVEY

Scale 1:30000

Date -6-91

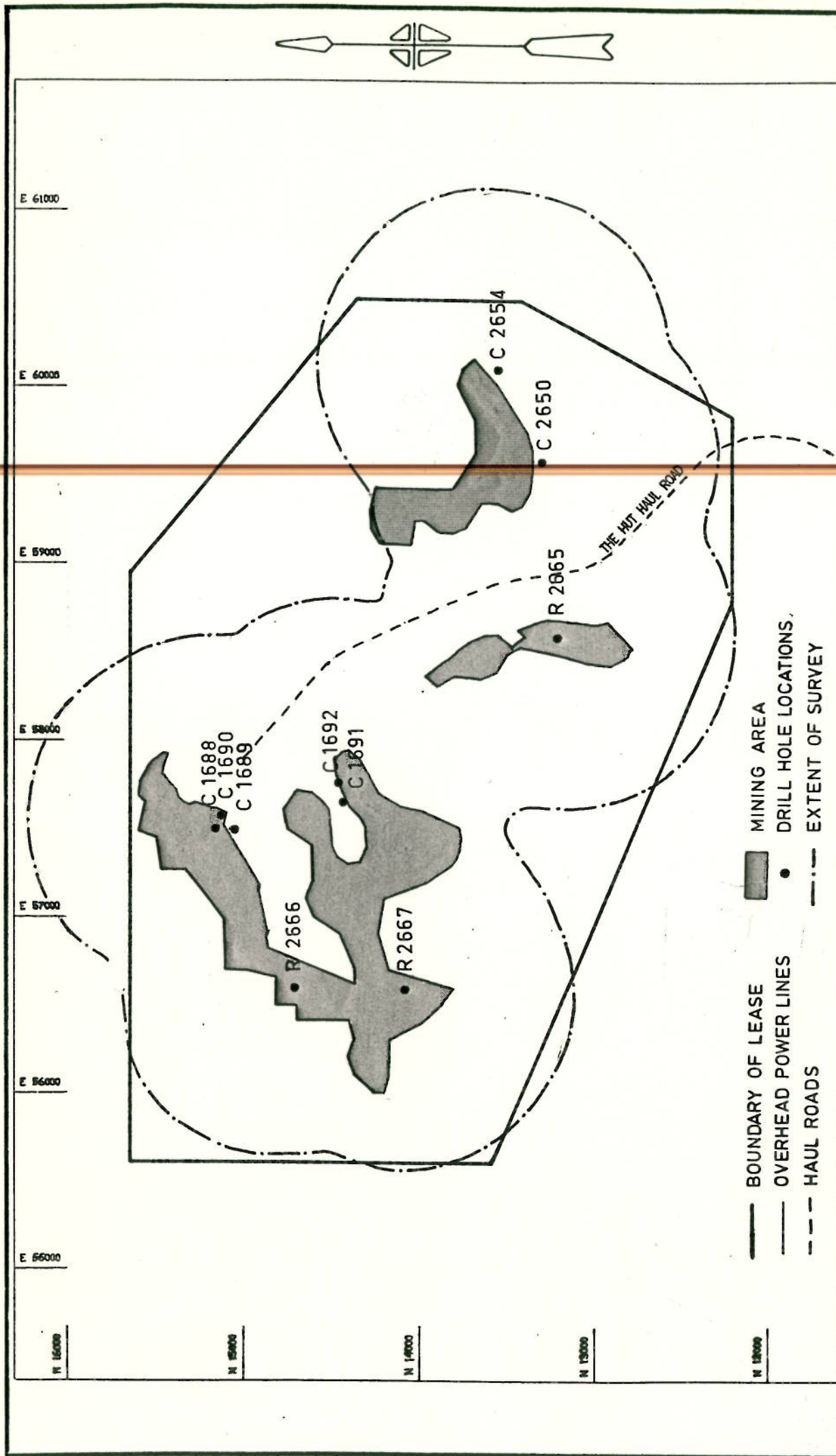
FIGURE 1C

CALLIDE COALFIELDS BOUNDARY HILL EXTENT OF SURVEY



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Scale 1:30000
 Date -6-91
 FIGURE 1D

CALLIDE COALFIELDS
THE HUT
EXTENT OF SURVEY



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4.0 OVERBURDEN CHARACTERISATION METHODS

4.1 INTRODUCTION

The methodology for classifying the overburden samples involves a three stage testing programme consisting of:-

- (1) a screening programme using index tests to provide a "fingerprint" of the overburden type;
 - (2) the selection of representative overburden classes using cluster analysis techniques applied to the results of the index tests; and
 - (3) the detailed physical and chemical testing of composite samples of the selected classes.
-

4.2 SAMPLE PREPARATION

The overburden samples were air-dried then each adjacent sample down each hole was subsetting and combined to form 2 metre composite samples. The supplied samples had been crushed to less than 2 mm diameter.

4.3 INDEX TESTS

For each of the 2m composites, the soil reaction and salinity as measured by the pH and electrical conductivity (EC) of a 1:5 soil-water solution were recorded. The standardised air-dry moisture (ADM) was measured after the samples were air-dried for five days then completely dried in a microwave oven (Perrins, S., pers. comm.).

The pH and the EC are important revegetation parameters while the ADM indicates cation exchange capacity and clay content. The results of the index tests are in Appendix A.

4.4 SELECTION OF OVERBURDEN CLASSES

It is not economically feasible to fully characterise the chemical and physical properties of every sample, hence a procedure is required to amalgamate similar samples to give a smaller set of classes. This procedure was described by Evans (1985).

The results of the index tests were standardised to allow a scaleless comparison between results. Nonlinear scales derived from biological limits pertaining to pH, salinity and plant available water were used for standardisation. A fusion of samples was then conducted such that classes were formed from samples with similar characteristics. The resulting classes should exhibit greater interclass variability than intraclass variation.

The fusion of 2 metre samples into similar classes was conducted to levels. Level 1 consisted of 60 classes while Level 2 reduced the class numbers to 17. Level 1 samples were used for acid-base accounting while the Level 2 samples were used for detailed chemical and physical analyses.

4.5 SOIL CHEMICAL AND PHYSICAL DETERMINATIONS

After selection of overburden classes, bulk samples representative of each class were obtained. The bulk samples were submitted to Consolidated Fertilizers Limited (CFL) for detailed chemical analyses. These tests included nitrate-nitrogen, phosphorus, potassium, calcium, sodium, sulphate-sulphur, organic carbon, iron, manganese, copper, zinc, chloride, boron and aluminium. These chemical tests are used as aids in predicting the nutritional status of the soil, and hence the potential nutrient deficiencies for improved pastures and/or crop production.

The physical test included particle size analysis which assist in determining aeration and infiltration rates, available plant moisture and the degree of mechanical impedance. The R1 dispersion test was also performed. This test indicates the susceptibility of the media to aggregate breakdown in water.

Results of these tests can be found in Appendix B.

4.6 ACID-BASE ACCOUNTING

The acidity of spoil is considered to be one of the most important site variables determining the success or otherwise of rehabilitation procedures. Acid-base

accounting (Sobek et al. 1978) was used in this study to study the potential for acid production.

Subsamples from the 60 class level were analysed for total sulphur content by Australian Laboratories Services and for acid neutralising capacity by SGS-Quantum. Using the stoichiometric equation of pyrite oxidation assuming that the sulphur present is in the form of pyrite, the maximum potential acidity was calculated. The net neutralising capacity was derived by the subtraction of the pyritic acid from the total neutralising capacity. Toxic material was defined by Sobek et al. 1978) as any material having a net potential deficiency of 5 tonnes of calcium carbonate equivalent per 1000 tonnes of material.

The laboratory results for acid-base accounting are displayed in Appendix C.

5.0 OVERBURDEN CLASS CHARACTERISTICS

Seventeen (17) classes of overburden were identified by the methods described above. These classes are henceforth identified by letters of the alphabet. The distribution of the classes is displayed in Appendix D while the relative proportions are indicated in Table 5.

TABLE 5
The proportion of the sampled overburden

Overburden Class	TG	DC	% of overburden sampled		Total
			TH	BH	
A	9	7	6	31	14
B	<1	1			<1
C	5	33		21	19
D	59	28	66	27	39
E		2			1
F	7	7			5
G	10	12	25	9	12
H		1		<1	<1
I	<1	2		3	1
J		1			<1
K	3	3	3		2
L		<1			<1
M		<1		9	2
N		<1			<1
O		1			<1
P		1			<1
Q	<1	<1			<1

Class D is the dominant class representing 39% of the sampled overburden while the other three most dominant classes are A, C and G. These four classes represent 84% of the sampled overburden.

The Dunn Creek mining area was the most variable containing all classes. The dominant classes here were C, D and G representing 71% of overburden sampled at Dunn Creek. The Trap Gully mining area was the next most variable containing nine classes of the 18 identified. The dominant classes here were A, D and G representing 78% of overburden sampled at Trap Gully.

The Boundary Hill mining area contained seven classes. The dominant classes here were A, C and D representing 79% of overburden sampled. The Hut mining area contained only four classes, these being A, D, G and K. The dominant classes here were A, D and G representing 97% of overburden sampled.

The following assessment of the material is derived from the properties of the samples as supplied, that is, assuming that vegetation is to be established immediately.

Chemical and physical changes can occur such as weathering, leaching and aggregation. Properties can change with time. These assessments provide an indication of plant growth immediately after establishment assuming that the consequences of a failed vegetation cover such as excessive erosion are not acceptable.

5.1 CLASS A

This class was a very strongly acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium and calcium and deficient in magnesium. The material was non-saline and non-dispersive although being sodic, however, some crusting on the surface can be expected. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by available moisture and sodicity. The emergence rating of this class was very low due to the low available moisture. Any seedlings germinating in this material would be very highly susceptible to drought stress.

5.2 CLASS B

This class was a strongly alkaline sandy clay loam. It was very deficient in nitrogen, phosphorus, calcium, zinc, manganese and iron and deficient in potassium and magnesium. The material was non-saline, sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would generally be limited to class VIII by sodicity. The emergence rating of this class was very low also due to the high sodicity.

5.3 CLASS C

This class was a medium acid loamy sand. It was very deficient in nitrogen, phosphorus, potassium, calcium and magnesium and was deficient in manganese and iron. The material was non-saline, sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by low water holding capacity and sodicity. The emergence rating of this class was very low also due to the low water holding capacity.

5.4 CLASS D

This class was a medium acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium and calcium and was deficient in magnesium. The material was non-saline, sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by low water holding capacity. The emergence rating of this class was very low also due to the low water holding capacity.

5.5 CLASS E

This class was a very strongly alkaline loamy sand. It was very deficient in nitrogen, phosphorus and zinc. The material was non-saline, sodic and slightly dispersive. The land capability would be limited to class VI by high pH. The emergence rating of this class was very low also due to the high pH. Excessive alkalinity can cause a reduction in available nutrients.

5.6 CLASS F

This class was a strongly alkaline loamy sand. It was very deficient in nitrogen, phosphorus, potassium, zinc, manganese and iron and was deficient in calcium and magnesium. The material was non-saline but sodic. The land capability would be limited to class IV by sodicity. The emergence rating of this class was very low due to poor nutritional status.

5.7 CLASS G

This class was a medium acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium and calcium. The material was non-saline, sodic but non-dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VII by low water holding capacity and sodicity and a probable excessive surface crusting. The emergence rating of this class was very low due to poor nutritional status.

5.8 CLASS H

This class was a medium acid sandy clay loam. It was very deficient in nitrogen, phosphorus and potassium and was deficient in calcium and zinc. The material had medium salinity through excessive chloride; it was very sodic but was non-dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VII by high sodicity. The emergence rating of this class was very low also due to the poor nutritional status.

5.9 CLASS I

This class was a medium acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium and zinc and was deficient in manganese and iron. The material was non-saline, slightly sodic and slightly dispersive. The CEC was low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by probable excessive surface crusting. The emergence rating of this class was very low due to poor nutritional status.

5.10 CLASS J

This class was a strongly alkaline sandy clay loam. It was very deficient in nitrogen, phosphorus, potassium and zinc and was deficient in manganese and iron. The material was non-saline, slightly sodic and slightly dispersive. The CEC was low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by a probable excessive surface crust. The emergence rating of this class was very low due to the poor nutritional status.

5.11 CLASS K

This class was a slightly acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium, calcium, zinc, manganese and iron and was deficient in magnesium. The material was non-saline, highly sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land

capability would be limited to class VIII by excessive sodicity. The emergence rating of this class was very low also due to the sodicity.

5.12 CLASS L

This class was a strongly alkaline sandy loam. It was very deficient in nitrogen, phosphorus, calcium, zinc, manganese and iron and was deficient in potassium and magnesium. The material was non-saline, highly sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VIII by excessive sodicity. The emergence rating of this class was very low also due to the sodicity.

5.13 CLASS M

This class was a moderately alkaline sandy loam. It was very deficient in nitrogen, phosphorus, potassium and zinc and was deficient in manganese and iron. The material was non-saline, non-sodic and non-dispersive. The land capability would be limited to class VI by an expected surface crusting problem. The emergence rating was very low through poor nutritional status.

5.14 CLASS N

This class was a medium acid sandy loam. It was very deficient in nitrogen, phosphorus and potassium and was deficient in calcium and zinc. The material had a medium salinity via chloride; it was non-sodic and non-dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VII by sodicity as too was the emergence rating.

5.15 CLASS O

This class was a very strongly alkaline sandy loam. It was very deficient in nitrogen, phosphorus and potassium. The material was non-saline, sodic and slightly dispersive. The land capability would be limited to class VII by surface crusting, sodicity and high pH. The emergence rating of this class was very low due to poor nutritional status.

5.16 CLASS P

This class was a medium acid sandy loam. It was very deficient in nitrogen, phosphorus and potassium and was deficient in calcium, zinc and manganese. The material was non-saline, sodic but non-dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VI by low water holding capacity and expected surface crusting. The emergence rating of this class was low also due to the low water holding capacity.

5.17 CLASS Q

This class was a very strongly acid sandy loam. It was very deficient in nitrogen, phosphorus, potassium and calcium and was deficient in magnesium. The material was non-saline, sodic and slightly dispersive. The CEC was very low indicating a poor available moisture holding capacity. The land capability would be limited to class VII by low water holding capacity, sodicity and expected surface crusting. The emergence rating of this class was very low also due to the low water holding capacity.

6.0 CHEMICAL AND PHYSICAL CHARACTERISTICS

The use of chemical tests as aids in predicting the nutritional status of agricultural soils for crop and pasture production has become well established and critical levels exist for most nutrients. These values however are guides only as the response by a plant to the deficiency or toxicity of a nutrient will depend upon (1) the plant species, (2) the physical nature of the material and (3) environmental conditions such as temperature and rainfall (Bell 1981).

Although a laboratory test may indicate a nutritional deficiency, a response to application of that element as fertiliser may not occur if growth is limited by excessive levels of salinity, alkalinity, acidity or toxic elements. It is essential, therefore, to delineate the potential for these problems at an early stage. The response of plants to a fertiliser may also be reduced if the soil is characterised by low aeration, infiltration,

available water and mechanical impedance (Bell 1981). Hence, there is also a requirement to characterise materials with respect to their physical properties.

Of the 17 classes, three comprised of insufficient material to allow chemical analyses to be performed. Of these classes, (L, N and R), were most similar to classes B, H and A respectively according to the index tests and the chemical results from these latter classes have been assumed where necessary for the classes.

6.1 pH

Acidity of spoil is considered to be one of the most important site variables determining the success of revegetation. In contrast, spoil can also be highly alkaline as a result of high levels of sodium, calcium and magnesium carbonates and hydroxides.

The pH of the overburden varied widely from 4.8 (classes A and Q) to 9.3 (classes E and O). The dominant classes recorded pH levels of between very strongly acid of 4.8 for class A and medium acid (pH around 5.5) for classes C, D and G. In general the overburden will be medium acid unless class A is present where an increase to very high levels can occur.

6.2 SALINITY

The sampled overburden was non-saline in general with only classes H, K and N having some salinity present as chloride. These classes are minor accounting for only less than 4% of the overburden sampled. A salinity problem is not expected.

6.3 SODICITY

Sodicity can influence physical properties of material adversely by causing a dispersion of clay aggregates leading to a decrease in infiltration rates, increased surface crusting and increased erosion. The overburden classes were generally sodic as measured by extractable cations percentages. The generally sandy nature of the material will encourage infiltration and, in time, with weathering and leaching processes occurring, an improvement in the sodicity levels would be expected.

The dominant classes are generally highly sodic. Although improvement will probably occur with time, these materials will limit initial vegetation survival.

6.4 R1 DISPERSION RATIO

An indication of the dispersive characteristics of the silt and clay fraction of the spoils is provided by the R1 ratio (Bruce and Rayment 1982). The materials were either non- or slightly dispersive. Of the dominant classes, C and G were slightly dispersive. The materials recorded low dispersion in part due to the low fine fraction present. A worsening of this property may occur as the sodicity present influences the fine fraction.

6.5 PARTICLE SIZE ANALYSIS

Almost all of the classes were loamy sands or sandy loams in texture. Only classes B, H and J were of heavier texture being sandy clay loams. These classes are all minor.

6.6 SURFACE CRUSTING

An indication of surface crust strength can be obtained from the Crust Index (CI) (FAO 1984). The occurrence of surface crusting has been identified for several classes. Moderate crust strengths of between 5.0 and 7.5 kg/cm² would be expected in classes H and K. Hard crusts up to 10 kg/cm² in strength can be expected in classes J, N, O and P while severe crust strengths would be likely to occur in classes G, I, L and M. G was the only dominant class in which crusting was identified as a limitation. Problems are likely where this class dominates.

6.7 NUTRITIONAL FERTILITY

The classes have a very poor nutritional status. Fertiliser applications will be required if any reasonable grass cover is required. Nitrogen and phosphorus was very deficient in all classes while potassium was deficient in all classes except E. The status of all nutrients is summarised in Table 6.

Calcium and magnesium are generally deficient in the dominant classes and micronutrients were widely deficient. In practice, species used in revegetation are tolerant of micronutrient deficiencies especially if a nonproductive end use is desired.

TABLE 6
The nutritional deficiencies of the sampled overburden

Overburden Class	N	P	K	Ca	Mg	Cu	Zn	Mg	Fe
A	X	X	X	X	X				
B	X	X	X	X	X		X	X	X
C	X	X	X	X	X			X	X
D	X	X	X	X	X				
E	X	X					X		
F	X	X	X	X	X		X	X	X
G	X	X	X	X					
H	X	X	X	X			X		
I	X	X	X				X		
J	X	X	X				X	X	X
K	X	X	X	X			X		
L	X	X	X	X	X		X	X	X
M	X	X	X				X	X	X
N	X	X	X	X			X		
O	X	X	X				X		
P	X	X	X	X			X	X	
Q	X	X	X	X	X				

7.0 ACID PRODUCTION POTENTIAL

Extreme acidity of mining spoils is often directly related to the oxidation of sulphide minerals (mainly marcasite and pyrite) to form sulphuric acid. This acid can lead to revegetation failure, water pollution and severe erosion. Potentially toxic material was defined by Sobek et al. (1978) as material having a net potential deficiency of calcium carbonate or equivalent of 5 tonnes per 1000 tonnes of material. At this level, pH values below 4.0 can develop.

The majority of the overburden sampled had little neutralising capacity and acid potential was absent (Appendix D). Some net acid production was identified and these classes were either at the surface or at depth. The acid/base account assumes that all of

the sulphur present was in the form of pyrite. The net acid values near the surface can be attributed to sulphur in the form of sulphate being present. The remaining negative values were largely associated with carbonaceous material. Two classes each representing one sample were considered toxic, these being at 26 metres depth in hole 2469 and at 80 metres depth in hole 2864. Both of these samples were associated with coal.

There were three areas where substantial levels of neutralising capacities were present. All extended from the surface to depths of 14, 26 and 28 metres in holes 1772, 2475 and 2864 respectively.

The overburden sampled was non-toxic with respect to acid production apart from the two samples mentioned above. Although the remaining classes in which some acid production may occur were non-toxic, it would be preferable that this carbonaceous material did not appear on the final recontoured landform surface in any concentration as there is little neutralising capacity present.

8.0 EROSION POTENTIAL

Factors affecting water induced erosion include vegetation, slope and topography, rainfall characteristics and soil variables. Vegetation is influenced by many factors and can essentially be considered as a management factor. A cover of 70% is considered necessary to achieve maximum protection against erosion (Morgan 1979). For any given site, rainfall can be considered a constant. Thus the susceptibility of various materials to erosion for any given location is a function of topography and the erodibility of soils.

An erodibility index (EI) for Australian conditions was developed by Charman (1978) working on the premise that erodibility is proportional to solid detachability and inversely proportional to water transmissivity. The EI equation is thus:

$$EI = T \cdot S \cdot D / \text{SQRT}(I \cdot K \cdot C)$$

where:

T	=	texture
S	=	structure
D	=	dispersion
I	=	infiltration
K	=	permeability
C	=	water holding capacity.

The erodibility of the spoil classes was assessed and the results are presented in Table 7. All of the overburden sampled would be expected to be only slightly erodible. Much of the overburden is sandy in nature leading to reduced erodibility. Where clay contents were higher, the materials were non-dispersive, again increasing resistance to erosion.

Based solely upon erodibility, the land capability class would decline from I to VIII as indicated in Table 7 as slope grades increased.

TABLE 7
Decline in Land Capability as Slope Grades Increase

Capability Class	Slope %
I	0-4
II	4-6
III	6-8
IV	8-12
VI	12-16
VII	16-24
VIII	> 24

9.0 USE OF SOIL AS A PLANT EMERGENCE ZONE

Revegetation after mining depends upon the initial emergence of plants after sowing. If poor establishment occurs, the investment made in recontouring is threatened by uncontrolled erosion, and further regrading and seeding may be necessary at a later date. Excessive siltation of mine dams dramatically shortens their effective lives and erosion can reduce the capacity of other water storages off-site.

The suitability of spoil for use as a plant emergence zone has been examined and a series of suitability ratings developed based upon criteria considered important for pasture seedling emergence. All of the classes were limited in their use as a surface zone to promote emergence. All classes were limited by a poor nutritional status. This limitation however can be easily overcome with application of fertilisers. The remaining limitations outlined in Table 8 would still restrict plant emergence to some degree.

Four minor classes were either moderate or good as an emergence material while the dominant classes A, C and D were rated as being very poor and class G was rated as poor. Establishment difficulties are likely unless management strategies such as intensive ripping is employed.

Intensive ripping can assist in reducing sodicity in the furrows by increasing the leaching effect on a microrelief scale. Greater surface retention of water can also occur decreasing the influence of low water storage capacities.

TABLE 8

The limitations to plant emergence in the sampled overburden

Overburden Class	Limitation	Rating
		Very Poor
B	Sodicity	0.01
K	Sodicity	0.01
L	Sodicity	0.01
C	Low moisture storage	0.04
A	Low moisture storage	0.10
Q	Low moisture storage	0.10
D	Low moisture storage	0.12
		Poor
G	Low moisture storage	0.21
O	pH	0.22
P	Low moisture storage	0.22
E	pH	0.26
H	Low moisture storage	0.34
N	Low moisture storage	0.34
		Fair
F	pH	0.41
J	pH	0.44
		Moderate
I	Surface crust	0.66
M	Surface crust	0.64

10.0 LAND CAPABILITY

The ability of a land unit to support a particular use is termed land capability. As postmining land use alternatives commonly revolve around dryland agriculture, a capability assessment for this use has been used to assess the spoil classes. If uses other than dryland agriculture are envisaged, this capability scheme can still assist in providing a relative comparison between each soil class. Eight land capability classes have been used to describe dryland agricultural potential (Rosser et al. 1974). These classes are as follows:-

-
- I. suitable for all agricultural and pastoral uses;
 - II. suitable for all agricultural uses but with slight restrictions;
 - III. suitable for all agricultural uses but with moderate restrictions;
 - IV. primarily suited for pastoral use but can be cultivated occasionally with careful management;
 - V. arable but has limitations which, unless removed, make cultivation impractical;
 - VI. well suited for pastoral use and pasture improvement involving machinery is practicable;
 - VII. pastoral use is possible with careful management, and,
 - VIII. unsuitable for grazing.

The classes have been rated in terms of expected land capability. As in the case of plant emergence, nearly all classes are limited by sodicity or low water holding capacity. A summary of the limitations of the overburden as is, and with topsoil added is shown in Table 9. The dominant classes recorded capability ratings of VII and VIII. Land capability of the minor classes varied from IV to VIII.

Most of the overburden classes would be expected to respond similarly to applications of topsoil. It has been assumed that between 100 and 200 mm of soil would be used. Where surface crusting is the limitation, application of topsoil would overcome this problem by creating a new surface zone. If topsoil of higher moisture holding capacity

is applied, an increase of stored moisture in the rooting depth would occur. Little improvement however is expected where sodicity is present. Adverse physical conditions can still develop in the bulk of the rooting zone.

TABLE 9

The limitations to land capability in the sampled overburden

Class	Limitations	Capability Rating	
		As is	+ Topsoil
B	Sodicity	VIII	VIII
K	Sodicity	VIII	VIII
L	Sodicity	VIII	VIII
G	Low moisture storage VII	VI	
	Sodicity		
	Surface crusting		
H	Surface crusting	VII	VI
N	Sodicity	VII	VII
O	Low moisture storage	VII	VI
	Sodicity		
	Surface crusting		
Q	Low moisture storage VII	VI	
	Sodicity		
	Surface crusting		
A	Low moisture storage VI	VI	
	Sodicity		
C	Low moisture storage VI	VI	
	Sodicity		
D	Low moisture storage VI	VI	
E	pH	VI	VI
I	Surface crusting	VI	IV
J	Surface crusting	VI	IV
M	Surface crusting	VI	III
P	Surface crusting	VI	VI
	Low moisture storage		
F	Sodicity	IV	IV

11.0 IMPLICATIONS FOR REHABILITATION

11.1 SPOIL UNITS

This investigation suggests that an appreciable portion of the overburden will exhibit properties that will limit rehabilitation options. The classes have been classified into broad categories based upon limitations to plant emergence and land capability. These

categories have been used to describe spoil units which can be used to predict the spatial distribution of spoil quality. The final surface expression of spoil will reflect overburden lithologies, and, mining and regrading methods. Consequently, the accurate prediction of the distribution of spoil is not possible. A general indication however can be given so as to aid in the selection of rehabilitation strategies.

Results from previous overburden testing have been included here. Due to some changes in classification criteria, the class VIII overburden from Boundary Hill has been reclassified to class VII. Based upon differences in emergence zone rating and land capability, 5 unique spoil units can be described with respect to land capability and 4 units with respect to emergence. These are outlined in Table 10.

In determining the spatial distribution of the spoil units, several assumptions have been used. Sobek et al. (1978) indicated that material constituting less than 15% of the overburden would be diluted during mining to such an extent that it would not be observable on the spoil surface as a discrete unit. Therefore, any unit that constituted less than 15% of the drill hole samples were disregarded. Secondly, the properties of the least suitable dominant units in each hole were used to determine the overall spoil properties.

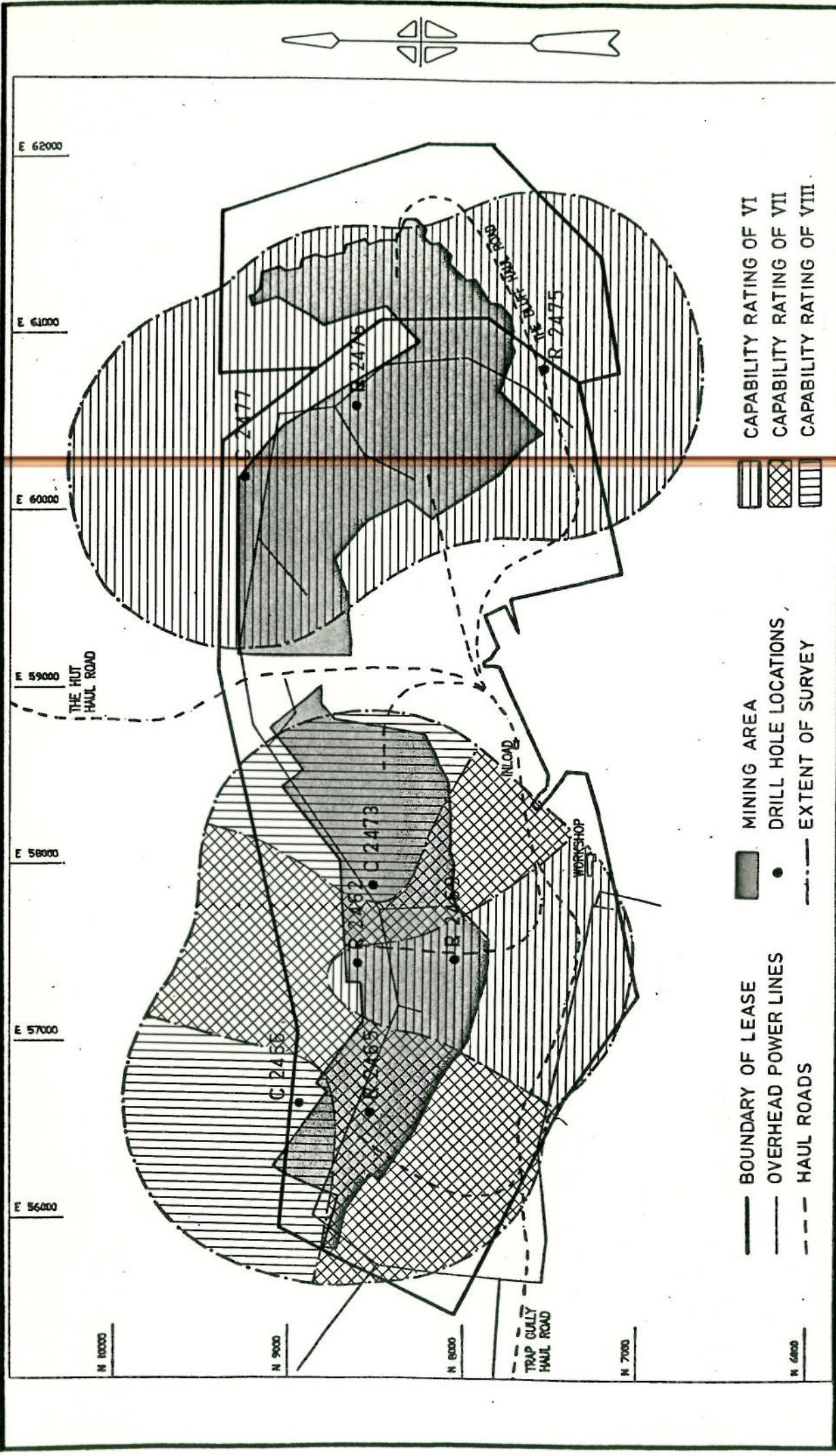
TABLE 10**The spoil units applied to overburden classes**

Mining Area Hole		Land capability	Emergence
Dunn Creek	C2462	VI	Very poor
	R2465	VII/VI	Very poor/Poor
	C2466	VIII/VI	Very poor
	R2469	VI	Very poor
	C2473	VIII/VI	Very poor
	R2475	VI/IV	Very poor/Poor
	R2476	VI	Very poor
	C2477	VI	Very poor
Trap Gully	C1771	VI	Very poor
	R1772	VI	Very poor
	R1773	VI	Very poor
	R1774	VI	Very poor
Boundary Hill	F2131	VII/VI	Poor
	F2132	VII	Poor
	F2133	VII/VI	Poor
	F2135	VII/VI	Poor
	R2858	VI	Very poor
	R2864	VI	Very poor/Moderate
	C2866	VI	Very poor
	C2867	VI	Very poor
The Hut	R2666	VI	Very poor
	C1688	VII/VI	Poor
	C1689	VII	Poor
	C1690	VII/VI	Poor
	C1691	VIII/VI	Poor
	C1692	VIII/VI	Poor
	R2667	VII/VI	Very poor/Poor
	R2665	VII	Poor
	C2650	VI	Very poor
	C2654	VI	Very poor

The distribution of the simple land capability classes are shown in Figures 2(a) to 2(d).

Only three discretely different surface units with different revegetation properties would be expected after mining. The majority of the spoil would be unsuitable for emergence of plants and the land capability would be VI.

The application of suitable topsoil to 200 mm depth would not improve the land capability but would overcome emergence difficulties.

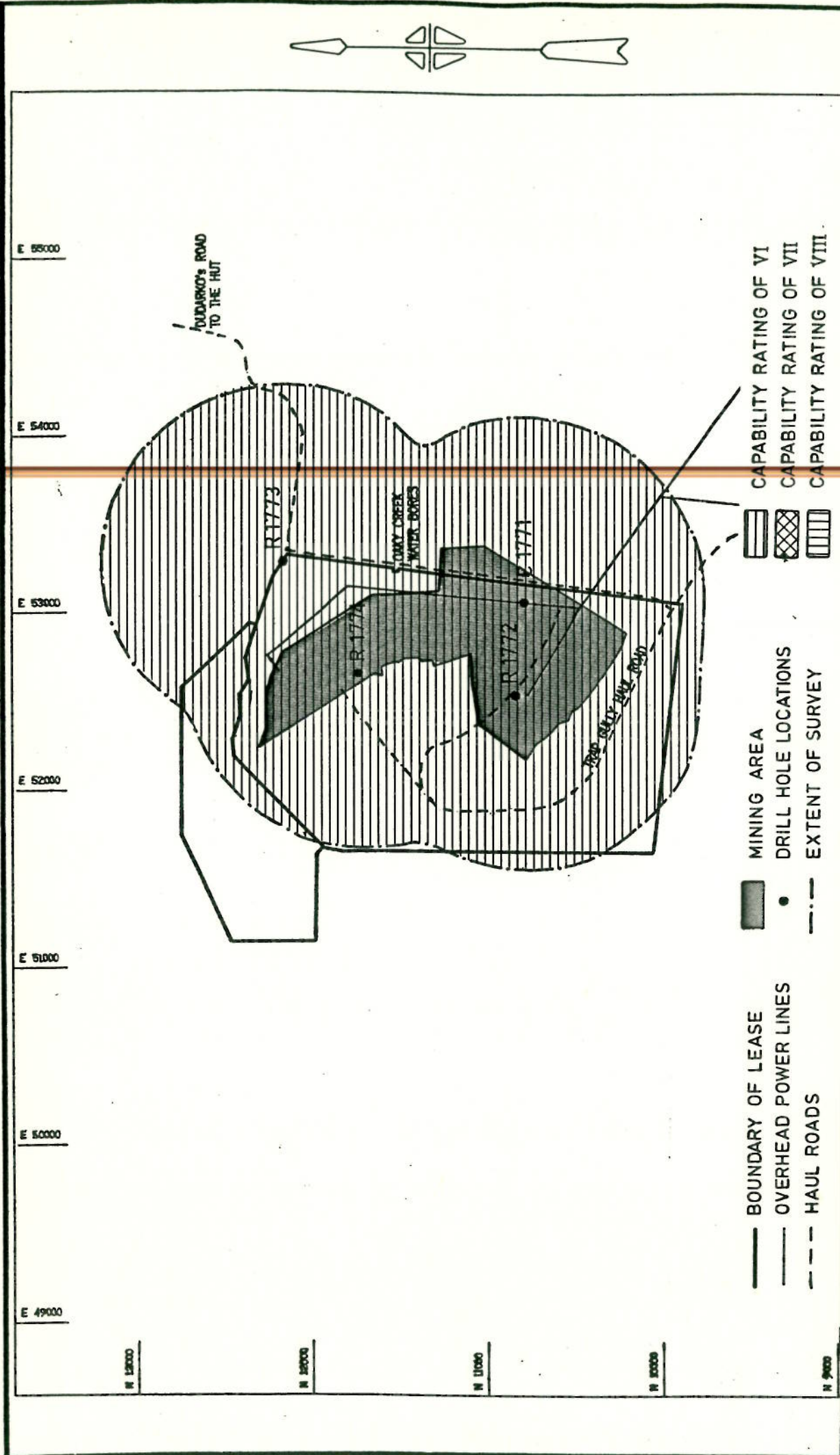


Scale 1:30000
 Date -6-91
 FIGURE 2A

**CALLIDE COALFIELDS
 DUNN CREEK
 LAND CAPABILITY RATINGS**

SOIL CONSERVATION AND ENVIRONMENTAL SERVICES

PO Box 320, Red Hill, QLD 4059
 Ph: (07) 300 2516 Fax: (07) 300 3061

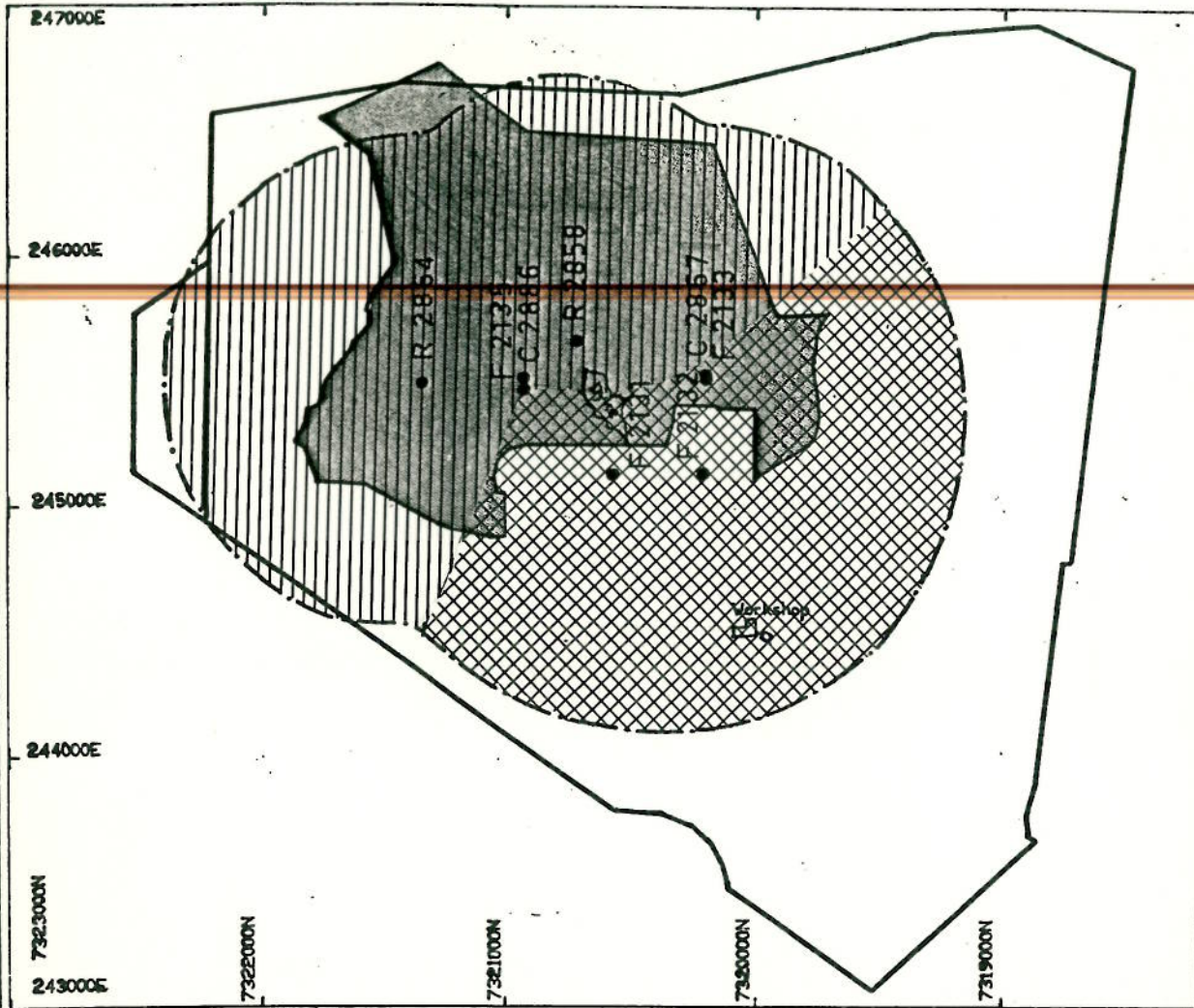


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 Date -6-91
 FIGURE 2B

**CALLIDE COALFIELDS
 TRAP GULLY
 LAND CAPABILITY RATINGS**

**SOIL CONSERVATION AND
 ENVIRONMENTAL SERVICES**

PO Box 520, Pad 146, Old 4009
 Ph: (07) 360 2918 Fax: (07) 360 3091



- BOUNDARY OF LEASE
- - - OVERHEAD POWER LINES
- ... HAUL ROADS
- MINING AREA
- DRILL HOLE LOCATIONS
- - - EXTENT OF SURVEY

- ▨ CAPABILITY RATING OF VI
- ▩ CAPABILITY RATING OF VII
- ▧ CAPABILITY RATING OF VIII

**SOIL CONSERVATION AND
ENVIRONMENTAL SERVICES**



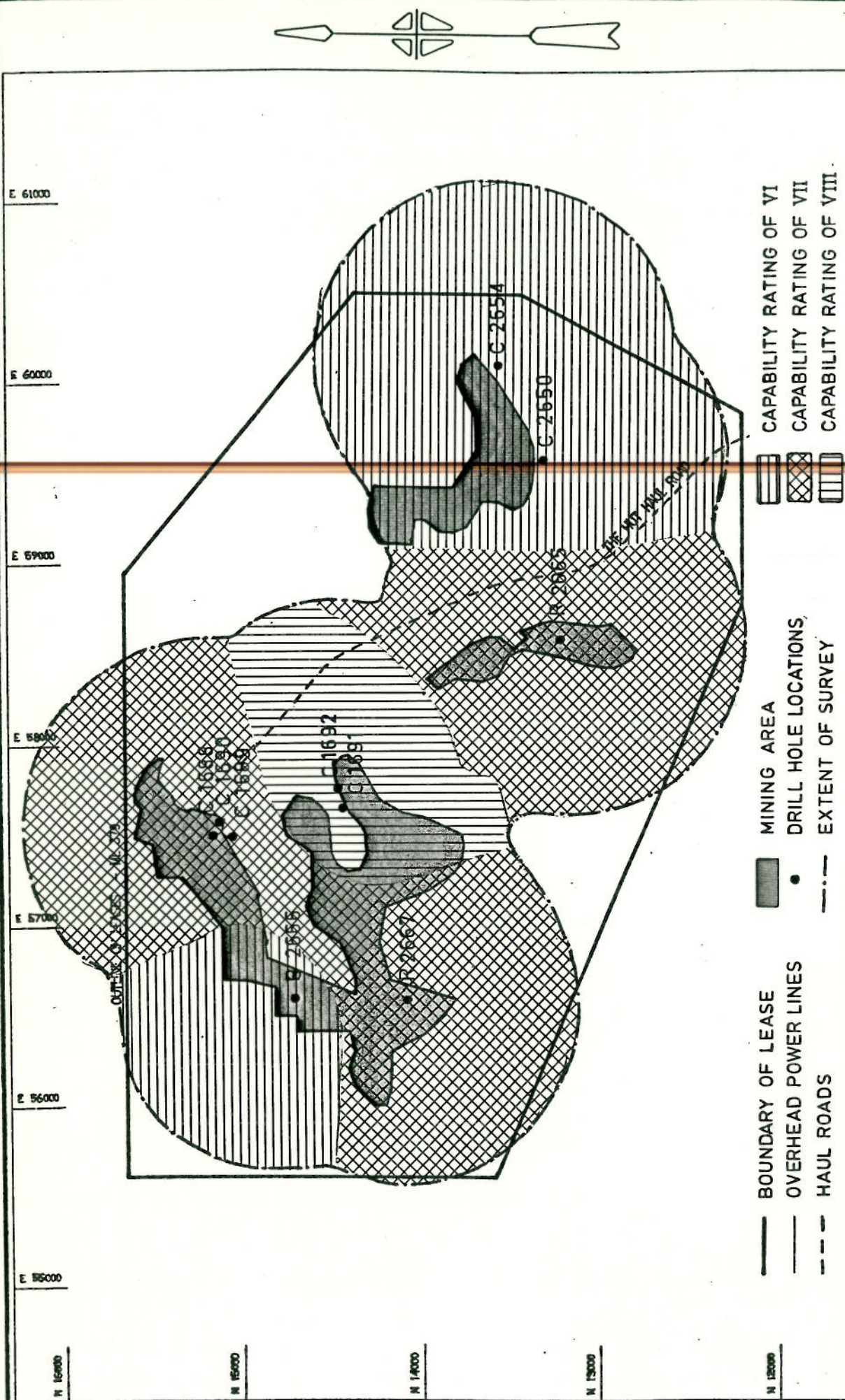
PO Box 320, Red Hill, QLD 4209
Ph: (07) 398 2918 Fax: (07) 398 3981

**CALLIDE COALFIELDS
BOUNDARY HILL
LAND CAPABILITY RATINGS**

Scale 1:30000

Date -6-91

FIGURE 2C



Scale 1:30000
Date -6-91
FIGURE 2D

CALLIDE COALFIELDS THE HUT LAND CAPABILITY RATINGS



**SOIL CONSERVATION AND
ENVIRONMENTAL SERVICES**

PO Box 320, Red Hill, QLD 4059
Ph: (07) 306 2918 Fax: (07) 306 3061

11.2 POSTMINING LAND USE

The spoil, as mentioned above, is expected to be able to support pastoral activities based on land capability if satisfactory emergence can be accomplished. Without the use of topsoil, only class VII activities can be contemplated, and, preferably class VIII capability should be aimed for. Although the erodibility of the materials is generally low, pastoral activities should be restricted to slopes below 16% for class VI activities and 24% for class VII.

To be more definitive on land use, information on the availability and quality of topsoil is required in conjunction with expected postmining landforms.

APPENDIX "A"

INDEX TEST RESULTS

APPENDIX A - INDEX TEST RESULTS

The results of the index tests for standardised air-dry moisture, pH and salinity for the overburden 2m composites.

pH and salinity as measured by electrical conductivity were recorded on a 1:5 solid:water ratio by volume.

The standardised air dry moisture has been regressed against standards of known cation exchange capacity (CEC) to compensate for different atmospheric conditions.

	pH	EC (mS/cm)	CEC (meq/100g)
1771_2	6.7	0.23	20.2
1771_4	6.8	0.46	13.4
1771_6	7.3	0.46	11.2
1771_8	7.3	0.44	11.5
1771_10	7.4	0.38	10.7
1771_12	7.5	0.39	10.6
1771_14	7.5	0.18	9.2
1771_16	7.3	0.10	8.1
1771_18	7.0	0.11	8.6
1771_20	6.9	0.07	8.1
1771_22	6.8	0.07	8.6
1771_24	6.9	0.04	9.4
1771_26	6.8	0.04	8.0
1771_28	6.8	0.03	8.3
1771_30	6.5	0.03	7.7
1771_32	6.4	0.03	7.5
1771_34	6.4	0.03	7.5
1771_36	6.5	0.03	8.2
1771_38	6.6	0.03	8.5
1771_40_61	6.8	0.05	8.1
1771_42_1	7.1	0.07	7.6
1771_44_2	7.3	0.06	7.6
1771_46_3	7.7	0.05	7.5
1771_48_4	8.0	0.06	7.3
1771_50_5	7.2	0.07	7.4
1771_52_6	7.5	0.07	7.4
1771_54_7	7.3	0.07	7.4
1771_56_8	7.1	0.07	7.4
1771_58_9	8.2	0.07	10.5
1771_60_10	8.6	0.05	10.3
1771_62_11	8.2	0.07	10.4
1771_64_12	7.7	0.08	10.8
1771_66_13	7.5	0.10	12.1
1771_68_14	6.8	0.15	11.7
1771_70_15	5.9	0.19	11.6
1771_72_16	5.4	0.18	11.4
1771_74_17	6.1	0.11	12.4
1771_76_18	6.4	0.11	11.7
1771_78_19	6.4	0.14	11.8
1771_80_20	6.4	0.13	11.5
1771_82_21	6.3	0.13	11.4
1771_84_22	5.1	0.16	11.0
1771_86_23	5.0	0.19	12.2
1771_88_24	6.0	0.11	11.6
1771_90_25	5.3	0.12	11.5
1771_92_26	6.0	0.11	12.0
1771_94_27	6.3	0.10	10.8
1771_96_28	6.6	0.06	9.7
1771_98_29	6.6	0.10	10.2
1771_100_30	6.2	0.16	11.9
1771_102_31	6.6	0.08	11.9
1771_104_32	6.5	0.20	11.9
1771_106_33	6.7	0.14	13.2
1771_108_34	6.1	0.23	12.1
1771_110_35	6.3	0.14	11.4
1771_112_36	5.9	0.21	13.8
1771_113_37	6.1	0.11	17.5

Appendix J

Infrastructure Retention Statement

Infrastructure retention statement

1. Batchfire Callide Pty Ltd ACN 081 022 228 and Batchfire Pty Ltd ACN 004 784 454 (together **Batchfire**) operate the Callide Coal Mine under environmental authority EPML00720413 (**EA**). The EA relates to ML 5632, ML 5641, ML 5653, ML 5654, ML 5655, ML 5662, ML 6993, ML 6994, ML 700059, ML 80030, ML 80092, ML 80093, ML 80107, ML 80115, ML 80117, ML 80118, ML 80122, ML 80151, ML 80186 (together the **MLs**).
2. Batchfire are the registered owners or the registered lessees of a number of properties comprising the Boundary Hill, Trap Gully, The Hut, and Dunn Creek mining areas.

Table 1 Summary of property, mining areas and infrastructure to be retained post mining

Lot	Plan	Relevant MLs	Mining area	Infrastructure to be retained
38	RP801409	ML 6994	Boundary Hill	All sediment dams, nominated mine water dams, farm dams and drains, and fencing
1	SP200831	ML 5655		
3	SP216326	ML 80107		
2	SP231268	ML 80151		
153	RN1431	ML 5655; ML 80115		
11	RP801163	ML 5655; ML 80115		
1	SP301592	ML 80186		
134	SP301592	ML 80186		
94	SP301592	ML 80186		
17	SP346688	ML 80122; ML 5662	Trap Gully	All sediment dams, nominated mine water dams, farm dams, drains and (including creek diversion), and fencing
7	RN1519	ML 80117		
152	RN1429	ML 5662		
4	SP328354	ML 5653; ML 80117 ML 80122 ML 700059		
10	SP307514	ML 80117	Dunn Creek	All sediment dams, nominated mine water dams, farm dams and drains, and fencing
17	SP346688	ML 80118; ML 80030		
10	RP912765	ML 80118		
6	RP848846	ML 6993; ML 80030		
13	RP848909	ML 80030		
12	RP848908	ML 80030; ML 80092		
23	SP129150	ML 80030; ML 80092		
16	SP120478	ML 80092		
17	SP120478	ML 80092		

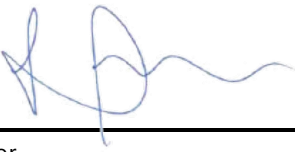
100	SP301602	ML 80092; ML 5632; ML 80030; ML 5641		
101	SP301602	ML 80093		
31	RN869	ML 80092		
52	RP843058	ML 80093		
17	SP346688	ML 5654	The Hut	All sediment dams, nominated mine water dams, farm dams and drains (including creek diversion), and fencing

3. Batchfire hereby states that the infrastructure listed in Table 1 will remain in situ at the closure of the Callide Coal Mine and the surrender of the MLs

Statement confirmed by

Batchfire Callide Pty Ltd ACN 081 022 228

On 05 / 05 / 2026 by:

X 

Director

X 

~~Director~~ / Secretary

X John O'Connell

Full name of Director

X Lisa Andrews

Full name of ~~Director~~ / Secretary

Batchfire Callide No. 2 Pty Ltd ACN 004 784 454

On 05 / 05 / 2026 by:

X 

Director

X 

~~Director~~ / Secretary

X John O'Connell

Full name of Director

X Lisa Andrews

Full name of ~~Director~~ / Secretary

Infrastructure retention statement

Water compensation agreement

Batchfire Callide Management Pty Ltd ACN 009 666 200 as manager of the
Callide Joint Venture

Batchfire Callide Pty Ltd ACN 081 022 228

Batchfire Callide No. 2 Pty Ltd ACN 004 784 454

Craig Earl Polsen

Dated: 17 December 2021

8.2 Retention of Sediment Dam for stock watering

- (a) The Landholder consents and agrees to the retention of the Sediment Dam on the Land from the surrender or termination of ML80093 for the Approved Use by the Landholder.
- (b) From the date of surrender or termination of ML80093, the Landholder accepts responsibility and ownership for the Sediment Dam and will have no further Claim in relation to the Sediment Dam against the Company.
- (c) The Landholder must do all things necessary to give effect to the retention of the Sediment Dam on the Land and the transfer of the Sediment Dam to the Landholder, including by signing any letter or other document as reasonably required to confirm and provide evidence of the agreement under this clause.
- (d) The parties acknowledge and agree that this document may be provided as evidence of the Landholder's consent to the Sediment Dam remaining on the Land, and pleaded as an absolute bar in relation to any Claim made in relation to the Sediment Dam.

9 Supply of Mine Affected Water

9.1 No guarantee as to volume and quality

- (a) The Company agrees to supply Mine Affected Water at the Take Off Points.
- (b) Subject to clause 9.1(c), the parties may negotiate and agree additional take off points for the Land, and the parties will vary this document to record their agreement in relation to the additional take off points in accordance with clause 21.1.
- (c) The Landholder acknowledges that the Company will only supply Mine Affected Water at the Take Off Points if:
 - (i) the Company has excess water (as determined by the Company in its absolute discretion);
 - (ii) the Company is satisfied that it is lawful to do so, including under the terms of the Environmental Authority and any other Approvals; and
 - (iii) there are no leakages, breakdowns of equipment, power outages or other relevant issues, including in the Landholder Infrastructure, preventing supply.
- (d) The Landholder acknowledges that the Company makes no representation or warranty as to the volume, quality or suitability of the Mine Affected Water, including for the Approved Use.

9.2 Termination of supply by Company and Callide Joint Venturers

The Company and the Callide Joint Venturers may terminate the supply of Mine Affected Water under this document at any time by notice to the Landholder, for any of the following reasons:

- (a) the Landholder is in breach of this document, and fails to remedy that breach within 14 days (or such other period required) after notice has been given by the Company requiring it to do so;
- (b) the Landholder fails to construct the Landholder Infrastructure;