

Application form

Environmental Protection Act 1994

Submission of a progressive rehabilitation and closure plan

This is the approved form for a progressive rehabilitation and closure plan (PRC plan) under section 126C of the Environmental Protection Act 1994 for a site-specific application for a mining activity relating to a mining lease.

Only use this application form if you are required to submit a PRC plan, where:

- You are applying for a new site-specific environmental authority for a mining activity relating to a mining lease.
OR
- The administering authority has included the requirement to submit a proposed PRC plan in an information request for a new site-specific environmental authority for a mining activity relating to a mining lease.
OR
- You completed a PRC plan as part of an EIS process and are submitting the PRC plan in the approved form as required under section 126C.
OR
- You have an existing site-specific environmental authority for a mining activity relating to a mining lease and have received a transition notice from the administering authority¹ in accordance with section 754 of the *Environmental Protection Act 1994* (EP Act).
OR
- Where none of the above apply: you have an existing site-specific environmental authority for a mining activity, you do not otherwise have a PRCP schedule approved yet one is required, and any of the following applies:
 - You have failed to comply with a transition notice;
 - You did not receive a transition notice as required under the legislation;
 - The administering authority has refused your proposed PRCP schedule.

Before completing this application form it is recommended that you:

- Read the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964²), which explains the information you are required to provide with this application.
- Have a pre-lodgement meeting. To request a pre-lodgement meeting, please fill out and lodge the form Application for pre-lodgement services (ESR/2015/1664).

¹ The Department of Environment, Science and Innovation is the administering authority under the *Environmental Protection Act 1994*.

² This is the publication number. The publication number can be used as a search term to find the latest version of a publication at www.qld.gov.au.



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If you require assistance in answering any part of this form, or have any questions about your application, please contact the relevant business centre. Contact details are at the end of this form (Section 10).

Privacy statement

The administering authority is collecting the information on this approved form to process your application for a PRC plan. The collection of information is authorised under Chapter 3 and Chapter 5 of the EP Act. Some of the information may be disclosed to the Department of Resources and Queensland Treasury for the purpose of processing this application or the Rehabilitation Commissioner in accordance with s444J of the EP Act the if accessing the information is necessary or convenient to be done in the performance of the Commissioner's functions.

Please note that the administering authority is required to keep this application on a register of documents open for inspection by members of the public under section 541 of the EP Act, and must permit a person to take extracts from the register pursuant to section 542 of the EP Act.

Your personal information will not be otherwise disclosed to any other parties unless authorised or required by law. For queries about privacy matters please email privacy@des.qld.gov.au or telephone 13 74 68.

Definitions of terms used in this form	
<i>(Where there is inconsistency between the definition of terms used here and the terms used in the EP Act, the terms in the EP Act apply)</i>	
Available for improvement	In relation to land in an improvement area for a non-use management area, means land in the improvement area that is not being mined, other than land to which any of the following applies— a) the land is being used for operating infrastructure or machinery for mining, including, for example, a dam or water storage facility; b) the land is identified in the PRCP schedule or the application for an environmental authority relating to the schedule as containing a probable or proved ore reserve that is to be mined within 10 years after the land would otherwise have become available for improvement; c) the land is required for the mining of a probable or proved reserve mentioned in paragraph (b).
Available for rehabilitation	For a rehabilitation area, means land in the area is not being mined, unless— a) the land is being used for operating infrastructure or machinery for mining, including, for example, a dam or water storage facility; or b) the land is identified in the PRCP schedule or the application for an environmental authority relating to the schedule as containing a probable or proved ore reserve, under section 126D(6) of the EP Act, that is to be mined within 10 years after the land would otherwise have become available for rehabilitation; or - ba) the land is required for the mining of a probable or proved reserve mentioned in paragraph (b); or c) the land contains permanent infrastructure identified in the proposed PRCP schedule as remaining on the land for a post-mining land use.
Land outcome document	For land, means the following documents relating to the land— a) an environmental authority for a resource activity on the land; b) a document made under a condition of an environmental authority

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	mentioned in paragraph (a), if– i. the document relates to the management of a void within the meaning of section 126D of the EP Act on the land, or the rehabilitation of the land; and ii. the document was received by the administering authority before the assent date; and iii. the administering authority has not, within 20 business days after the assent date, given notice to the environmental authority holder that the document is insufficient in a material particular relevant to a matter mentioned in subparagraph (i); and iv. before the assent date, the document has not been superseded; c) a document made under a condition of an environmental authority mentioned in paragraph (a), if– i. the document relates to the management of a void within the meaning of section 126D of the EP Act on the land, or the rehabilitation of the land; and ii. the environmental authority requires the document to be given to the administering authority on a stated day that is on or after the assent date, or does not state a day when the document must be given; and iii. the document is received by the administering authority within three years after the assent date; and iv. the administering authority does not, within 20 business days after receiving the document, give the environmental authority holder a notice that the document is insufficient in a material particular relevant to a matter in subparagraph (i); d) a report evaluating an EIS under the <i>State Development and Public Works Organisation Act 1971</i>, section 34D; e) an EIS assessment report; f) a written agreement between the holder of an environmental authority mentioned in paragraph (a) and the State that is in force on the assent date.
Improvement area	For a non-use management area, means an area of land in the non-use management area to which a management milestone relates.
Management milestone	For a non-use management area, means each significant event or step necessary to– a) achieve best practice management of the area; and b) minimise risks to the environment.
Non-use management area	Means an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended.
Post-mining land use	For land the subject of a PRC plan, means the purpose for which the land will be used after all relevant activities for the PRC plan carried out on the land have ended.
PRC plan	For land the subject of a mining lease, means a progressive rehabilitation and closure plan for the land that consists of – a) the rehabilitation planning part of the PRC plan; and

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	b) the PRCP schedule for the PRC plan, including any conditions imposed on the schedule.
PRCP schedule	For a PRC plan, means a schedule of the plan that – a) complies with section 126D of the EP Act; and b) is approved under chapter 5, part 5, division 2 of the EP Act, with or without conditions.
Proposed PRC plan	For an application, a proposed PRC plan means a PRC plan proposed for land the subject of a mining lease that: (a) complies with Chapter 5, part 2, division 3; and (b) either – accompanies the application; or is submitted for the application after the application is made
Rehabilitation area	For land the subject of a post-mining land use, means an area of the land to which a rehabilitation milestone for the post-mining land use relates.
Rehabilitation milestone	For the rehabilitation of land, means each significant event or step necessary to rehabilitate the land to a stable condition.

The fields marked with an asterisk * are mandatory. If they are not completed then your application may be considered not properly made under section 128 of the EP Act.

Section 1 – Environmental authority details		
Does this application relate to an <u>existing</u> environmental authority for a mining activity relating to a mining lease approved through a site-specific application?*	☐ No – Provide the reference number for your environmental authority application:	AR Insert.
	☒ Yes – Provide your environmental authority number:	EPML00865013

Section 2 – Applicant details	
Details of the applicant are to be provided in this section. If there is an agent acting on behalf of the applicant, details of the agent are to be provided. An agent could be a consultant or contractor for the environmental authority holder. The person nominated as the application contact will receive correspondence relating to this application.	
NAME / COMPANY NAME* BHP Mitsubishi Alliance (BMA)	TRADING NAME (*IF AN ORGANISATION) BMA
REGISTERED BUSINESS ADDRESS / RESIDENTIAL ADDRESS (NOT A POST OFFICE BOX) * Level 14, 480 Queen Street BRISBANE CITY Queensland 4000 Australia	POSTAL ADDRESS (*WHERE DIFFERENT) See registered business address
ABN / ACN (*IF AN ORGANISATION) ABN67096752	NAME OF APPLICATION CONTACT* Trudy Mazucco
EMAIL* trudy.mazucco@bhp.com	TELEPHONE* 0475 300 433

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- ☒ INDICATE IF YOU WANT TO RECEIVE CORRESPONDENCE VIA EMAIL
- ☐ INDICATE IF THIS FORM IS BEING COMPLETED BY AN AGENT FOR THE ENVIRONMENTAL AUTHORITY HOLDER*
- NOTE: If an agent is nominated, please provide evidence of appointment by the authority holder/s.**

Section 3 – Website address

If this application relates to an application for a new site-specific environmental authority for a mining activity, would you like to use the details on the environmental application form?	☒ No – Provide details below.	
	☐ Yes – Go to next section.	
Provide the website address for the application notice and application documents.	www.bhp.com	
Provide details of the contact person if technical assistance is required.	NAME Trudy Mazucco	TELEPHONE 0475 300 433
	EMAIL trudy.mazucco@bhp.com	

Section 4 – Non-use management areas (new environmental authority applications only)

Does this application for a proposed PRC plan include a NUMA justified under section 126D(2)(b) of the EP Act? *	☐ No – Go to next section.	
	☐ Yes	
Has a public interest evaluation been carried out by a qualified entity for the NUMA(s)? *	☒ No – Go to next section.	
	☐ Yes	
Has the proposed NUMA(s) changed since the public interest evaluation was carried out in the EIS? *	☐ No – Go to next section.	
	☐ Yes – Provide details below.	
How has the proposed NUMA(s) changed since the public interest evaluation was carried out?	Please provide details below. Insert.	

Section 5 – PRC plan structure

The PRC plan must be prepared in accordance with the structure/format shown in Appendix 1 of this application form.	
Requirement	Requirement met?
Include a cover page that complies with Appendix 1 of this application form.	☒ Yes
Include a table of contents that complies with Appendix 1 of this application form.	☒ Yes

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Section 6 – PRC plan Checklist *			
The PRC plan must meet the information requirements stated in section 3 of the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964), and sections 126C and 126D of the EP Act (note there is a limited exception for transitional PRC plans). All PRC plan requirements are mandatory. For each requirement, insert a reference to the section of the PRC plan which satisfies the requirement. Justification must be provided for any requirement for which the response is Not Applicable (NA). If more space is required, please attach a separate sheet.			
PRC plan Requirement	Requirement met? (Yes / NA)	PRC Plan Section No.	Justification
Rehabilitation planning part of the PRC plan			
The rehabilitation planning part of the PRC plan must include the information required under section 126C the EP Act, including information requirements described in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) in accordance with section 126C(1)(j) of the EP Act.			
Project description			
<i>Note: For existing mines transitioning to the PRC plan framework, pre-disturbance information collected as part of an EIS process or original environmental authority application should be included. If this information is unable to be provided, or cannot be developed because of the mine's life stage, this should be clearly explained in this section of the rehabilitation planning part of the PRC plan.</i>			
Describe the following:			
each resource tenure, including the area of each tenure, to which the application relates;	Yes	Section 1.1.2	-
the relevant activities to which the application relates;	Yes	Section 1.4.1	-
the likely duration of the relevant activities	Yes	Section 1.4.1	-

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Include a detailed description, including maps, of how and where the relevant activities are to be carried out.	Yes	Section B: PRCP Schedule	-
Consultation			
Include details of the consultation undertaken by the applicant in developing the proposed PRC plan.	Yes	Section 2	-
Include details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.	Yes	Section 2.3.3.2	-
Post-mining land use			
State the extent to which each proposed post-mining land use identified in the proposed PRCP schedule for the plan is consistent with the outcome of consultation with the community in developing the PRC plan.	Yes	Section 2.5	-
State the extent to which each proposed post-mining land use identified in the proposed PRCP schedule for the plan is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.	Yes	Section 3.3	-
Non-use management area			
<i>Note for Transitional PRC plans: The holder is not required to comply with a requirements under section 126C(1)(g) or (h) or 126D(2) or (3) for the proposed PRCP schedule for the plan in relation to land if a land outcome document identifies the outcome for the land as the same, or substantially similar to, the outcome for the land if it were a non-use management area.</i>			
State the extent to which each proposed non-use management area identified in the PRCP schedule for the plan is consistent with the outcome of consultation with the community in developing the PRC plan.	Yes	Section 2.5	-

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State the extent to which each non-use management area identified in the PRCP schedule for the plan is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.	Yes	4.5	-
For each proposed non-use management area, state the reasons the applicant considers the area cannot be rehabilitated to a stable condition because of a matter mentioned in section 126D(2).	NA	Section 4	As outlined in Section 754 (3) of the EP Act and sections 6.3.2 of the PRCP Guideline "a NUMA will be taken to be pre-approved if a land outcome, the same or substantially similar to a NUMA, is contained in a land outcome document". This is the case for SSM due to the residual voids being authorised under Schedule E (Condition E6 and E7 of the LOD. BMA has transitional arrangements for residual voids as pre-approved NUMAs.
For each matter mentioned in the requirement above, include copies of reports or other evidence relied on by the proponent for each proposed non-use management area.	NA	Section 4	The EA is the LOD for Saraji South Mine and it is included in the PRCP as Appendix A (Part C of the SSM PRCP)
Rehabilitation and management methodology			
<i>Note: Section 3.5 of the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964) outlines the range of information that must be included as appendices to the rehabilitation planning part of the PRC plan.</i>			
For each post-mining land use, state the applicant's proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule.	Yes	Section 6	-
For each non-use management area, state the applicant's proposed methodology for achieving best practice management of the area to	Yes	Section 6	-

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support the management milestones under the proposed PRCP schedule for the area.				
Risk assessment				
Identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.	Yes	7	-	
PRCP Guideline				
Include any other information prescribed by the administering authority in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964).	Yes	8	Monitoring and Maintenance	
Include the spatial information required in the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964). See Attachment 1 of this form for details on how spatial information must be submitted.	Yes	10	Spatial Data submitted as per requirements	
Other information				
Include the other information the administering authority reasonably considers necessary to decide whether to approve the PRCP schedule.	Yes	Part C Appendices	Supporting studies and information included in Part C Appendices	
PRCP Schedule				
The proposed PRCP schedule must comply with section 126D of the EP Act, and be written in accordance with the Guideline – Progressive Rehabilitation and Closure Plans (ESR/2019/4964). The administering authority will assess the proposed PRCP schedule in conjunction with the rehabilitation planning part of the PRC plan and other application documents, and decide whether to approve the proposed PRCP schedule, with or without conditions, or refuse the proposed PRCP schedule.				

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Include a PRCP schedule prepared using the PRCP schedule template (ESR/2019/5103 ³).	Yes	10	Summarised in Section 10, but also submitted separately in the PRCP schedule template
Include maps showing all of the land mentioned in the PRCP schedule, as it relates to being progressively rehabilitated.	Yes	10	-

Section 7 – Non-use management areas (transitional applications only) ⁴	
Does this application for a proposed PRC plan include a NUMA? *	☐ No – Go to next section. ☒ Yes
Does the relevant environmental authority or any other land outcome document identify an outcome for the land that is the same, or substantially similar, to the outcome for the land if it were a NUMA under a PRCP schedule?	☐ No – Go to next section. ☒ Yes
Does the environmental authority or any other land outcome document state sufficient detail to identify either the location or the area of the land to which the outcome relates?	☒ No – Provide details below. ☐ Yes – Provide the document name(s) in Section 8.
If the area is not identified – how will the total area of the land to which the outcome relates be minimised? *	As outlined in Section 754 (3) of the EP Act and Section 6.3.2 of the PRCP Guideline “a NUMA will be taken to be pre-approved if a land outcome document”. This is the case for SSM due to the residual voids being authorised under Schedule E (Condition E6 & E7) of the LOD. BMA has transitional arrangements for residual voids as pre-approved NUMAs. As per the PRCP Guideline, if a NUMA has already been identified in a LOD, the applicant is not required to comply with Sections 126C (1)(g) or (h) or Section 126 D (2) or (3) of the EP Act and is not required to complete the

³ This is the publication number. The publication number can be used as a search term to find the latest version of a publication at www.qld.gov.au.

⁴ Transitional applications mean the holder of an existing EA for an ineligible mining activity relating to a mining lease that has been issued a transition notice and is transitioning into the new PRC plan framework.

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	information requirements under Section 126C (1)(j) of the EP Act for the approved NUMAs. As the LOD does not state the area or the location of the proposed NUMAs, the PRCP Guideline (in terms of s754(4) of the EP Act) also requires this PRC Plan to include the detail on how the total area will minimise risk to the environment.
	See Section 4.2 for specific details on minimising the extent of the NUMAs.
If the location is not identified – how will the environmental authority holder ensure the location of the land to which the outcome relates minimises risks to the environment? *	See comment above and Section 4.2 for specific details on the final location and extent of the NUMAs, and how these will not present an unacceptable risk of environmental harm outside of the tenure boundary.

Section 8 – Transitional PRC plan requirements (transitional applications only) ⁴					
In accordance with transitional provisions in the EP Act, an applicant with an existing environmental authority is able to transition aspects of the PRCP schedule from existing land outcome documents. Indicate below any information that is being transitioned from a land outcome document.					
PMLU/NUMA	Rehabilitation /improvement area	Milestone Reference	Identify which of the below is being transitioned from a land outcome document		Page No.
			Land outcome	Milestone criteria	
EA Table E1 Cattle Grazing	RA3, RA7, RA9, RA13, RA14, RA16, RA19	RM0, RM2, RM2, RM3, RM4, RM7, RM10, RM13, RM17, RM19	☒	☒	EA Page 15-17
EA Table E1 Dry Land Cropping	NA	NA	☒	☒	EA Page 15-17

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EA Table E1 Woodland Habitat	RA1, RA4, RA10, RA12, RA15, RA18	RM0, RM1, RM2, RM3, RM5, RM8, RM11, RM14, RM18	☒	☒	EPML00865013	EA Page 15-17
EA Table E1 Water Storage	RA5	NA	☒	☒	EPML00865013	EA Page 15-17
EA Table E1 Watercourse	RA2	RM0, RM1, RM3, RM6, RM9, RM12, RM15	☒	☒	EPML00865013	EA Page 15-17
Each land outcome document must be submitted with this approved form						
☒ All land outcome documents identified above have been attached to this approved form.						
Is the land outcome in the PRCP considered the same or substantially similar to the land outcome provided in the LOD ?						
☒ Yes ☐ No						
If no, please identify the land outcome:						
As per section 755B of the EP Act, the notification stage under chapter 5, part 4 applies for the assessment process because the outcome for land under a land outcome document is different to the outcome for the land under the proposed PRCP schedule.						

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Section 9 – Declaration*

Note: If you have not told the truth in this application you may be prosecuted.

I declare that:

- I am the holder of the environmental authority, or authorised signatory for the holder of the environmental authority.
- The information I have provided is true and correct to the best of my knowledge.
- I understand that it is an offence under section 480 of the *Environmental Protection Act 1994* to give to the administering authority or an authorised person a document containing information that I know, or ought reasonably to know, is false or misleading in a material particular.
- I understand that under section 480A of the *Environmental Protection Act 1994* that, if I am required to give a document to the administering authority or an authorised person, it is an offence to give a document that I know or ought reasonably to know, contains incomplete information in a material particular.
- I understand that failure to provide sufficient information may result in the application being refused. I understand that an incomplete application may be invalid. Invalid applications will be returned without processing and will only be processed if resubmitted with all invalidating issues addressed.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.
- I will comply with all conditions and milestones of my approved PRCP schedule as well as any relevant provisions in the *Environmental Protection Act 1994*.
- I understand that I am responsible for managing the environmental impacts of these activities, and that approval of this application is not an endorsement by the administering authority of the effectiveness of management practices proposed or implemented.

Where an agreement is in place between all holders of the environmental authority, one holder can sign on behalf of the other joint holders. Please tick the checkbox below.

☒ I HAVE AUTHORITY TO SIGN THIS FORM ON BEHALF OF ALL THE JOINT HOLDERS OF THE ENVIRONMENTAL AUTHORITY.

Applicant's signature

APPLICANT'S NAME BHP Mitsubishi Alliance (BMA)	POSITION -	COMPANY / ORGANISATION BMA
APPLICANT'S SIGNATURE Digitally signed by Nielsen, Dane DN: cn=Nielsen, Dane, o=BHP Billiton Group Operations Pty Ltd, ou=MULTI-ALLOWED Date: 2024.09.23 08:56:51 +10'00'	DATE Select.	

Joint holder(s) signature if applicable

NAME, POSITION AND COMPANY NAME Insert.	SIGNATURE	DATE Select.
NAME, POSITION AND COMPANY NAME Insert.	SIGNATURE	DATE Select.

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OR ☐ I HAVE ATTACHED A DOCUMENT THAT PROVIDES THE REQUIRED INFORMATION FOR ALL JOINT HOLDERS.

Where the environmental authority holder is a company, this form must be signed by an authorised person for that company. Where there is more than one holder of the environmental authority, this declaration is to be signed by all holders, unless there is an agreement between all holders that one can sign on behalf of the other(s).

If you are signing on behalf of the environmental authority holder(s) you must provide a letter of authorisation.

Section 10 - Submission

Please submit your completed application form and supporting material to the Department of Environment, Science and Innovation office that services the industry applicable to your environmental authority.

A list of business centres can be found at www.des.qld.gov.au using the words 'business centres' as a search term.

Enquiries: Minerals Business Centre
PO Box 7230
Cairns QLD 4870
Phone: 07 4222 5352
Fax: 07 4222 5070
Email: ESCairns@des.qld.gov.au

Coal Business Centre
PO Box 3028
Emerald QLD 4720
Phone: 07 4987 9320
Email: CRMining@des.qld.gov.au

The latest version of this publication and other publications referenced in this document can be found at www.qld.gov.au using the relevant publication number (ESR/2019/4957 for this form) or title as a search term.

Appendix 1–PRC plan structure

Appendix 1 describes the formatting/structural requirements for a completed PRC plan. This includes the information required in a PRC plan cover page and table of contents, and the structure of a PRC plan.

A PRC plan must include the following sections in the order listed:

1. **Cover page:** This section must include the following information:
 - Title of the project
 - Document title
 - Version number
 - Document ID number
 - Date of submission
 - Tenure number(s)
 - Environmental authority holder name
 - Environmental authority holder contact details.
2. **Table of contents:** This section must include the following information:
 - Sections of PRC plan
 - Sub-sections of PRC plan
 - Figures, tables and maps (as applicable).
3. **Rehabilitation planning part**
 - 3.1. **Project planning:** This section will include baseline information, site location details, a description of the project and information on rehabilitation/improvement planning.
 - 3.2. **Community consultation:** This section will include information on stakeholder consultation including a community consultation register and community consultation plan. The community consultation register must include consultation dates, identification of each community member, description of consultation type (workshop, quarterly meetings, etc.), information provided to the community, issues raised/discussed by the community, how issues have been considered, decisions/outcomes of engagement, and commitments made by the applicant. The community consultation plan must include the objectives for community consultation, how the community will be engaged, proposed consultation frequency, what information will be released for community consultation, and how feedback/comments will be considered.
 - 3.3. **Post-mining land use:** This section will include the assessment of PMLU options, methodology for determining PMLU options, and details of each nominated PMLU. It must be consistent with the outcome of consultation with the community in developing the plan, and any strategies or plans for the land of a local government, the State or the Commonwealth.
 - 3.4. **Non-use management areas (if applicable):** This section will include the justification for the NUMA and details of each nominated NUMA. In providing justification for the NUMA, it must:
 - state the reasons the applicant considers the area cannot be rehabilitated to a stable condition
 - include copies of reports or other evidence relied on by the applicant for each proposed non-use management area
 - state the extent to which the proposed non-use management area is consistent with the outcome of consultation with the community in developing the plan, and
 - state the extent to which the non-use management area is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.
 - The detail of each nominated NUMA must include information demonstrating that the proposed footprint of each NUMA is as small as practicable, an assessment of the NUMA location options, a description of the proposed location of each NUMA and the environmental values of the

surrounding environment, and evidence showing how the proposed location will prevent or minimise environmental harm.

- 3.5. Rehabilitation management methodology:** This section will include information describing how the proposed rehabilitation and management methodology have been developed and will be implemented. For each proposed post-mining land use for land, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule. This should include details of the general rehabilitation practices, tailings storage facilities, voids, underground mining and built infrastructure. For each proposed NUMA, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP schedule for the area.
- 3.6. Risk assessment:** This section will include a risk assessment that identifies the risk of a stable condition for land not being achieved and a risk treatment plan outlining how the applicant will manage or minimise the risk. All proposed NUMAs should also have a completed risk assessment. If rehabilitation trials are planned, this is also where relevant details must be given.
- 3.7. Monitoring and maintenance:** This section will include a monitoring and maintenance program that identifies and describes the monitoring systems that will be undertaken to demonstrate a milestone and milestone criteria have been achieved. It must include timing of when each rehabilitation or management milestone is to be achieved and be accompanied by maps outlining the relevant land.
- 4. Appendices and attachments:** The completed PRCP schedule and any relevant required reports/plans are to be included in this section. The Progressive Rehabilitation and Closure Plan Schedule template (ESR/2019/5103) should be included.

Attachment 1—Spatial data requirements for PRC plan

Attachment 1 provides guidance on the required content of spatial information (shapefiles) for the submission of a PRC plan. This attachment should be read in conjunction with the department's guideline: Spatial Information Submission (ESR/2018/4337). To obtain a copy of the guideline, the spreadsheet containing the schema (in Table 2) and a shapefile template for PCR plans are available on the Queensland Government's website at www.qld.gov.au, using the search term "submission of spatial information". The following sections provide information about the required fields and attributes for datasets.

Required files—Table 1

The applicant must submit shapefiles detailing the following:

- the location and maximum extent of disturbance footprint for the mine life
- the PMLU and NUMAs for the area within the resource tenure(s)
- the rehabilitation and improvement areas within the resource tenure(s)
- any sensitive receptors
- extent of a floodplain
- existing rehabilitation (if the PRC plan is for an existing environmental authority).

A minimum of one (1) shapefile must be submitted for a PRC plan, detailing the above-listed information, as outlined within Table 1. Each file must be named in accordance with the requirements outlined within the department's guideline: Spatial Information Submission (ESR/2018/4337).

Where the PRC plan relates to a site where a NUMA or floodplain are not present, this should be stated in the spatial information submission email to which the relevant spatial files are attached.

Table 1: Shapefile checklist

File	Spatial information requirement	Schema	Example file name (e.g. using submission date of 30 June 2020)
1	PRC plan – polygon	Table 2	EPPR00372556_PRC_PY_30062020

Where:

- PRCP = PRC plan
- PY = polygon (geometry)

Table 2: Schema for PRC plan

Field Name	Type	Length	Definition	Domain Values ⁵	Domain Value Description	Mandatory/ Optional
PERMIT_REF	TEXT	50	The alpha-numeric environmental authority number relevant to the spatial information (if this PRC plan does not relate to an existing EA, please provide the relevant application number instead).			Mandatory
PROCESS	TEXT	4	The relevant process spatial data is being submitted for	PRCP	Progressive rehabilitation and closure plan	Mandatory
SITE_NAME	TEXT	254	Site name relating to the environmental authority.			Mandatory
SITE_ID	TEXT	20	This field contains a unique identifier for the spatial feature, which has been generated by the applicant.			Mandatory
FEATURE	TEXT	10	This field contains the land use feature on site which this polygon or point is describing. Select the relevant option of either post-mining land use, rehabilitation area, non-use management area, improvement area, maximum disturbance footprint, sensitive receptor, existing rehabilitation or floodplain using the codes specified.	PMLU	Post-mining land use	Mandatory
				REHAB_AREA	Rehabilitation area	Mandatory
				NUMA	Non-use management area	Mandatory if the PRC plan schedule proposes or changes a non-use management area
				IMPRV_AREA	Improvement area	Mandatory if the PRC plan schedule proposes or changes a non-use management area

⁵ If blank, populate based on Attribute type & definition

Application form
Submission of a progressive rehabilitation and closure plan

				FOOTPRINT	Maximum disturbance footprint over mine life	Mandatory
				SR	Sensitive receptor	Mandatory
				EX_REH	Existing rehabilitation	Mandatory if the application is for an existing EA and there is existing rehabilitation undertaken
				FLDP	Floodplain	Mandatory if there is a floodplain located within the EA boundary
FEAT_DESC	TEXT	254	Feature description		This field provides a description of the feature identified in 'FEATURE'.	Mandatory
PMLU_TYPE	TEXT	10	This field provides a description of the post mining land use type. If PMLU_TYPE is 'Other' additional information in the comments field is required.	GRAZ NAT_ECO WTR_ST REC HB_ECS AGRI FOR CROP PERM_INFRA IND LNDFL Oth	Grazing Native ecosystem Water storage Recreation Habitat and ecosystem services Agriculture Forestry Cropping Permanent infrastructure Industrial Landfill Other	Mandatory for each PMLU.
DATE_SUBMT	DATE	dd/mm/yyyy	Date of submission. This field identifies the date the spatial information was submitted.		Date of submission	Mandatory
SOURCE	TEXT	5	This field identifies the source of the spatial information and the capture	DIG	Digitising (Tracing over Ortho Imagery)	Mandatory

Application form

Submission of a progressive rehabilitation and closure plan

			methodology for the spatial information provided.	GPSD	GPS Differential Survey	
				GPSND	GPS Non Differential Survey	
				RTK	Real-Time Kinematic (RTK) Survey	
				UK	Unknown	
AREA_HA	DOUBLE	N/A	This field indicates the area in Hectares. (Polygon only)			Mandatory if GEOMETRY = polygon.
COMMENTS	TEXT	254	A free text field has been provided to include any additional information the proponent wishes to provide in relation to the data.			Mandatory if PMLU_TYPE = Oth



BHP Mitsubishi Alliance

Progressive Rehabilitation and Closure Plan

Saraji South Mine (Norwich Park Mine)

Status: DRAFT

Version: v1 (1 October 2024)

Business Owner: Saraji South Mine

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Tenure Number(s)

ML1782, ML70126, ML70127, ML70325,
ML70328, ML70350, ML70369, ML70370,
ML70410

EA holder name

BHP COAL PTY LTD
QCT Management Pty Limited
Mitsubishi Development Pty Ltd
Umal Consolidated Pty Ltd
QCT MINING PTY. LTD.
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Glossary of terms and abbreviations

Key terms and abbreviations, and associated definitions used in this report are listed below.

Term/Abbreviation	Description
3P grasses	Perennial, productive and palatable
ACARP	Australian Coal Research Association Research Program
Administering authority	Department of Environment, Science and Innovation (Queensland)
AD	Acid/acidic drainage
AEP	Annual exceedance probability
AHD	Australian height datum
AMD	Acid and metalliferous drainage
AQP	Appropriately qualified person
ASC	Australian Soil Classification
ATP	Authority to prospect
BBAC	Barada Barna Aboriginal Corporation
bcm	Bank cubic meter
BMA	BHP Mitsubishi Alliance
BOM	Bureau of Meteorology
CEC	Cation exchange capacity
CHPP	Coal handling processing plant
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAF	Department of Agriculture and Fisheries (Queensland)
DDG	Deputy Director-General
DEM	Digital elevation model
DES	Department of Environment and Science (Queensland)
DESI	Department of Environment, Science and Innovation (Queensland) (the administering authority) (previously referred to as the Department of Environment and Science)
DLGP	Department of Local Government and Planning (Queensland)
DNRME	Department of Natural Resources, Mines and Energy
DoR	Department of Resources (Queensland) (previously referred to as the Department of Natural Resources, Mines and Energy)

Term/Abbreviation	Description
DSITI	Department of Science, Information Technology and Innovation (Queensland)
DTMR	Department of Transport and Main Roads (Queensland)
EA	Environmental Authority (in terms of the <i>Environmental Protection Act 1994</i> , Queensland)
EC	Electrical conductivity
EIS	Environmental impact statement
EP Act	<i>Environmental Protection Act 1994</i> (Queensland)
EP Regulation	<i>Environmental Protection Regulation 2019</i> (Queensland)
ERA	Environmentally relevant activities
ERD	Effective rooting depth
ESA	Environmentally sensitive area
ESP	Exchangeable sodium percentage
FoS	Factor of safety
FRREMP	Fitzroy Basin regional receiving environment monitoring program
GDE	Groundwater dependent ecosystem
GMA	Groundwater management area
Ha	Hectares
HCL	Harrow Creek lower seam group
HCU	Harrow Creek upper seam group
HVR	High value regrowth
IA	Improvement area “...for a NUMA, means an area of land in the NUMA to which a management milestone for the NUMA relates”. (PRCP Guideline, 2023)
IDC	Index of diversion condition
Interburden	Mineral (mining) waste located between mined coal seams
IRC	Isaac Regional Council
LOD	Land outcomes document
LSA	Land suitability assessment
MERFP Act	<i>Mineral and Energy Resources (Financial Provisioning) Act 2018</i> (Queensland)
MIA	Mine industrial area

Term/Abbreviation	Description
Milestone criteria	<i>"...for a management milestone or a rehabilitation milestone, means a requirement that must be met to achieve the milestone". (PRCP Guideline, 2023)</i>
Mineral waste	Material comprising spoil, ± tailings, ± rejects, ± waste coal. Sometimes called 'mine waste' or 'mining waste'
ML	Mining lease
MM	Management milestone <i>"...for a NUMA, means each significant event or step necessary to achieve best practice management of the area and to minimise risks to the environment (section 112 of the EP Act)" (PRCP Guideline, 2023)</i>
NAF	Non-acid forming
NC Act	<i>Nature Conservation Act 1992 (Queensland)</i>
NMD	Neutral and metalliferous drainage
NPM	Norwich Park Mine (operationally referred to as Saraji South Mine (SSM))
NUMA	Non-use management area
OQMRC	Office of the Queensland Mine Rehabilitation Commissioner
OTD	Old Tailings Dam
Overburden	Mineral (mining) waste located above the top coal seams
PAF	Potentially acid forming
PMF	Probable maximum flood
PMLU	Post-mining land use <i>"...for land, means the purpose for which the land will be used after all environmentally relevant activities carried out on the land have ended (section 112 of the Environmental Protection Act 1994)" (PRCP Guideline, 2023)</i>
PMP	Probably maximum precipitation
PRCP	Progressive Rehabilitation and Closure Plan
PRCP Guideline	Progressive Rehabilitation and Closure Plan Guideline (April 2023)
QA/QC	Quality assurance and quality control
QR	Queensland Rail
RA	Rehabilitation area <i>"... for a post-mine land use, means an area of land in the post-mine land use to which rehabilitation milestone for the post-mining use relates" (PRCP Guideline, 2023)</i>
RCP	Representative concentration pathway

Term/Abbreviation	Description
RE	Regional ecosystems
Rejects	Waste material produced during coal processing
REMP	Receiving environment monitoring program
Residual void	An open pit resulting from the removal of ore and/or waste rock that will remain following the cessation of all mining activities and completion of rehabilitation processes
RM	Rehabilitation milestone <i>"...for the rehabilitated land, means each significant event or step necessary to rehabilitate the land to a stable condition (section 112 of the EP Act)" (PRCP Guideline, 2023)</i>
ROM	Run-of-mine
RRR	Residual risk rating (with reference to the risk assessment)
SCL	Strategic cropping land
SD	Saline drainage
Spoil	Rock material overlying and between 'target' coal seams, which is mined and placed in the spoil dumps (i.e. overburden and interburden)
SPR	Source-pathway-receptor
SQP	Suitably qualified person (for performing a regulatory function)
SRM	Saraji Mine
SSM	Saraji South Mine
STAC	Smart Transformation Advisory Council
TDS	Total dissolved solids
Transitional PRCP	<i>"...the holder of an existing EA for an ineligible mining activity relating to a mining lease that is transitioning into the new PRCP framework" (PRCP Guideline, 2023)</i>
TSF	Tailings storage facility
VM Act	<i>Vegetation Management Act 1999</i> Queensland
Waste coal	Sub-economical coal that reports to the spoil dumps as waste
WEPP	Water erosion prediction program

INTRODUCTION

Norwich Park Mine (NPM), operated by BHP Mitsubishi Alliance (BMA), is a metallurgical coal mine located in the Bowen Basin, Queensland. NPM is now operationally referred to as Saraji South Mine (SSM) and will be referred to as such in this document.

This transitional Progressive Rehabilitation and Closure Plan (PRCP) has been prepared for SSM in accordance with the requirements of the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act). This PRCP has been developed to meet the requirements of the *Environmental Protection Act 1994* (EP Act) and the *Progressive Rehabilitation and Closure Plan Guideline* (PRCP Guideline) (DES, 2023a).

Environmentally relevant activities (ERAs) at SSM include mining black coal, chemical storage, mineral processing and sewage treatment. These are undertaken under the conditions of the site Environmental Authority (EA) EPML00865013, provided in Appendix A.

Environmental Authority Holder:	BHP COAL PTY LTD, QCT Management Pty Limited, Mitsubishi Development Pty Ltd, Umal Consolidated Pty Ltd, QCT MINING PTY. LTD., QCT INVESTMENT PTY. LTD., BHP Queensland Coal Investments Pty Ltd
Environmental Authority Number:	EPML00865013 (29 June 2023)
Tenements:	ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410

This PRCP comprises two parts:

- Section A: Rehabilitation planning part - provides information about the site, details the rehabilitation methodologies and techniques, and includes evidence and justification to support the development of the proposed PRCP schedule; and
- Section B: PRCP schedule - includes maps of rehabilitation and closure outcomes for the site, and tables of time-based rehabilitation milestones.

This PRCP also includes Section C: Appendices, providing specialist studies and technical assessments used to support the development of the PRCP.

TRANSITIONAL PROVISIONS

Part 27, Chapter 13 of the EP Act sets out the transitional provisions following the commencement of the MERFP Act. In particular, BMA is a 'mining EA holder' for the purposes of the transitional provisions on the basis that, on commencement of the MERFP Act, BMA was "*the holder of an environmental authority (EPML00865013) for a mining activity relating to a mining lease authorising operations*" at SSM (section 750, EP Act).

Furthermore, Section 6 of the PRCP Guideline makes provision for "*existing EA holders who must transition into the new PRC Plan framework*". As SSM has an approved EA, the site falls under the ambit of the requirements of a transitional PRCP.

Based on the requirements of Section 6 of the PRCP Guideline, the following are applicable to this PRCP:

- In accordance with transitional provisions (section 750, EP Act), the SSM EA (EPML00865013) is an approved land outcome document (LOD).
- A Transition Notice for SSM was issued to BMA by the administering authority (Department of Environment, Science and Innovation (DESI), previously known as Department of Environment and Science (DES)), dated 27 May 2021 (Appendix B). This Transitional Notice required submission of the SSM PRCP by 1 October 2024.
- The Transitional Notice was issued following a pre-notification meeting held between the administering authority and BMA on 6 May 2021. This PRCP is based on the key aspects agreed on

by the administering authority during this meeting, as documented in the PRCP NPM Notification Memo, provided in Appendix C.

- Prior to the PRCP submission, a pre-lodgement meeting between the administering authority and BMA was held on 16 September 2024. This was arranged to discuss the key content of the site's draft plan, aimed at identifying any notable gaps or refinements needing to be addressed prior to the final submission.
- The SSM PRCP was submitted to the administering authority on 1 October 2024.

Similar conditions in relation to acceptance criteria for rehabilitation requirements were included consistently across EAs for all BMA sites in 2018. Per BMA's understanding of the legislative intent, it intended to transition the EA rehabilitation requirements and criteria into the PRCPs for all BMA sites. During the assessment of the Saraji Mine (SRM) PRCP (Notice of Decision received 4 September 2024):

- the administering authority:
 - adopted a position, that despite BMA's conditions being transitional under the legislation, that these criteria/requirements were insufficient to achieve rehabilitation and management outcomes
 - refused criteria proposed by BMA, instead imposing new and significantly revised criteria
 - acknowledged BMA's intention to develop site-specific criteria for SRM
- BMA:
 - agreed to the criteria as revised, except in respect of erosion management.
 - sort inclusion of PRCP Schedule conditions that facilitated the development of site-specific criteria.

Noting the above, BMA has therefore not attempted to transition the EA rehabilitation requirements and criteria within this SSM PRCP. Instead, the SRM PRCP schedule conditions and milestone criteria that are agreed and relevant to SSM, have been included in the SSM PRCP. Similarly, BMA has included and makes reference to, PRCP Schedule conditions, including those that facilitate the development of site-specific criteria for SSM.

As per the PRCP Guideline, the following process for transitioning rehabilitation and closure outcomes from the SSM EA into the site's PRCP schedule has been followed:

1. Identifying rehabilitation and closure outcomes in the LOD (EPML00865013)
2. Identifying post-mine land uses (PMLUs)
3. Identifying non-use management areas (NUMAs)
4. Defining rehabilitation areas (RAs) within the PMLU, or improvement areas (IAs) within the NUMA
5. Identifying milestones
6. Identifying milestone criteria
7. Identifying when the first rehabilitation milestone must commence and completion dates for the milestones

It is noted that under step 5 and step 6 there are milestones and milestone criteria within the LOD (the EA) that were identified. For reasons outlined above, despite being identified, some milestones and milestone criteria from the LOD have been replaced by those preferred and previously imposed by DESI.

KNOWLEDGE BASE REFINEMENT

Compilation of this PRCP has been supported by the rehabilitation and closure-related knowledge base for SSM at the time of submission of this PRCP (1 October 2024). Relevant studies contributing to this knowledge base have been referenced throughout this PRCP, with key resources provided in Part C: Appendices.

As highlighted by the International Council of Mining and Metals in the *Integrated Mine Closure: Good Practice Guide*, 2nd Edition (ICMM, 2019), "the collection, updating, use and review of the knowledge base is considered an ongoing and iterative process over the mine life, and will be used to inform iterative refinement and improvement of the rehabilitation and closure planning process over time". As the rehabilitation and closure knowledge base for SSM develops over the life of the operation, it will be used to inform ongoing refinement of the plans for rehabilitation and closure, as well as this PRCP as required.

A: REHABILITATION PLANNING

1 PROJECT PLANNING

Legislative Requirement

In accordance with Section 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part of the PRC Plan must include a description of:

- each resource tenure, including the area of each tenure
- the relevant activities to which the application relates
- the likely duration of the relevant activities
- how and where the relevant activities are to be carried out, including maps.

PRCP Guideline

- The following spatial information must be submitted as part of the PRC Plan:
- the location and maximum extent of disturbance footprint for the mine life
- the PMLUs and NUMAs for the area within the resource tenures
- any sensitive receptors.

In addition to the list above, the PRC Plan must include spatial information outlining the rehabilitation and improvement areas that correspond to the proposed PRCP Schedule. The spatial information must show the locations of the rehabilitation and improvement areas for a 10-year period (minimum).

All spatial information must be prepared and submitted in accordance with the guideline 'Spatial Information Submission' (ESR/2018/4337).

1.1 Project description

1.1.1 Geographic location

SSM is located 5km east of the town of Dysart and 86km northeast of Emerald, in Queensland's Bowen Basin (Figure 1). BMA's SRM is located directly to the north of SSM.

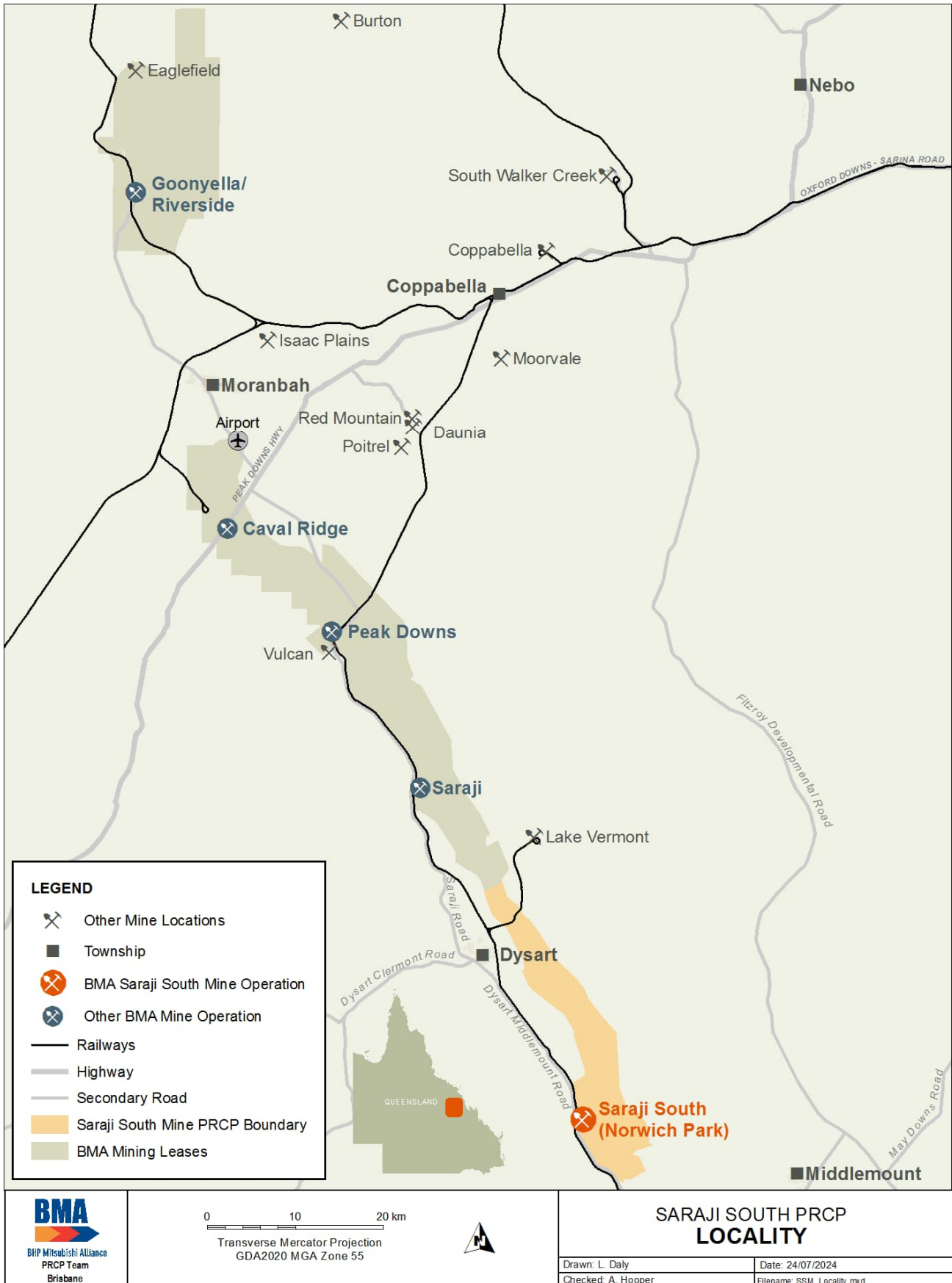


Figure 1: SSM location map

1.1.2 Mining tenements

SSM operates on the mining leases (MLs) listed in Table 1 and illustrated in Figure 2. The mining tenements associated with the SSM EA boundary cover 16,139 hectares (ha). The SSM PRCP boundary shown in Figure 2 aligns to the SSM EA boundary. The SSM EA includes the southern part of ML1782 and ML70328, with the northern parts of these MLS included within the SRM EA area.

Table 1: SSM mining tenements

Lease number	Name	Date granted
ML1782 (part)	Lotus Pit	22 December 1983
ML70126	Infrastructure associated with coal mining	22 April 2004
ML70127	Campbell Pit	10 April 1997
ML70325	Lotus pit	01 September 2006
ML70328 (part)	Tay-Glen	01 December 2006
ML70350	East-Pit	01 May 2009
ML70369	Lotus Pit Infrastructure	17 April 2008
ML70370	South Lotus Pit	01 January 2011
ML70410	Norwich Park Industrial Area South	01 December 2011

This PRCP covers mining activities within the State approved mining footprint, which does not include the nil surface areas within ML1782 to the east of Lotus/Campbell Pit, ML70126 to the north of the rail loop and the Lake Vermont rail line (Figure 2).

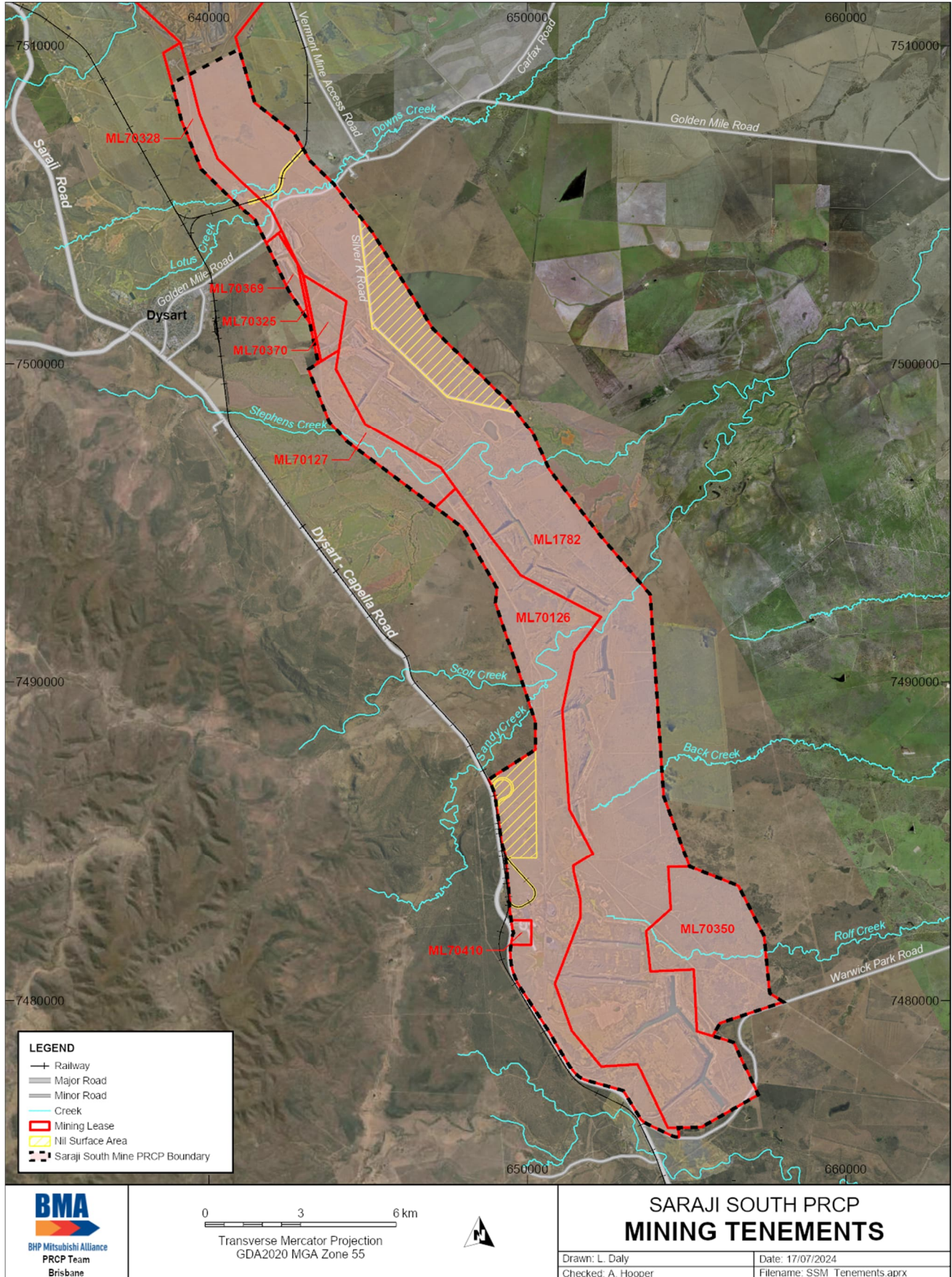


Figure 2: SSM mining tenements

1.1.3 Primary mine features and infrastructure on-site

The current primary mine features and infrastructure, including BMA and third-party owned, within SSM are summarised in Table 2. The current site layout is shown in Figure 3.

Table 2: Primary mine features and infrastructure at SSM

Mine domain	Description
Voids and spoil dumps	- Lotus/Campbell Pit - Gilbert Pit - Price/Leichhardt Pit - Roper Pit - East Pit (future pit)
Stockpiles	- Run-of-mine (ROM) coal stockpiles - Product coal stockpiles - Topsoil stockpiles - Rock stockpiles
Rejects dump	Ramp 67/68 (in-pit)
Tailings storage facilities (TSFs)	- Ramp 67 (in-pit) - Old tailings dam (OTD)
Dams	- Mine affected water dams - Raw water dams - Sediment dams
Creek diversions	- Stephens Creek - Downs Creek - Lotus Creek - Rolf Creek
Mine industrial area (MIA) and rail infrastructure	- Workshops and warehouse - Various buildings - Fuel, oil, chemical and water storage - Fuel and wash bays - Park up and laydown areas - Rail loop and spur - Train load-out bin and facilities - Conveyors and transfer stations - Reclaim tunnel
General infrastructure	- Various buildings - Sewage treatment plants

Mine domain	Description
	• Landfills • Pipes and pumps • Powerlines • Switchyard and substations • Communication and lighting towers • Fences
General disturbance	• Laydown areas • Access roads • Haul roads • Drains and culverts • Exploration
Regional infrastructure	• Golden Mile Road • Silver K Road • Warwick Park Road • Lake Vermont Railway Spur • Regional powerlines • Regional water pipelines

1.1.4 Type of mining operation

SSM is a conventional open cut, strip mine with mining progressing eastwards, down the coal dip. Mining activities at SSM involve the removal and stockpiling of topsoil, drilling and blasting of overburden and interburden, and mining of overburden, interburden and coal. The majority of the overburden and interburden is placed in spoil dumps within the void of the previous mined out strips.

Mining at SSM is currently undertaken with truck and shovel fleets. Prior to 2012, SSM was mined with both dragline and truck and shovel fleets, and draglines may be utilised again in the future.

Coal was processed at the SSM coal handling processing plant (CHPP) located within the mine industrial area prior to 2012. Coal is currently hauled from the pits to designated coal stockpiles on SSM, before being hauled to the SRM CHPP for processing. Product coal is transported by rail from SRM to the Hay Point Coal Terminal for export.

1.1.5 Proposed duration of the operation

Operations at SSM commenced in 1979. SSM was placed in care and maintenance in 2012 with mining recommencing in October 2022. SSM is planned to be mined until 2098 in the current life-of-mine plan, within the approved extent of the EA. Variations to the planned mining rates due to business or market conditions, changes to technology, or refined resource information may also change the proposed duration of the operation, and as a result, when necessary, a PRCP amendment would be submitted to the administering authority.

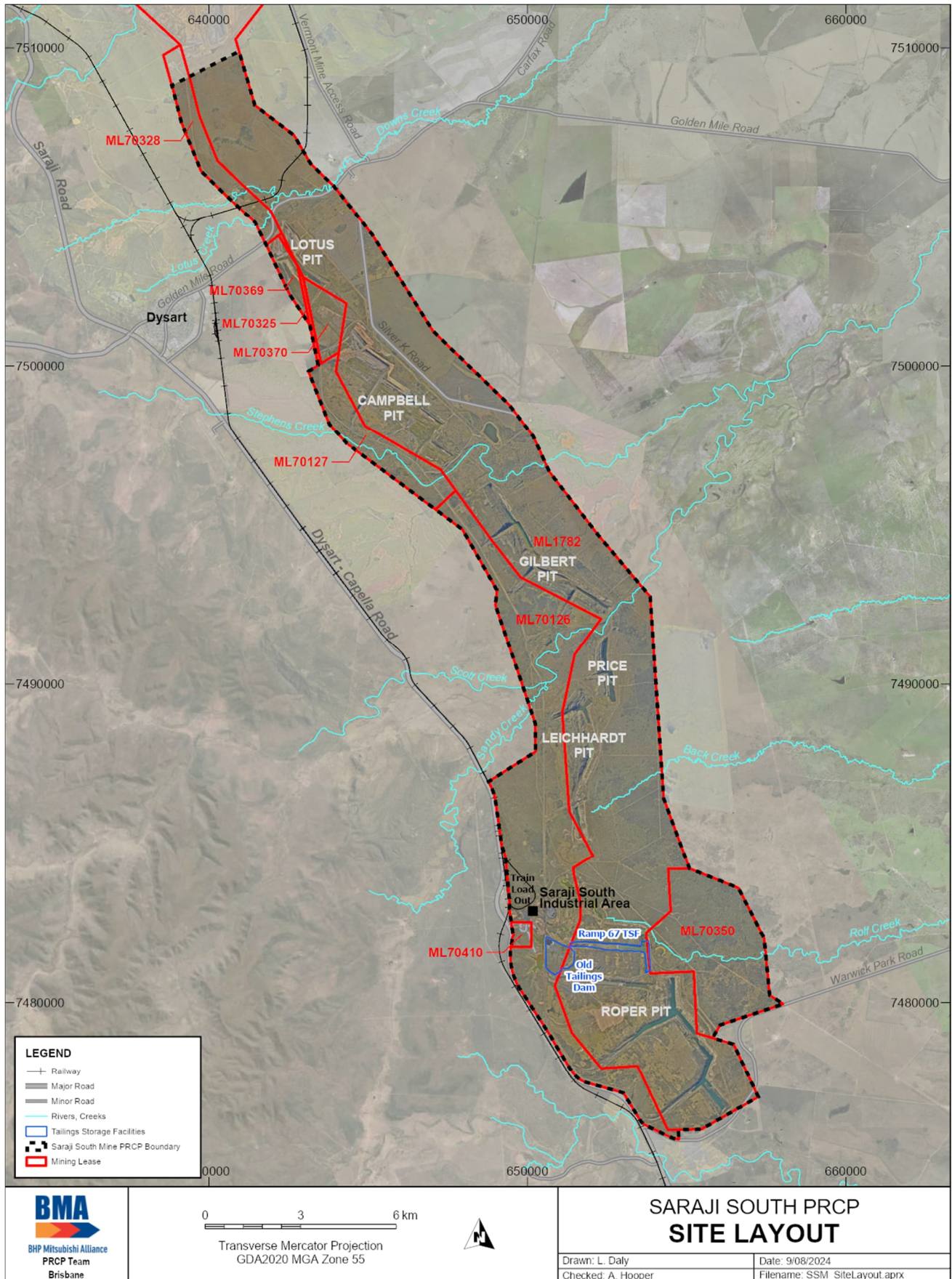


Figure 3: SSM current site layout

1.2 Baseline information

PRCP Guideline (Section 3.1)

In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)(j) of the EP Act) to decide whether to approve the PRCP Schedule:

- site topography (locally and regionally)
- climate (general and specific (rain, evaporation, temperatures)) including long-term projections
- geological setting
- site hydrology and fluvial networks
- groundwater levels and properties
- soil types, properties, and productivity
- land stability (pre-existing land degradation/erosion and predisposition to ongoing stability issues)
- vegetation communities and ecological data (including existing regional ecosystem mapping)
- fauna presence and populations
- pre-mining land use
- identification of underlying landholders

Transitional PRC Plans must include any baseline information collected as part of an EIS process or original EA application. If this information is unavailable, the reasons should be explained in this section of the rehabilitation planning part. Transitional PRC Plans are not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance. However, any expansion to an existing site must demonstrate how it has been designed for closure. The rehabilitation/improvement planning must include data from when mining first commenced up until planned surrender. The transitional provisions of the EP Act include an exceptional circumstance for when land is available for rehabilitation.

1.2.1 Site topography

The topography of the SSM area is relatively flat with gentle undulations, with an overall easterly gradient of less than 1% from the Harrow Range in the west to the Isaac River in the east.

The elevation across SSM ranges from approximately 180m Australian height datum (AHD) along the central eastern boundary to 220m AHD along the southern western boundary.

1.2.2 Climate

SSM is located in a semi-arid climatic zone, which is characterised by high summer temperatures, warm dry winters and a distinct wet and dry season.

Climate data is sourced from the Bureau of Meteorology (BOM) (BOM, 2023). The closest BOM weather stations for rainfall data are located at Dysart Post Office (Station No. 35278) and Dysart Station (Station No. 35092), approximately 3km to the west of the SSM area. The Dysart Post Office weather station operated between 1988 and 2006 and Dysart Station operated between 1956 and 2008. The nearest weather station with a longer data record for rainfall is Booroondarra (Station No. 35109) located at the southern extent of SSM. The Booroondarra weather station has been in operation since 1929. The closest BOM weather station for temperature is Moranbah Airport (Station No. 34035).

1.2.2.1 Temperature

Maximum average temperatures range from 24°C in June/July to 35°C in December/January, with minimum average temperatures ranging from 9°C in July to 21°C in January/February.

1.2.2.2 Rainfall

Rainfall occurs throughout the year, though it is more prevalent in the summer months (Table 3).

Table 3: Average monthly rainfall

Month	Dysart Post Office (Station No. 35278)	Dysart Station (Station No. 35092)	Booroondarra (Station No. 35109)
January	91.5	105.5	111.8
February	85.6	103.7	95.8
March	46.0	60.4	71.6
April	28.5	38.7	33.4
May	37.1	42.0	36.3
June	23.1	23.4	24.2
July	7.8	28.1	23.4
August	30.0	18.8	23.4
September	9.6	13.7	15.5
October	43.4	34.7	38.2
November	48.1	58.9	54.3
December	115.4	94.2	95.7
Annual	523.6	601.7	623.5

1.2.2.3 Evaporation

The actual evapotranspiration is highest in December at 130mm, and lowest in June at 35mm.

1.2.2.4 Wind

Wind records for Moranbah for January-April show an easterly predominance of moderate strength (1 - 20km/h), with easterlies dominating in May-July with some south-easterly influence. Easterly winds predominate for August-December which tends north to north-easterly from October to December.

1.2.2.5 Long-term climate projections

To account for potential future climate uncertainties within hydrologic designs and mine water planning, this PRCP and supporting technical studies have utilised the *BMA Climate Change Adaptation in Mine Water Planning and Hydrologic Assessments Guideline* (BMA, 2023). This guideline was developed specifically for the locations of the BMA assets to provide a consistent approach to the adoption of future climate variables. The approach and baseline data, on which the guideline was based, has been derived from Commonwealth Scientific and Industrial Research Organisation (CSIRO), BOM, DESI and other published sources and is aligned with the published projection database and methods including Consistent Climate Scenarios Projection Data and High-Resolution Projection Data.

1.2.3 Geological setting

SSM is located on the western limb of the northern Bowen Basin, and is characterised by a relatively thin accumulation of sediments, gentle easterly dips and minor to moderate deformation. The lithology at SSM is characterised by typical basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone, carbonaceous sediments and coal seams. Igneous intrusions are present as dykes and sills throughout the site.

The depth to base of weathering ranges from about 15 to 25m below natural surface in the northern half of the site (north of Leichhardt Pit) to about 25 to 50m below natural surface in the southern half of the site (Leichhardt Pit and further south). The Queensland regional detailed surface mapping (DNRME, 2018) indicates that significant areas of Quaternary alluvium are present across the surface of SSM. However, site investigations have noted that surface cover is Tertiary aged colluvium and regolith, therefore the actual distribution of Quaternary alluvium in the SSM area is more restricted than is mapped in the public surface geology. See Section 1.2.5.2 for further information on Quaternary and Tertiary sediments.

The coal bearing sequences at SSM are the late Permian-age German Creek Formation and contemporaneous equivalent Moranbah Coal Measures, with the facies change between the German Creek Formation and Moranbah Coal Measures located approximately at Lotus/Campbell Pit area. As such, most of SSM is within the German Creek Formation. The site comprises the following seam groups in stratigraphic order, from youngest to oldest:

- P seam group (minor upper seams; mostly in the weathered zone; potentially only encountered in late-stage mining below base of weathering in Gilbert, Price and Leichhardt pits)
- Harrow Creek Upper (HCU) seam group
- Harrow Creek Lower (HCL) seam group
- Dysart seam group, comprising Dysart Upper and Dysart Lower seams

Seam splitting is prevalent along the length (north-south) of all pits.

Overlying the German Creek Formation/Moranbah Coal Measures at SSM is the late Permian-age Macmillan Formation – a transgressive marine unit within the weathered zone at SSM and comprised of fine-grained weathered mudstone/siltstone sediments. The late Permian-age Fort Cooper Coal Measures also overly the Moranbah Coal Measures and sub-crop east of SSM, therefore they are not present at SSM.

To date, all of the coal mined at SSM has been from the HCL and Dysart seam groups. As mining progresses eastwards (down-dip) the HCU seam group will become more prevalent. The P seam group is currently well within the weathered zone and may only be mined from fresh rock towards the latter years of mining.

Geological cross-sections (indicatively west-east) through the pits (including current topography) are provided in Figure 4, Figure 5 and Figure 6. The seam groups are shown in the geological sections. The proposed East pits are directly down dip of Roper Pit and will be mining the same overburden and coal seams as Roper Pit, down to the base of the HCU.

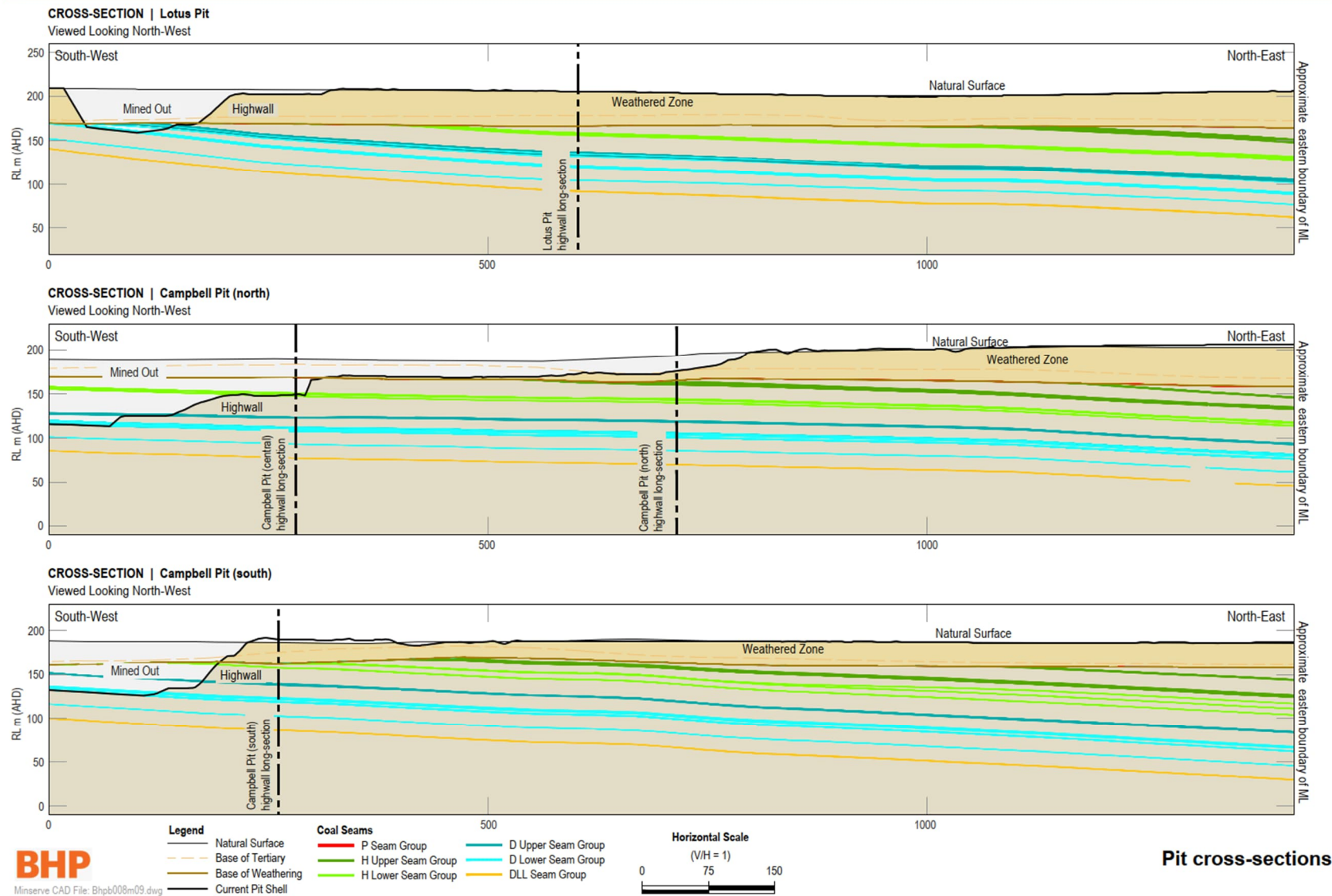


Figure 4: Geological cross-sections – Campbell Pit

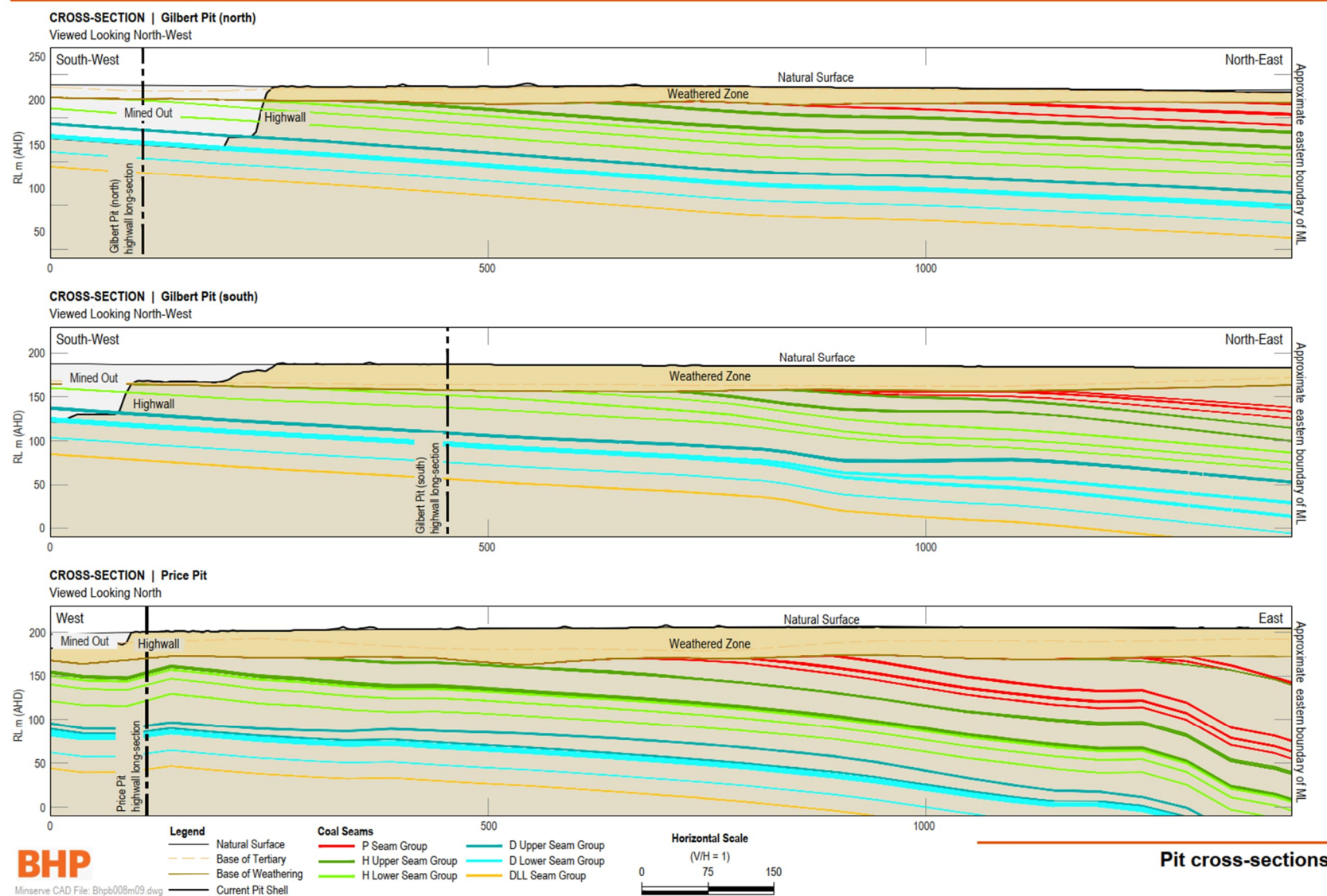


Figure 5: Geological cross-sections – Gilbert and Price Pits

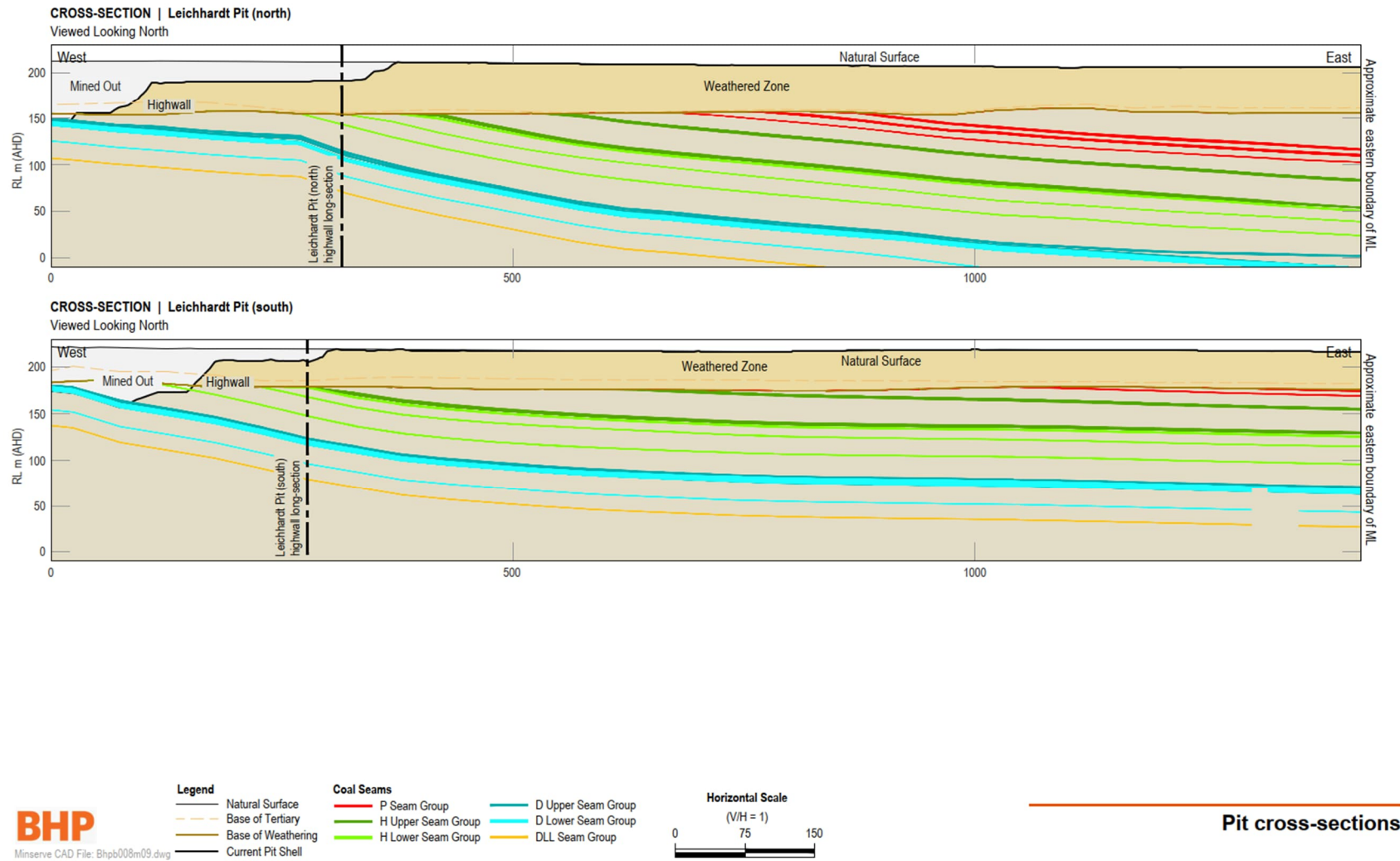


Figure 6: Geological cross-sections – Leichhardt Pit

1.2.4 Site hydrology and fluvial networks

The SSM site is located within the Fitzroy Basin and across both the Isaac River and Mackenzie River Sub-basins.

The majority of SSM is located within the Isaac River Sub-basin. Within the Isaac River Sub-basin, the site spans across both the Upper and Lower Isaac Catchments and the Isaac Western Upland Tributaries Sub-catchment. This portion of the site generally drains to the east towards the Isaac River, which is located approximately 50km from the eastern EA boundary.

The southern most portion of SSM, consisting of the southern end of the Roper Pit, is located within the Mackenzie Sub-basin and within the Mackenzie Northern Western Tributaries Sub-catchment of the Mackenzie Catchment. This area generally drains to the southeast towards the Mackenzie River located approximately 55km from the southern EA boundary.

The catchments in which SSM are located are covered under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* and Department of Environment and Heritage Protection (2011):

- Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including water of the Isaac River Sub-basin (including Connors River); and
- Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin.

The prescribed environmental values of the sub-catchments are summarised in Table 4.

Table 4: Surface water environmental values

Sub-catchment	Aquatic ecosystems	Irrigation	Farm supply/ use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary Recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual value
Isaac Western Upland Tributaries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mackenzie north-western tributaries - developed areas	✓	-	-	✓	-	✓	✓	✓	✓	✓	✓	✓

All watercourses and tributaries within and in the vicinity of SSM are ephemeral and only flow briefly after rainfall that is significant enough to generate surface runoff. After ephemeral flows within the watercourses, water remains temporarily in shallow non-flowing pools. Watercourses at SSM have their headwaters in the Denham Range located to the west of the site. The watercourses that intersect SSM are summarised in Table 5 and are shown in Figure 7.

Table 5: Watercourses and key drainage lines within and immediately surrounding SSM

Watercourse	Perennially	Hierarchy	Strahler stream order*	Comment
Downs Creek	Intermittent	Minor	2 - 3	Runs west to east on the northern side of the Golden Mile Road. A diversion is present immediately downstream of the confluence with Lotus Creek on ML1782.

Watercourse	Perennially	Hierarchy	Strahler stream order*	Comment
Lotus Creek	Intermittent	Minor	1 - 2	Tributary of Downs Creek with the confluence on ML1782. A diversion is present immediately prior to the confluence with Downs Creek diverting the flows to the north of the Golden Mile Road.
Stephens Creek and tributaries	Intermittent	Major	5	Drains from west to east across the site with the confluence with Blackburn Creek approximately 24km to the northeast. A diversion is present that directs flows to the south of Campbell Pit.
Scott Creek and tributaries	Intermittent	Minor	5	Drains from west to the northeast between Gilbert Pit and Price Pit following the natural watercourse. Some minor diversion works present around the confluence with Sandy Creek, associated with the haul road on the western side of the site. Confluence with Stephens Creek is located approximately 7km to the northeast.
Sandy Creek and tributaries	Intermittent	Minor	3	Drains in a north easterly direction with the confluence with Scott Creek located on the western portion of the site. The catchment area is primarily located off site to the west of the MIA and rail loop.
Rolf Creek	Intermittent	Minor	1 - 2	The upper part of the catchment includes the MIA with the diverted drainage line running to the east on the northern side of Roper Pit. The confluence with the Isaac River is approximately 53km to the east of the site.
Roper Creek	Non-perennial	Major	4	Roper Creek runs to the south of SSM (outside of EA) in a west to east direction. The confluence of Roper Creek with the Mackenzie River is located approximately 55km to the southeast of the site.

* Within the area of the SSM EA area only

The voids at SSM are utilised as water storages within the BMA central complex (Caval Ridge Mine, Peak Downs Mine, SRM and SSM) water management network. The voids provide water storage capacity for runoff from mine affected areas during periods of above average precipitation and provide water to sustain operations during prolonged periods of drought.

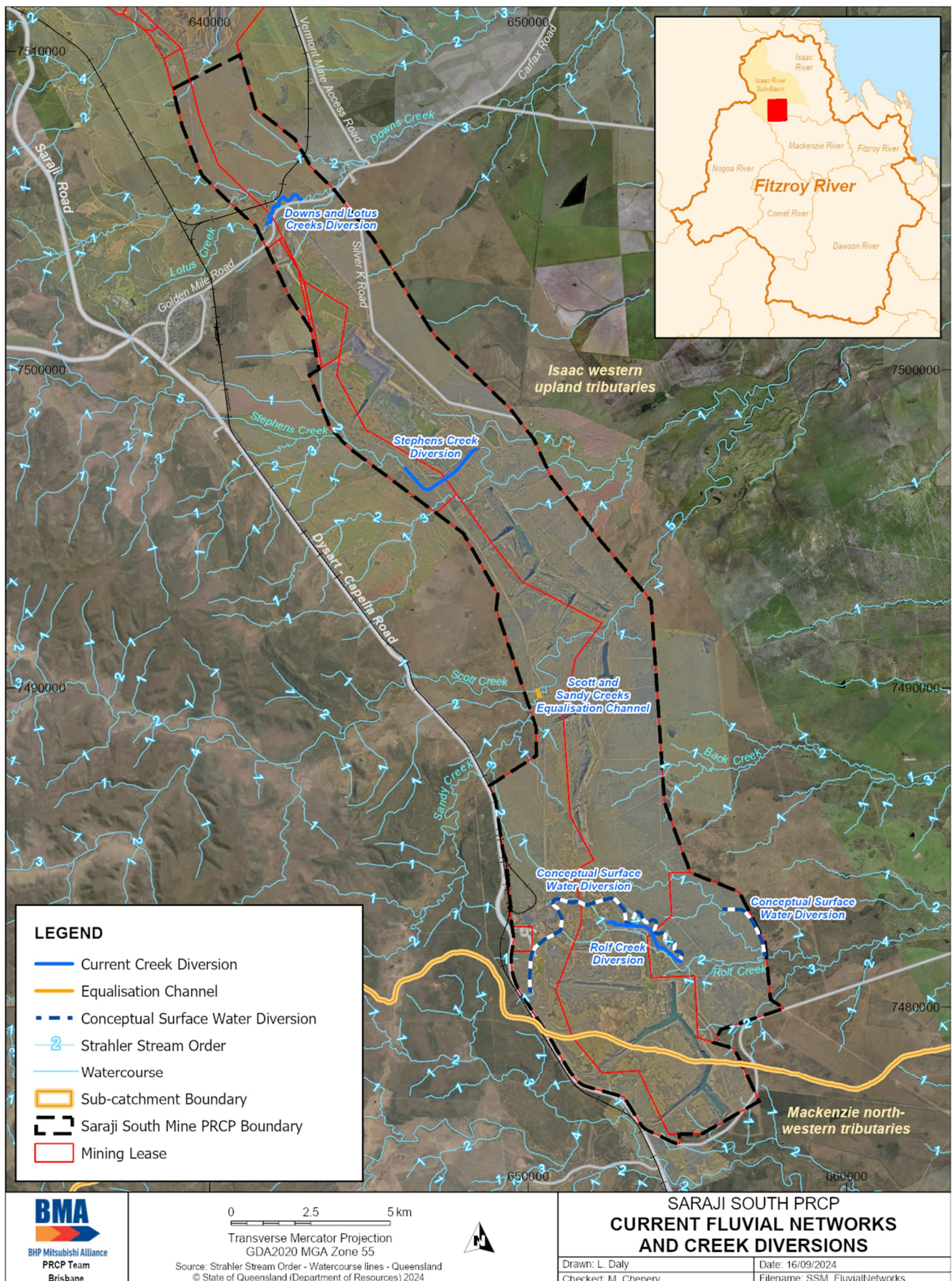


Figure 7: SSM Fluvial network and diversions

As part of the SSM mining operations, BMA currently holds water licences permitting:

- Diversion of watercourses
- Interfering with the flow of water by impounding

Water licences applicable to SSM are summarised in Table 6.

Table 6: Water licences applicable to SSM

Authorisation number	Authorisation activity	Authorised purpose	Approval date (most recent update)	Expiry date
402409	Licence to interfere by diversion – Channel: Downs Creek/Lotus Creek	Divert the course of flow	23/12/2014	30/06/2111
0426519F	Licence to interfere by diversion – Channel: Stephens Creek	Divert the course of flow	5/2/2015	30/06/2111
34744F	Licence to interfere by diversion – Channel: Rolf Creek	Divert the course of flow	16/12/2014	30/06/2111
52620F	Licence to interfere by impounding – Embankment or Wall: Rolf Creek	Impound Water	17/6/2010	30/06/2111
46304F	Licence to interfere by diversion: Scott Creek and Sandy Creek	Divert the course of flow	23/12/2014	30/06/2111

In accordance with Section 334ZP of the *Mineral Resources Act 1989* and Section 1283 of the *Water Act 2000*, a water licence for the taking of, or interfering with, underground water is considered granted where the taking of underground water, required for the safe extraction of the resource or due to evaporative losses on an approved mining project, began prior to commencement of the *Water Act 2000*. As SSM commenced operations in 1979, a water licence (in addition to those listed in the above table) is considered to be granted for the taking and interfering of underground water on the respective mining leases which pre-date the commencement of the provision.

1.2.4.1 Fluvial Water Quality

Surface water quality within the fluvial network that intersects SSM was previously assessed through the Receiving Environment Monitoring Program (REMP) and currently through the Fitzroy Basin Regional Receiving Environment Monitoring Program (FRREMP). These monitoring programs have been undertaken in accordance with the conditions of the EA and other approvals. This water quality monitoring program has been established with appropriate data quality objectives for routine monitoring to assess potential operational influences on water quality. The monitoring program has not been designed and undertaken for the establishment of surface water quality limits that are suitable for the post-mining environment. Post-mining water quality limits should be site-specific and developed in-line with relevant Australian guidance for temporal waters.

Background surface water quality has been assessed through sample points within Stephens, Scott and Sandy creeks, located upstream and to the west of SSM operations. The interpretation of upstream water quality has utilised suitable monitoring data collected during periods of flow from the commencement of the REMF in 2010. Upstream results reflective of background surface water quality at SSM, reproduced from the REMF report (Gauge, 2023), are summarised in Table 7.

Table 7: Summary of upstream water quality results (2015 to 2021)

Analyte	Unit	Combined Upstream Statistics				
		80 th percentile	80 th percentile plus one standard deviation	Mean	20 th percentile	20 th percentile less one standard deviation
Electrical conductivity (EC)	µS/cm	308	319	279	127	116
Turbidity	NTU	3,394	3,660	2,108	25	-241
Dissolved oxygen (DO)	%	90.44	95.47	82.93	53.07	48.05
Temperature	°C	28.25	28.88	27.83	24.25	23.62
TSS	mg/L	890.80	984.56	603.47	28.88	-64.88
Hardness	mg/L	67.84	72.73	65.07	36.96	32.07
SO ₄	mg/L	13.20	13.57	11.73	4.20	3.83
Fluoride	µg/L	168.00	173.17	140.00	50.00	44.83
Ammonia	µg/L	78.40	86.48	64.67	17.00	8.92
Nitrate	µg/L	293.84	314.20	210.53	8.60	-11.76
Total nitrogen (TN)	µg/L	5,356	5,762	3,840	1,132	726
Total phosphorus (TP)	µg/L	2,356	2,563	1,672	324	117
C6 - C9	µg/L	10	10	10	10	10
C10 - C36	µg/L	25	28	25	25	22
Al (dissolved)	µg/L	590.80	642.18	507.33	20.80	-30.58
As (dissolved)	µg/L	2.6	2.7	2.0	0.5	0.4
B (dissolved)	µg/L	58.40	63.98	47.00	25.00	19.42
Cd (dissolved)	µg/L	0.05	0.06	0.05	0.05	0.04
Cr (dissolved)	µg/L	0.50	0.57	0.50	0.50	0.43
Co (dissolved)	µg/L	0.50	0.53	0.50	0.50	0.47
Cu (dissolved)	µg/L	2.60	2.82	2.20	0.50	0.28
Fe (dissolved)	µg/L	816	851	648	79	43

Analyte	Unit	Combined Upstream Statistics				
		80 th percentile	80 th percentile plus one standard deviation	Mean	20 th percentile	20 th percentile less one standard deviation
Pb (dissolved)	µg/L	0.50	0.53	0.50	0.50	0.47
Mn (dissolved)	µg/L	3.48	4.96	3.27	0.60	-0.88
Hg (dissolved)	µg/L	0.05	0.05	0.05	0.05	0.05
Mo (dissolved)	µg/L	0.50	0.51	0.50	0.50	0.49
Ni (dissolved)	µg/L	4.68	4.83	4.07	2.00	1.85
Se (dissolved)	µg/L	5.00	5.00	5.00	5.00	5.00
Ag (dissolved)	µg/L	3.20	3.37	2.00	0.50	0.33
U (dissolved)	µg/L	0.50	0.50	0.50	0.50	0.50
V (dissolved)	µg/L	14.00	14.58	10.00	5.00	4.42
Zn (dissolved)	µg/L	5.76	7.09	4.63	2.50	1.17
Al (total)	µg/L	27,048	30,235	19,194	1,408	-1,779
As (total)	µg/L	5.56	5.79	4.20	1.10	0.87
B (total)	µg/L	50.00	52.40	46.67	25.00	22.60
Cd (total)	µg/L	0.05	0.06	0.05	0.05	0.04
Cr (total)	µg/L	80.32	86.16	51.53	2.56	-3.28
Co (total)	µg/L	19.04	22.96	13.47	1.16	-2.76
Cu (total)	µg/L	25.92	29.19	17.73	2.00	-1.27
Fe (total)	µg/L	39,028	43,038	26,814	2,440	-1,570
Pb (total)	µg/L	11.80	13.01	9.80	0.82	-0.39
Mn (total)	µg/L	515.80	604.61	364.07	46.28	-42.53
Hg (total)	µg/L	0.05	0.05	0.05	0.05	0.05
Mo (total)	µg/L	0.50	0.68	0.50	0.50	0.32
Ni (total)	µg/L	83.12	93.35	54.67	4.56	-5.67
Se (total)	µg/L	5.00	5.00	5.00	5.00	5.00
Ag (total)	µg/L	0.50	0.54	0.50	0.50	0.46

Analyte	Unit	Combined Upstream Statistics				
		80 th percentile	80 th percentile plus one standard deviation	Mean	20 th percentile	20 th percentile less one standard deviation
U (total)	µg/L	0.68	0.72	0.60	0.50	0.46
V (total)	µg/L	62.40	66.32	41.33	5.00	1.08
Zn (total)	µg/L	68.96	75.67	49.60	4.88	-1.83

Field monitoring of upstream sample locations during flow events, undertaken as part of the REMP, has also identified pH in surface water ranging between 6.89 – 8.29.

The background surface water quality results are reflective of the upstream catchment and land uses to the north-west of SSM, which primarily consist of cattle grazing and agricultural land uses. Due to the temporal nature of the creeks and the different land uses, there is reasonable variability between the monitoring points. Analytical results from the upstream sample locations have identified concentrations of various contaminants such as dissolved metals, pH, turbidity, ammonia, nitrogen and phosphorous outside of the default guideline values for selected prescribed environmental values. The variability in the background surface water quality and the presence of concentrations that exceed the default guideline values within up-stream sample locations warrants the development of site-specific criteria to evaluate if the final landform achieves a stable condition.

1.2.5 Hydrogeology

A hydrogeological assessment, including conceptual and numerical modelling, has been undertaken to support the development of this PRCP. The detailed report – *Saraji South Mine Transitional PRC Plan Hydrogeology Assessment* (SLR, 2024b), is provided in Appendix D.

SSM is located within the Isaac Connors and Highlands groundwater management areas (GMAs) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. Within the GMAs, alluvial groundwater is managed as Groundwater Unit 1 and water within the hard rock aquifers as Groundwater Unit 2 (sub-artesian aquifers). Volumetric limits apply to extraction of groundwater within the GMAs. The objectives for groundwaters within the GMA – Zone 34 management area of the Water Plan (Fitzroy Basin) 2011 are for sustainable management to maintain ecological values and enable maintenance and ongoing use of the resources through water allocations and licensing.

1.2.5.1 Groundwater environmental values

SSM is predominantly located within the Isaac Groundwaters environmental values area with only the southern portion crossing into the Mackenzie Groundwaters environmental values area. The Isaac Groundwaters are located within the groundwater chemistry zone of 'sodic sequence', which is saline, Na and Cl⁻ dominated while the Mackenzie Groundwater are located in the chemistry zone 'alluvial sequence' with low-moderate salinity: balanced cations, HCO₃/Cl (DEHP, 2011).

Groundwater resources in the SSM area are also scheduled under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*. The site predominantly falls within the Isaac Groundwaters of the Isaac River Sub-basin with only the southern end of the site located in the Mackenzie Groundwaters of the Mackenzie River Sub-basin. Both the Isaac River Sub-basin and the Mackenzie River Sub-basin fall within the Fitzroy Basin water plan (WQ1310). Table 8 summarises the groundwater environmental values.

Table 8: SSM groundwater environmental values

Groundwater zone	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual value
Isaac Groundwaters	✓	✓	✓	✓	-	-	✓	-	-	✓	-	✓
Mackenzie Groundwaters	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓

1.2.5.2 Hydrogeological units

The groundwater at SSM comprises the following key hydrogeological units:

- Cainozoic sediments:
 - Quaternary alluvium – unconfined aquifer (sporadically water-bearing strata of permeable unconsolidated sand or gravel) localised to watercourses of Downs, Scott and Rolf creeks and in the Isaac River Alluvium to the east
 - Quaternary to Tertiary non-alluvial sediments and weathered units overlying the Permian lithology – unconfined unit with limited saturation
- Permian coal measures – (Moranbah, Fort Cooper and Rangal Coal Measures)
 - Low permeability interburden and overburden units with aquitard properties
 - Coal seams that exhibit water bearing properties associated with primary matrix porosity and dominant secondary porosity through cracks and fissures.

The coal seams within the Moranbah Coal Measures (including the German Creek formation) are the primary aquifer at SSM. The coal seams can be characterised as semi-confined aquifers, with the P Seam, H Seam and D Seam forming the main aquifer units locally. The Moranbah Coal Measures overburden and interburden act as aquitards and are typically dry, or very low yielding.

Quaternary alluvium

The Queensland regional detailed surface mapping (DNRME, 2018) indicates that significant areas of Quaternary alluvium are present across the surface of SSM. However, site investigations have repeatedly noted that surface cover is Tertiary aged colluvium and regolith, with alluvial material limited to within the watercourse channels where they have eroded into the Tertiary profile. Therefore, the actual distribution of Quaternary alluvium in the SSM area is more restricted than is mapped in the public surface geology. BMA drilling investigations at SSM from 2014 to 2021 failed to identify saturated lenses of alluvial material suitable for installation of monitoring bores. The two monitoring bores screened within alluvial material that have been present at SSM were located adjacent to Stephens Creek. Monitoring of the alluvium indicated the presence of groundwater between 2004 and 2009 with subsequent monitoring finding the bores were dry.

Recharge to the alluvium is considered to be mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow subsurface. Groundwater within the alluvium within SSM is considered to be temporal in nature and only present for relatively short periods after significant rainfall events.

Quaternary to Tertiary non-alluvial sediments and weathered units

Across the SSM site, the Tertiary sediments and weathered strata are generally considered to form the water table aquifer, with saturation displayed in coarse lenses of clayey sand and weathered material between 20 - 35m below ground level. At SSM the Quaternary to Tertiary sediments and weathered strata are shown in the Queensland regional detailed surface mapping (DNRME, 2018) as consisting of the following:

- Tertiary-Quaternary alluvium distributed across SSM and the surrounding area. Tertiary-Quaternary alluvium is defined as a poorly consolidated or unconsolidated alluvial deposit in an ancestral valley, which has been dissected by more recent channel activity. The thickness of these sediments varies across the site, unconformably sitting on the erosional surface that forms the top of the underlying Permian sequence.
- Duaringa Formation covers a significant proportion of SSM, with the Lotus, Price, Leichhardt, Roper, and East pits located within this unit. Duaringa Formation is defined as mudstone, sandstone conglomerate, siltstone, oil shale, lignite and basalt.
- Colluvium and residual deposits (regolith) comprises unconsolidated undifferentiated sediments, derived from weathering of the underlying Permian strata.

Based on various BMA site investigations, the SSM area is predominantly underlain by interbedded sequences of sandstone and siltstone, dominated by highly weathered medium to coarse, low strength sandstone and moderate strength, medium to fine grained sandstone. These Quaternary to Tertiary non-alluvial sediments and weathered units are generally 6m to 20m thick, with the depth of weathering extending into the underlying Permian coal measures.

Tertiary monitoring bores at SSM are screened within Tertiary aged sand, clayey sand, sediments and basalt. Groundwater elevations within the tertiary bores are variable between locations and have varied during the monitoring period. Groundwater elevations within the Tertiary bores have been recorded between approximately 148mAHD and 211mAHD. The variability of groundwater heights within the Tertiary unit are influenced by the clay content and surrounding land uses with bores located in close proximity to the mine pits showing lower groundwater elevations compared to those areas utilised for water storage.

The relationship between Tertiary hosted groundwater elevations and weather patterns varies depending on the nature of the Tertiary material intersected. Selected Tertiary wells, particularly those screened in sand, have a high correlation with the Cumulative Rainfall Departure, while other bores have shown either subdued, delayed or no discernible response. Bores with a low correlation with the Cumulative Rainfall Departure are generally located in Tertiary and regolith material, which includes low hydraulic conductivity strata (i.e., clay and claystone) which restricts rainfall recharge. Recharge of the Tertiary aquifer is predominantly associated with losing ephemeral surface drainage conditions and some direct infiltration of precipitation and seepage from water storages.

Groundwater discharge from the Tertiary aquifers occurs primarily via evapotranspiration, with some baseflow to streams under wet climatic conditions and seepage to mining voids. Vertical seepage through the Tertiary sediments and regolith is limited by the underlying low hydraulic conductivity of the Permian overburden and other aquitards, such that the Tertiary sediments and regolith effectively form a perched groundwater system.

Permian coal measures

The coal seams of the Moranbah Coal Measures sub-crop throughout the western portions of SSM. Throughout the remainder of SSM, the coal seams underlie and sub-crop beneath the surficial cover. Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit both primary porosity and the more dominant secondary porosity through fractures and cleats. Pre-mining groundwater flow through the coal seams at SSM would have been to the east, consistent with the coal seam dip. Mining activities throughout the region have locally modified groundwater flows within the Permian coal measures with mine dewatering activities creating inward hydraulic gradients towards the extraction locations.

As mining at SSM began in the 1970's, there are no pre-mining groundwater records available for the site. The earliest available groundwater data is from bores that were established in approximately 2004. Therefore, pre-mining potentiometric surface maps for the coal measures cannot be generated due to the absence of data prior to mining.

Groundwater data for the Permian coal measures since 2004 indicates that groundwater elevations vary between approximately 151mAHD and 184.5mAHD. The variability in Permian groundwater elevations is associated with different coal seams, proximity to actively mined voids, in-pit water storages, and geological faults that have healed and act as a barrier to groundwater flows.

Recharge to the Permian coal seams, before mining, occurred where the seams were present at outcrop and sub-crop. Hydrograph analysis shows little to no reaction in water levels to significant rainfall events, suggesting that these units are insulated from direct recharge pathways. The Chloride Mass Balance method, indicates the recharge rate for the weathered Permian units is approximately 0.1mm/year. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along

the bedding plane of the coal seams themselves, resulting in confined conditions. Groundwater discharge occurs via inflow to, and evaporation from mine voids.

1.2.5.3 Groundwater quality

An assessment of groundwater quality for each of the hydrogeological units, based on the existing data held, was undertaken as part of the Hydrogeological Assessment. On-going monitoring of the groundwater undertaken throughout the operational life of the mine will continue to develop the SSM data set and enable future assessments of deep drainage from the rehabilitated closure landform. The following provides a summary of the currently known groundwater quality characteristics within each of the aquifers.

Interpretation of salinity levels provided below are based on the Food and Agriculture Organisation of the United Nations, Chapter 2 – Saline waters as resources (FAO, 2013).

Quaternary alluvium

Due to the absence of identified permanent saturated alluvial material at SSM, there is limited current data available on the quality of alluvial groundwaters.

Quaternary to Tertiary non-alluvial sediments and weathered units

Monitoring bores screened within the Tertiary material at SSM and to the east of the site have predominantly recorded Na-Mg-Cl type waters, with minor variances in HCO_3 and SO_4 ion proportions. The Tertiary groundwater signatures are indicative of natural salinisation of shallow groundwater through low recharge and long term evapo-concentration.

Tertiary sediment groundwater samples indicate a broad range of salinity with results identifying fresh to saline water quality. Monitoring results have recorded a salinity range between 377mg/L to 11,600mg/L, with a mean value of 4,808mg/L. One Tertiary bore screened in weathered basalt displays water quality in line with the broader Tertiary/Regolith aquifer, with three samples displaying a range between 4,384mg/L and 4,847mg/L.

Permian

Monitoring bores screened within the Permian consistently record mixed/intermediate type waters with moderate salinity. Within the Permian coal measures (interburden), monitoring bores recorded predominantly Na-Cl and Na-Mg water types. Bores that were shallower demonstrate relatively higher proportions of SO_4 ions, with deeper bores returning higher proportions of HCO_3 ions. This is likely due to interactions between groundwater and the weathered aquifer material in the shallow formations.

Water within the Moranbah Coal Measures is generally saline within the coal seams and moderately saline to saline in the interburden units. Coal seam units of the Moranbah Coal Measures record an average total dissolved solids (TDS) of 7,982mg/L, ranging between 1,314mg/L and 19,200mg/L. The interburden units of the Permian coal measures record an average TDS of 4,747mg/L, ranging between 1,280mg/L and 21,353mg/L.

1.2.5.4 Groundwater use

The Queensland Government's Groundwater Bore Database and the Bureau of Meteorology's National Groundwater Information System indicate there are 82 registered bores within 5km of SSM. Table 9 outlines the numerical split of bores allocated for each functional use.

Table 9: Registered use of groundwater bores within SSM

Groundwater bore use	Count	%
Groundwater monitoring (mine monitoring, water resource investigation etc.)	54	66
Water Supply	9	11
Unknown or resulted from exploration activities	19	23
Total	82	100

Groundwater bores at SSM within saturated units have low yields and have limited potential for beneficial use without prior treatment. Local properties primarily rely on surface water dams and water taken from regional

water supply pipelines. Available data on registered water supply bores on surrounding properties indicates where groundwater is extracted it is from the Permian coal seams (Fort Cooper Coal Measures) and not in the Tertiary sands and gravel, confirming the findings of the drilling completed at SSM and other neighbouring BMA sites, which has identified limited saturation within the Tertiary material.

A bore census near to SSM was undertaken in 2004 (AGE, 2004). The census identified that there were three bores that were in private extractive use between 10km and 18km to the east of SSM, adjacent to Rolf Creek. These bores are believed to have accessed the Permian and Tertiary aquifers and were used for stock and potentially domestic purposes. Only one of the three supply bores (Blanch's Bore 90264) identified within the census was registered.

There are no water entitlements for groundwater identified in the Water Entitlements Database Queensland, for within or immediately surrounding SSM, indicating groundwaters in this area are not used for activities requiring a license such as irrigation or other industrial purposes.

Desktop mapping of potential aquatic and terrestrial groundwater dependent ecosystems (GDEs) (GDE Atlas (BoM, 2017) indicates that areas with possible high, moderate and low potential for groundwater interaction occur in the vicinity of SSM. The GDE Atlas mapped ecosystems are predominantly associated with the watercourses that traverse the site. The potential GDEs in these locations would access temporal groundwaters within the alluvial material or the tertiary sediments. These groundwaters are primarily recharged during runoff events and due to the limited hydraulic conductivity of the Tertiary material and underlying Permian overburden, there is limited potential for groundwater drawdown in the potential GDE locations from the mining activities.

1.2.5.5 Conceptual site model

A hydrogeological conceptual site model representing the PRCP extent of mining and approved activities at the last day of mining at SSM is illustrated in Figure 8. The key hydrogeological features present at the end of mining that are relevant to the discussion of potential groundwater impacts post-mining are:

- Groundwater drawdown within the Moranbah Coal Measures, associated with passive dewatering into the SSM mine pits, results in inwards hydraulic flow gradients in the coal measures.
- Mine pits capture any seepage from spoil emplacements due to the hydraulic gradient orientated towards the mine void.
- No groundwater level drawdown of the alluvium due to the limited extent of continuous alluvial lenses.
- Limited groundwater level drawdown in the Tertiary formations due to low hydraulic conductivity of these zones and poor lateral connection.
- Limited potential for groundwater level drawdown impacts to potential terrestrial GDEs along Stephens Creek and Rolf Creek, where the water table in the regolith material may be accessed by deeper rooted riparian species and may be subject to relatively small drawdowns.
- Little to no impact on aquatic environmental receptors.
- No impact on anthropogenic receptors.

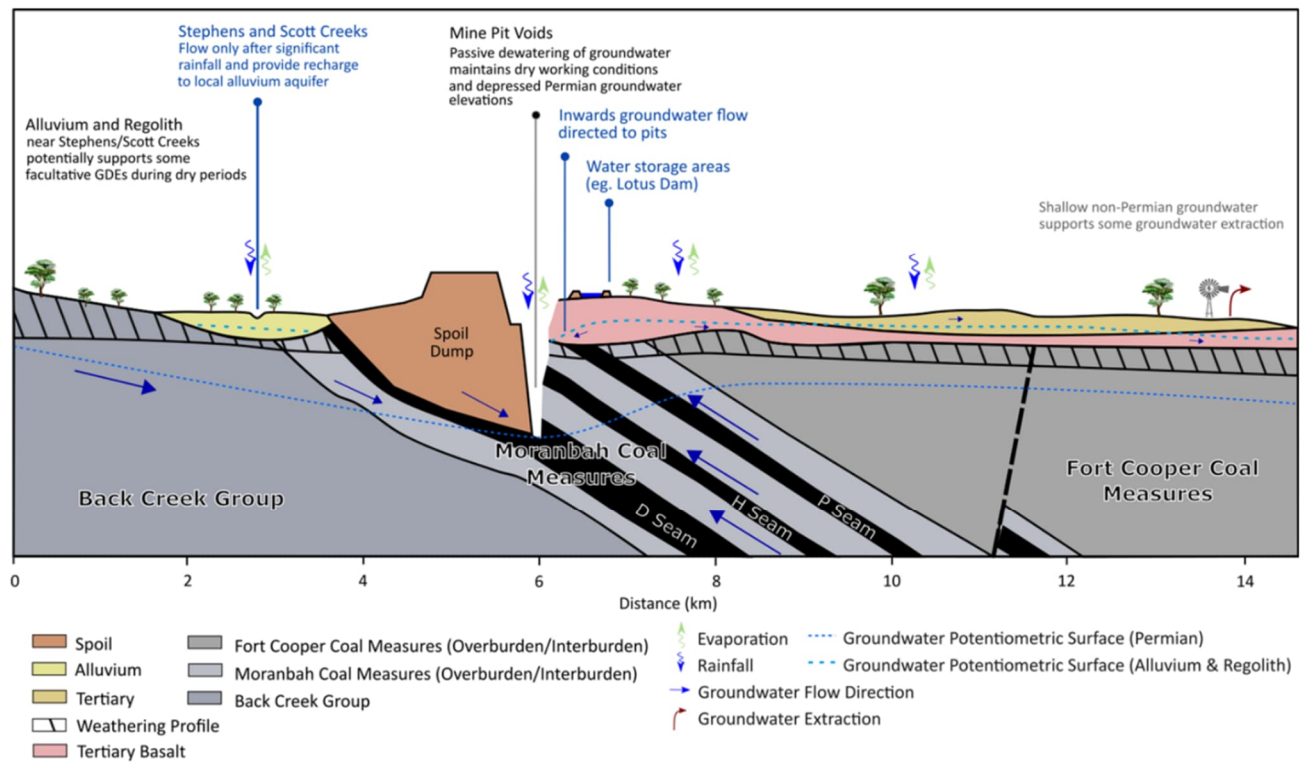


Figure 8: Conceptual site model of SSM at last day of mining (SLR, 2024b)

1.2.6 Soil types, properties and productivity

A number of baseline soil surveys have been undertaken at SSM. The soil information is detailed in *Saraji South Mine Soil and Land Suitability Assessment* (Landloch, 2023a) and *Saraji South Mine Material Characterisation Study* (Landloch, 2023b), provided in Appendix F.

Based on the undisturbed topsoil characteristics, two soil management groups have been identified for rehabilitation, clay topsoil and sand/loam topsoil. A summary of the Australian Soil Classification (ASC), soil type, soil management group and description for the soil types is provided in Table 10. The soil mapping according to the ASC is shown in Figure 9.

The pre-mining land suitability class of the soil types was assessed by Landloch (2023a). The assessment was in accordance with the Guidelines for Agricultural Land Evaluation in Queensland (DSITI & DNRM, 2015) classification system. This system allows for land to be allocated into five possible classes (with land suitability decreasing progressively from Class 1 to Class 5) which are derived from limitations that include soil type. The pre-mining land suitability by soil mapping unit is detailed in Appendix F.

Table 10: SSM baseline soil types

Australian Soil Classification	Soil type	Soil management group	Description	Land suitability class
Vertosol	Gilgaied cracking clays	Clay topsoil	Strongly self-mulching, grey or black cracking clay with developed linear gilgai over unconsolidated, calcareous sediments	2/3
Vertosol	Deep dark clays	Clay topsoil	Self-mulching (sometimes hard setting), black, brown and red-brown cracking clay over unconsolidated, calcareous sediments or alluvial layers	2
Vertosol, Dermosol	Dark and yellow friable earths with friable brown soils	Clay topsoil	Firm to hard setting, grey sodic cracking clay; over unconsolidated fine sandy clay sediments or reworked acidic Tertiary clay	3
Sodosol	Sandy duplex soils with moderately deep A horizons	Sand/ loam topsoil	Sandy/clay loam surfaced, sporadically bleached, mottled, brown, sodic texture contrast soil with coarse columnar structure; over unconsolidated sandy clay sediments	4/5

Table 11 summarises the chemical and physical parameters of the undisturbed topsoils at SSM. Clay topsoils are commonly alkaline in pH, low to moderate electrical conductivity (EC) and moderate to high cation exchange capacity (CEC). Sand/loam topsoils are commonly neutral in pH, low EC and have a low CEC. Clay soils account for 95% of the samples assessed across SSM.

Table 11: Summary of chemical properties of undisturbed SSM soil types (0 - 0.3m)

Analysis (unit)	Soil management groups			
	Clay soils		Sand/loam soils	
	Sample 21	Sample 55	Sample 12	Sample 22
Soil pH (1:5)	8.24	6.41	6.1	7.89
Soil EC (dS/m)	0.14	0.17	0.03	0.07

Analysis (unit)	Soil management groups			
	Clay soils		Sand/loam soils	
	Sample 21	Sample 55	Sample 12	Sample 22
Effective CEC (meq/100g)	54.9	37.6	3.02	15.3
Exchangeable sodium percentage (ESP) (%Na/CEC)	2.53	7.84	22.9	11.4
Ca/Mg (ratio)	1.32	0.88	0.9	0.82
Clay content	>35%		<25%	
Water holding capacity	Moderate to high		Low	

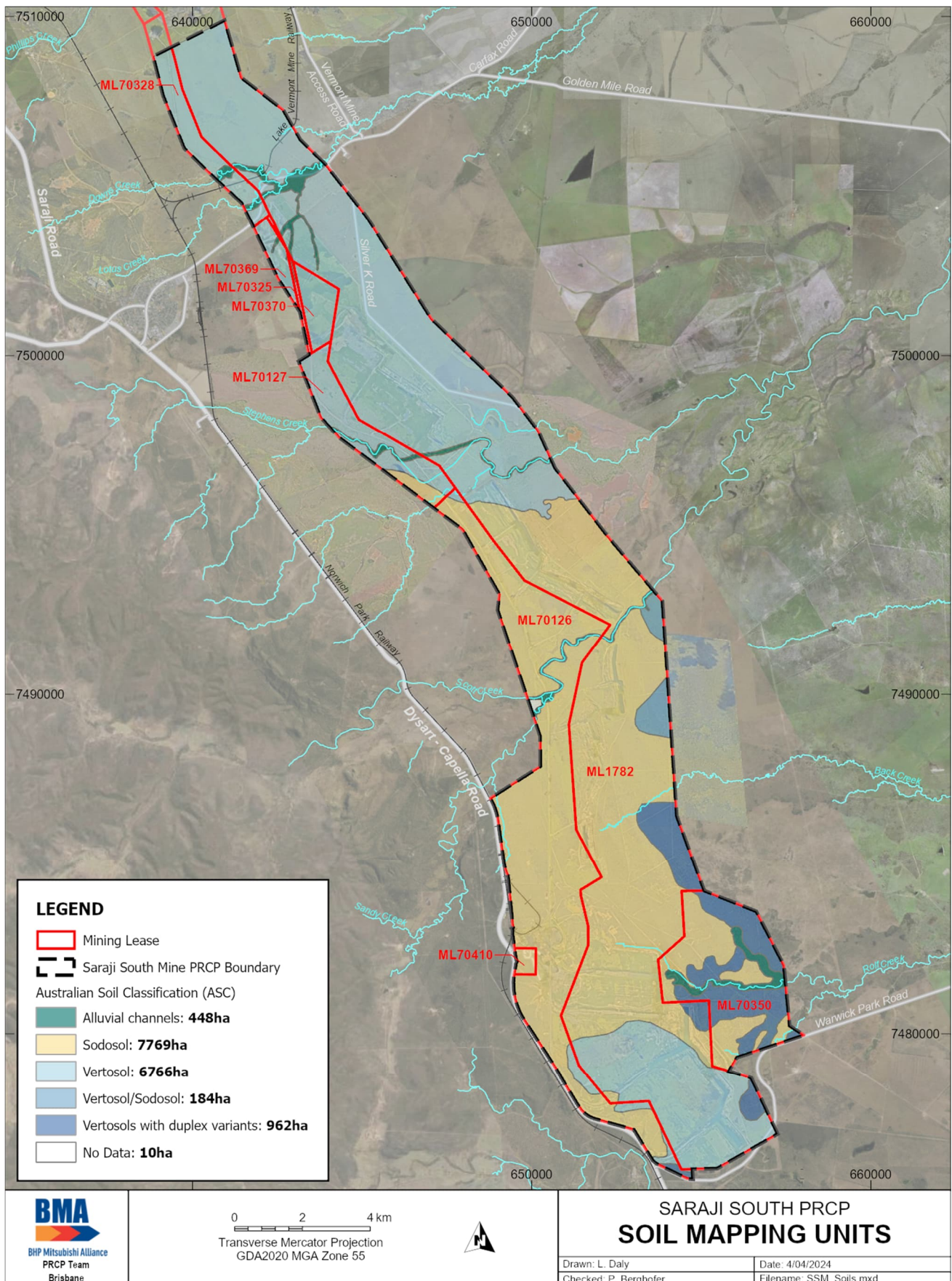


Figure 9: SSM soil mapping units - ASC

1.2.7 Land stability

The pre-mining topography at SSM was generally flat to undulating and is consistent with the regional landscape. Land within SSM that is undisturbed by mining activities and land adjacent to SSM is consistent with land within the Bowen Basin, which indicates surface erosion is common upon disturbance of soils and vegetation from cattle grazing.

1.2.8 Vegetation communities and ecological data

A number of previous baseline and project based ecological studies relating to vegetation communities and ecological values (i.e. regional ecosystems, threatened flora and fauna species and their habitats) have been undertaken within the SSM site including:

- Terrestrial Ecological Assessment of Lands (WBM, 2003) within the proposed East Pit Extension Norwich Park Coal Mine
- Norwich Park Mine Baseline Flora and Fauna Habitat Assessment (WBM, 2004)
- Biodiversity and Threatened Species Action Plan, BMA Norwich Park Mine (EcoServe and LAMR, 2005)
- Ecological Baseline Assessment, Saraji Soft Restart Project (BAAM, 2020)
- Ecological Baseline Assessment, Saraji South Mine (BAAM, 2021).

The results of the ecological studies and the following Queensland Government ecological database searches have been used to describe the ecological values of the SSM site, including the fauna presence and populations (Section 1.2.9):

- Wildlife Online Database (DES, 2023b)
- Regional ecosystem mapping (DES, 2023c)
- Matters of State Environmental Significance mapping (DES, 2023d)
- Maps of environmentally sensitive areas (ESAs) (DES, 2023e).

It is important to note that vegetation clearing and disturbance activities approved within the SSM site may have occurred since the previous ecological assessments.

1.2.8.1 Regional ecosystems

The regional ecosystems (REs) were ground-truthed and mapped as part of the baseline ecological assessment undertaken by BAAM (2021). The remnant vegetation cover on SSM has been altered over time due to pre-mining clearing for agricultural land use purposes and clearing for approved mining activities. The highest disturbance to date is associated with areas previously cleared for cattle grazing in the north of the site, as well as areas cleared for mining activities and associated infrastructure through a central strip of site extending north to south (Figure 10). The remaining areas of remnant and/or high value regrowth (HVR) vegetation on SSM are associated with watercourses, alluvial plains, patches occurring on the undulating Tertiary clay and sand plains to the southeast and patches of remnant vegetation towards the foothills of the Cherwell Range to the west (Figure 10).

The ground-truthed REs mapped during baseline assessments at SSM are listed in Table 12, with their associated *Vegetation Management Act 1999* (VM Act) class and biodiversity status, and have been mapped in Figure 10 (BAAM, 2021).

Table 12: Ground-truthed regional ecosystems recorded during baseline assessments at SSM

RE descriptions	RE Code	Remnant/ HVR	RE VM Act class	RE Biodiversity status
<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	11.3.1	Remnant HVR	Endangered	Endangered

RE descriptions	RE Code	Remnant/ HVR	RE VM Act class	RE Biodiversity status
<i>Eucalyptus populnea</i> woodland on alluvial plains	11.3.2	Remnant HVR	Of concern	Of concern
<i>Eucalyptus coolabah</i> woodland on alluvial plains	11.3.3	Remnant	Of Concern	Of Concern
<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains	11.3.4	Remnant	Of concern	Of concern
<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	11.3.25	Remnant	Least concern	Of concern
<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains	11.3.37	Remnant	Least concern	No concern at present
<i>Eucalyptus spp.</i> and/or <i>Corymbia spp.</i> grassy or shrubby woodland on Cainozoic clay plains	11.4.2	Remnant	Of concern	Of concern
<i>Eucalyptus populnea</i> with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on Cainozoic clay plains	11.4.7	Remnant	Endangered	Endangered
<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains	11.4.8	Remnant HVR	Endangered	Endangered
<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains	11.4.9	Remnant HVR	Endangered	Endangered
<i>Eucalyptus orgadophila</i> open woodland on Cainozoic clay plains	11.4.13	Remnant HVR	Least concern	Of concern
<i>Eucalyptus crebra</i> , <i>Corymbia spp.</i> , with <i>E. moluccana</i> woodland on lower slopes of Cainozoic sand plains and/or remnant surfaces	11.5.2	Remnant	Least concern	No concern at present
<i>Eucalyptus populnea</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces	11.5.3	Remnant HVR	Least concern	No concern at present
<i>Eucalyptus crebra</i> and other <i>Eucalyptus spp.</i> and <i>Corymbia spp.</i> woodland on Cainozoic sand plains and/or remnant surfaces	11.5.9	Remnant	Least concern	No concern at present
<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	11.8.5	Remnant	Least concern	No concern at present
<i>Eucalyptus brownii</i> or <i>Eucalyptus populnea</i> woodland on Cainozoic igneous rocks	11.8.15	Remnant	Endangered	Endangered

RE descriptions	RE Code	Remnant/ HVR	RE VM Act class	RE Biodiversity status
<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	11.9.7	Remnant	Of concern	Of concern
<i>Acacia shirleyi</i> or <i>A. catenulata</i> open forest on coarse-grained sedimentary rocks. Crests and scarps	11.10.3	Remnant	Least concern	No concern at present
<i>Eucalyptus crebra</i> woodland on coarse- grained sedimentary rocks	11.10.7	Remnant	Least concern	No concern at present
<i>Eucalyptus populnea</i> woodland on medium to coarse-grained sedimentary rocks	11.10.12	Remnant	Least concern	No concern at present

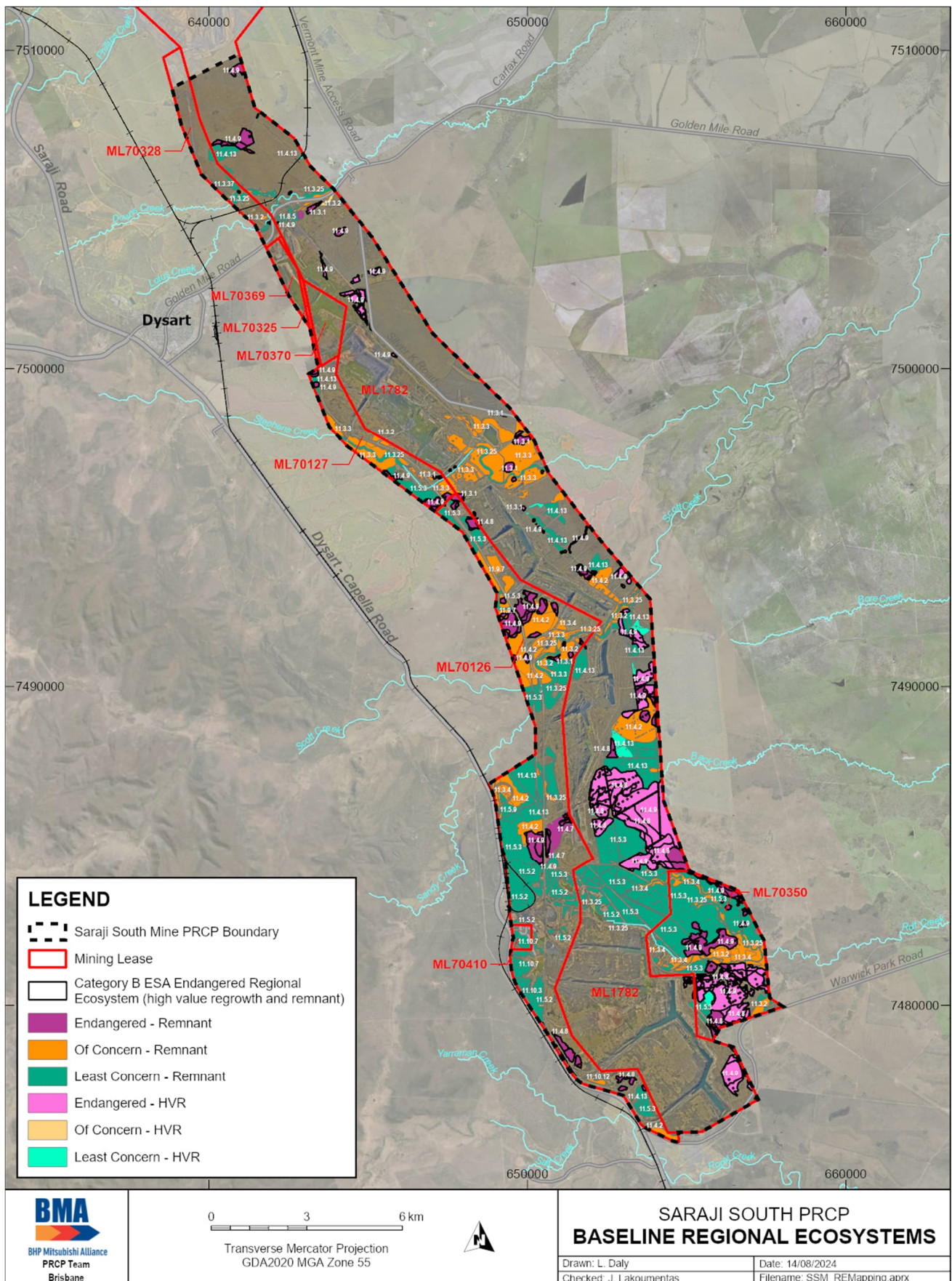


Figure 10: SSM Baseline regional ecosystems and environmentally sensitive areas

1.2.8.2 Environmentally sensitive areas

Category B ESAs are defined under Schedule 19 of the *Environmental Protection Regulation 2019* to include Endangered REs based on the biodiversity status identified in the 'Regional ecosystem description database' (Queensland Herbarium, 2018).

The following REs with an Endangered biodiversity status have been ground-truthed on SSM in association with Category B ESAs (BAAM, 2021) (Figure 10):

- RE 11.3.1 *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
- RE 11.4.7 *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on Cainozoic clay plains
- RE 11.4.8 *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
- RE 11.4.9 *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains
- RE 11.8.15 *Eucalyptus brownii* or *Eucalyptus populnea* woodland on Cainozoic igneous rocks.

1.2.8.3 State significant threatened flora species

The following threatened state significant flora species under the *Nature Conservation Act 1992* (NC Act) have been recorded on SSM based on the results of previous ecological surveys:

- *Solanum adenophorum* (Endangered NC Act) (BAAM, 2021).

The presence of *Solanum adenophorum* was confirmed within a patch of regrowth RE 11.4.9 in the south-east portion of the site south of Rolf Creek (BAAM, 2021) (Figure 10).

No other threatened flora species listed under the NC Act have been recorded on site during previous ecological surveys.

1.2.9 Fauna presence and populations

1.2.9.1 State significant fauna species

Fauna habitat on SSM has been influenced by previous clearing for agriculture and mining, with higher value habitat associated with larger areas of intact remnant vegetation (EcoServe and LAMR, 2005) (Figure 10).

The following threatened fauna species under the NC Act are known to occur on SSM based on the results of previous ecological surveys:

- Koala (*Phascolarctos cinereus*) (Endangered NC Act) (EcoServe and LAMR, 2005; WBM, 2004; BAAM, 2020; BAAM, 2021)
- Central greater glider (*Petauroides volans*) (Endangered NC Act) (BAAM, 2020; BAAM, 2021)
- Ornamental snake (*Denisonia maculata*) (Vulnerable NC Act) (EcoServe and LAMR, 2005; BAAM, 2021)
- Squatter pigeon (southern) (*Geophaps scripta scripta*) (Vulnerable NC Act) (EcoServe and LAMR, 2005; WBM, 2003; BAAM, 2020; BAAM, 2021)
- Grey falcon (*Falco hypoleucos*) (Vulnerable NC Act) (WBM, 2004; BAAM, 2021)
- Caspian tern (*Hydroprogne caspia*) (Special least concern NC Act) (EcoServe and LAMR, 2005)
- Latham's snipe (*Gallinago hardwickii*) (Special least concern NC Act) (EcoServe and LAMR, 2005)
- White-throated needletail (*Hirundapus caudacutus*) (Vulnerable NC Act) (EcoServe and LAMR, 2005)
- Short beaked echidna (*Tachyglossus aculeatus*) (Special least concern NC Act) (EcoServe and LAMR, 2005; WBM, 2004; WBM, 2003; BAAM, 2021).

Koalas have been recorded within riparian forests and woodlands in the northern section of the SSM site and along Stephens and Sandy creeks (WBM, 2004; BAAM, 2021). Evidence of koala scats have also been detected within preferred habitat associated with eucalypt forests and woodland containing a good diversity of preferred koala feed tree species including *Eucalyptus camaldulensis*, *E. tereticornis*, *E. populnea*, *E. coolabah* and *E. orgadophila* (Figure 11). Koala habitat on SSM has been mapped on Figure 11 in association with eucalypt open forests and woodlands with known food trees and areas known to be used as movement corridors (WBM, 2004; BAAM, 2021).

The central greater glider has been recorded within preferred habitat in the northern section of SSM along Downs Creek (BAAM, 2020), as well as along Sandy Creek (BAAM, 2021). Preferred habitat for the greater glider has been mapped in Figure 11 and includes remnant eucalypt woodlands with habitat connectivity containing more than two hollow bearing trees per hectare, with hollows medium-large in size (>10cm entrance) (BAAM, 2021). Preferred foraging and den trees include *E. camaldulensis*, *E. tereticornis*, *E. fibrosa* and *Corymbia citriodora* (Kerswell A, 2020).

The ornamental snake has been recorded on SSM in association with regenerating brigalow with gilgai formations in the south (WBM, 2004) (Figure 12). Preferred habitat for ornamental snake includes areas currently or previously dominated by brigalow or coolibah communities with gilgai micro-relief and/or deep soil cracks (BAAM, 2021).

Squatter pigeons have been observed during surveys in 2003, 2020 and 2021 (WBM, 2003; BAAM, 2020; BAAM, 2021). Squatter pigeon habitat has been mapped on SSM in association with remnant and regrowth eucalypt dominated REs within 1km of suitable water sources, including larger watercourses and waterbodies that hold pools of water for extended periods (BAAM, 2021) (Figure 12).

The grey falcon has previously been recorded within the local district, however its local occurrence could only be regarded as rare and nomadic (WBM, 2004). The grey falcon has been observed hunting in treeless areas and frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined watercourses, and tussock grassland and open woodland especially in winter (BAAM, 2021) (Figure 12).

The Caspian tern and Latham's snipe were recorded during baseline water bird surveys with records on Murphy dam and old tailings dam (WBM, 2004). The white-throated needletail is a highly mobile species and may occur in air space over parts of SSM (WBM, 2004).

The short-beaked echidna has been recorded across the SSM site (WBM, 2004). The short-beaked echidna is a dietary specialist having few specific habitat requirements other than the supply of ants and termites and suitable refuge sites (e.g. sites under dense bushes, in hollow logs and deserted burrows). This species occurs in a wide range of habitats and is likely to occupy remnant and regrowth habitats within SSM site (BAAM, 2021) (Figure 10).

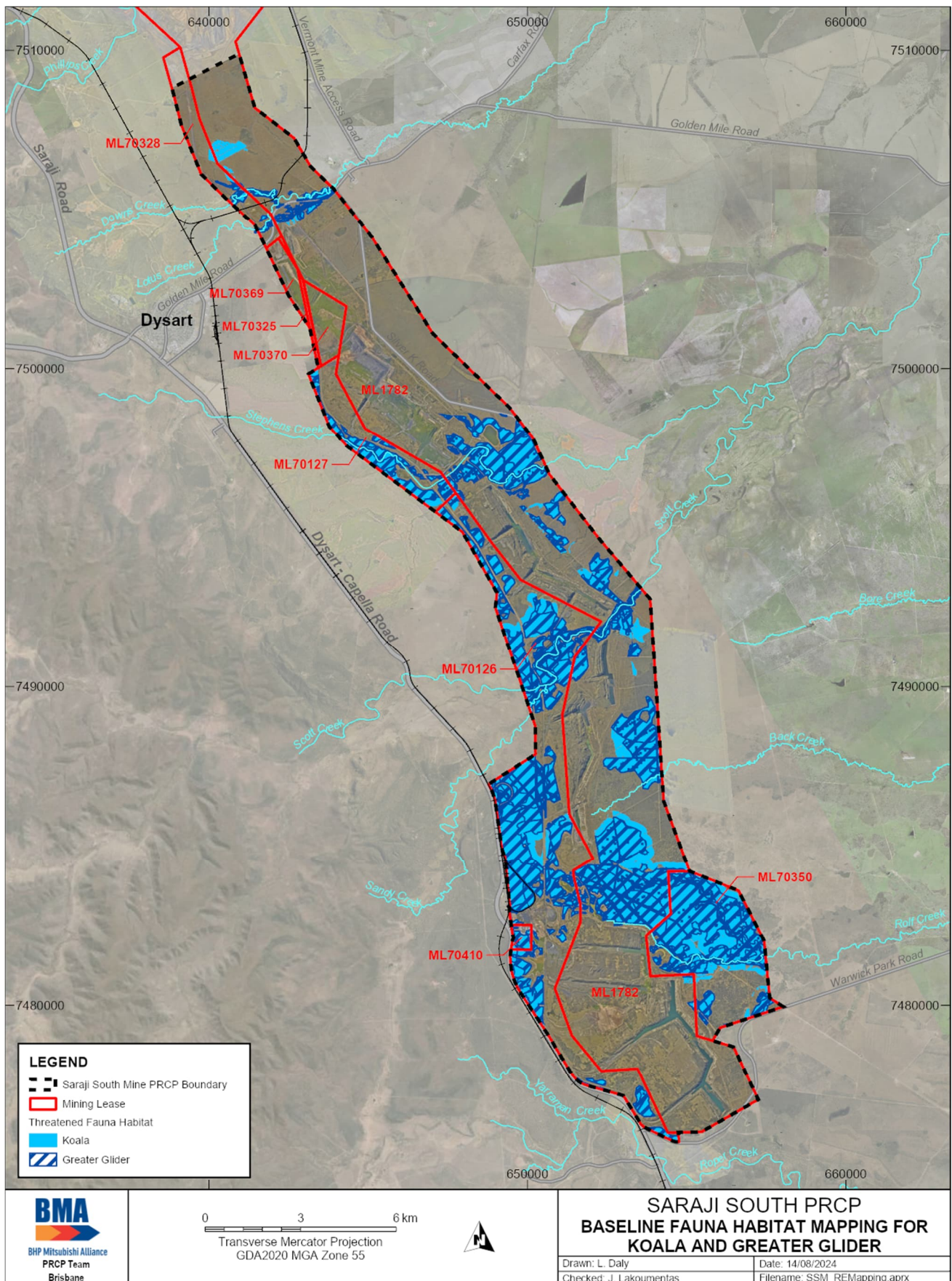


Figure 11: SSM baseline fauna habitat for mapping koala and greater glider

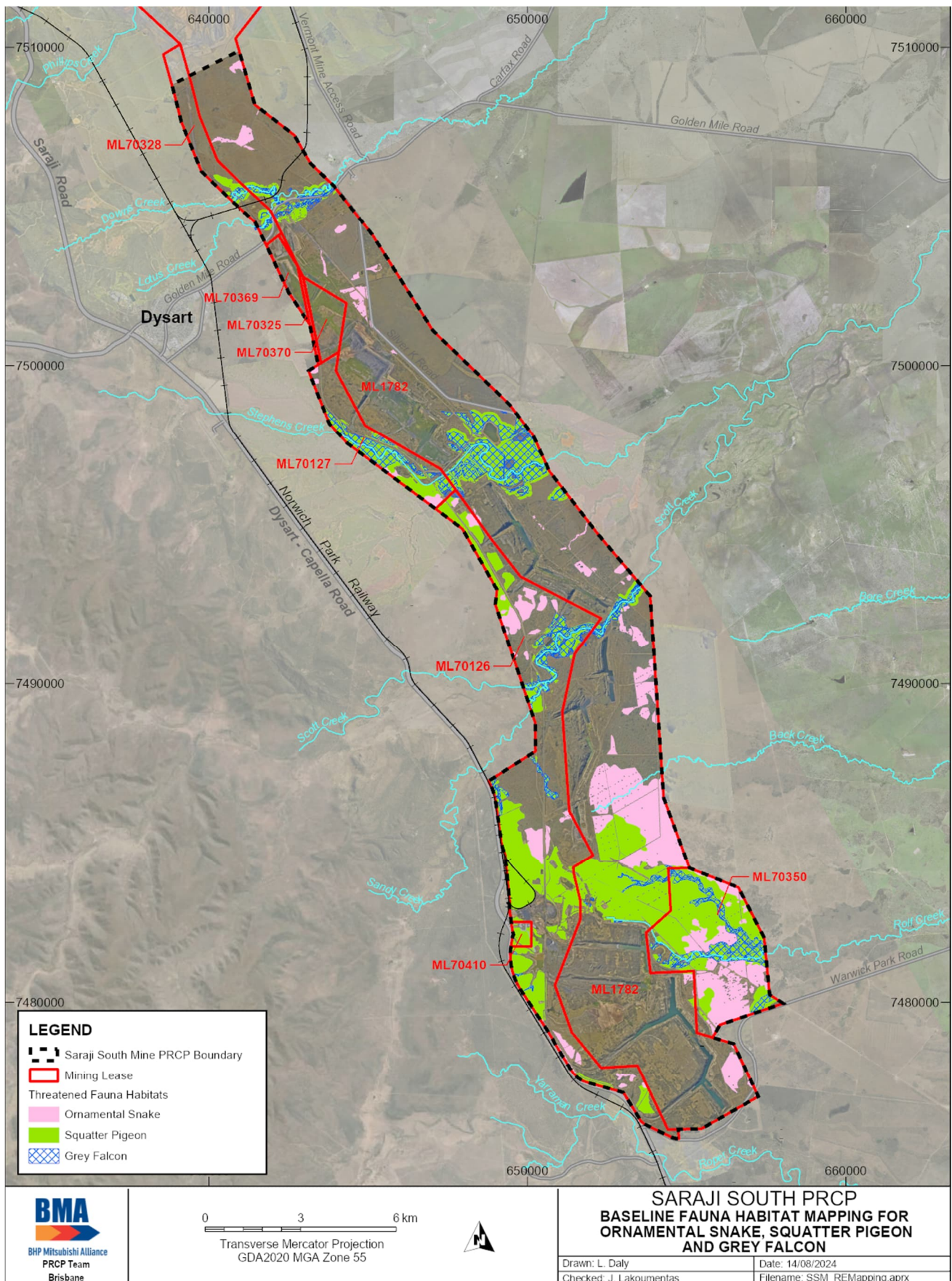


Figure 12: SSM baseline fauna habitat for ornamental snake, squatter pigeon and grey falcon

1.2.10 Pre-mining land use

Prior to mining, the SSM site was predominantly used for cattle grazing. A review of publicly accessible Queensland Government aerial images for the SSM area prior to mining (Cotherstone, 1978) (Queensland Government, 2024) indicates significant clearing of native vegetation, with only some remnant tracts of vegetation currently remaining within SSM.

The aerial images did not indicate any cropping prior to mining, however cropping is currently undertaken within ML1782, predominately within the nil surface area to the east of Silver K Road, with small portions also to the north-west and south of Silver K Road. Cropping is also undertaken on areas surrounding SSM.

1.2.10.1 Strategic cropping land

Under the *Regional Planning Interests Act 2014*, strategic cropping land (SCL) “means land that is, or is likely to be, highly suitable for cropping because of a combination of the land’s soil, climate and landscape features”. The SCL trigger map published by the Department of Resources (DoR) indicates the location of land that is expected to be SCL. An on-ground assessment against the SCL criteria is required to confirm the actual extent of SCL. Based on the outcome of the assessment, an application can be made to amend the SCL trigger map to remove or add land.

The SCL trigger map shows SCL mapped over a number of areas predominately in the north of the site. An on-ground assessment of the SCL trigger map areas at SSM has not been undertaken to verify the actual extent of land suitable for cropping. Of the mapped SCL locations within the SSM ML surface area, only a small portion is currently cropped.

1.2.11 Contaminated land

Mining operations at SSM commenced in 1979, prior to the inclusion of modern environmental legislative requirements and standards. Therefore, pre-mining baseline contaminated land data and records pertaining to historical environmental incidents/management from the earlier SSM operations are not available.

Operations at SSM have included heavy industrial type activities and supporting infrastructure since the commencement of mining/exploration, including the following:

- Drilling/exploration
- Extraction and processing of coal
- Operation of a variety of plant/equipment workshops and scrap yards
- Operation of regulated structures such as TSFs and other dams
- Operation of landfills
- Chemical storage
- Sewage treatment
- Petroleum product storage

The nature of these types of operations, which include the storage, handling, use and disposal of hazardous materials, particularly over SSM’s historical operations, have the potential to result in contamination of land.

Select properties covered by the SSM EA are listed on the Queensland Environmental Management Register for a range of notifiable activities including:

- Abrasive blasting
- Chemical storage
- Electrical transformers
- Engine reconditioning works
- Landfill
- Mine wastes

- Petroleum product or oil storage

No properties covered by the SSM EA are known to be listed on the Queensland Contaminated Land Register or to have approved Site Management Plans.

The current SSM EA provides for the conditional on-site disposal of various wastes including:

- Bulk rubber
- Inert waste
- Poly-pipe and other plastics
- Fibreglass
- Treated and untreated timber
- Asphalt
- Asbestos
- Rejects
- Sediment or water containing hydrocarbons
- Tailings
- Spoil or overburden
- Vegetation

Current management of contaminated land is undertaken in accordance with EP Act 1994 and the EA conditions that require the reporting of releases of hazardous contaminants and monitoring of surface water, sediment and groundwater on a regular basis. However, historical practices are not well documented due to the age of operations. Based on the nature of site operations/licenced activities and historical practices, it is anticipated that waste disposal and other activities have occurred at the site that potentially have resulted in land contamination that will require ongoing management post-mining.

1.2.12 Underlying landholders

The majority of land within SSM is BMA and/or related companies freehold and leasehold land except for:

- Land within ML1782 (northern section), ML70369, ML70370, ML70126 (west section), owned by Cradcorp Pty Ltd
- A small section of land within ML1782 (eastern section), owned by private landholders
- Lake Vermont Railway within ML1782 and ML70328, owned by Bowen Basin Coal Pty Ltd
- SSM rail loop land within ML70126, owned by Queensland Rail (QR)
- Various road reserves, owned by Isaac Regional Council (IRC)

The underlying landholders for the SSM area are shown in Figure 13. BMA has agreements and surface area rights under the *Mineral Resources Act 1989* for a substantial portion of the non-BMA owned land enabling BMA to control the land and undertake mining activities with conditions.

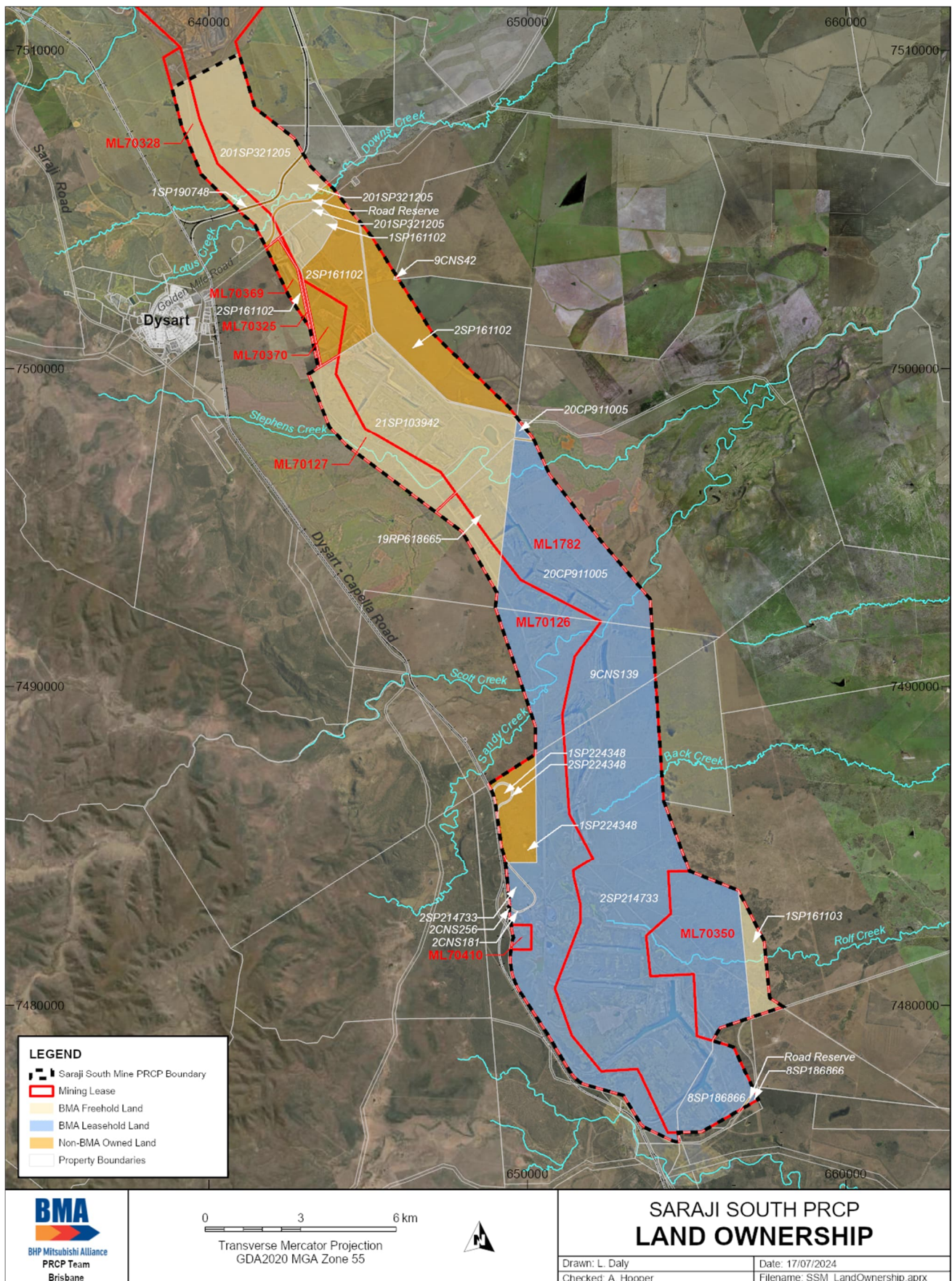


Figure 13: SSM land ownership

1.3 Design for closure

As this PRCP for SSM is subject to transitional PRCP arrangements, it is not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance (PRCP Guideline, Section 3.1).

However, this PRCP has been developed to manage progressive rehabilitation of the SSM site, aiming to minimise long-term management requirements as well as associated closure costs. Importantly, a focused design for closure underpins all sections of this plan, including:

- Engagement with relevant stakeholders to define suitable PMLUs and NUMAs
- Defining and implementing rehabilitation practices based on scientific studies and data, as well as identified risks that could influence achievement of milestone criteria
- Demonstrating a successful rehabilitation trajectory towards achievement of these milestone criteria by ongoing site monitoring and maintenance

1.4 Rehabilitation and improvement planning

Legislative Requirement

In accordance with sections 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part must include:

- *identification of all relevant activities on the mine site*
- *the predicted duration of each of the relevant activities proposed for the mine site*
- *the size/extent of the relevant activities*
- *whether the different relevant activities can be progressively rehabilitated.*

PRCP Guideline (Section 3.1)

Under section 126C(1)(j) of the EP Act, transitional PRC Plans must also include the following details about any existing rehabilitation already completed at the time of submission of the proposed PRC Plan:

- *a description of the rehabilitation works previously carried out*
- *when the rehabilitation works commenced and were completed*
- *whether the rehabilitation has been applied for or approved as progressively certified under the EP Act.*

1.4.1 Relevant activities requiring rehabilitation

The relevant activities and BMA owned infrastructure at SSM that will require rehabilitation, the predicted duration and availability for progressive rehabilitation, are provided in Table 13. Any infrastructure that is beneficial to the PMLU may be retained at closure and will not be available for rehabilitation.

Table 13: Relevant activities requiring rehabilitation at SSM

Relevant activity	Predicted duration	Availability for progressive rehabilitation
Spoil dumps	Dumping to spoil dumps will continue in active pits until the end of mining in 2098	• Progressive rehabilitation has commenced • Available for progressive rehabilitation as dump areas reach final position and they are no longer required for associated infrastructure or access requirements • Roper Pit spoil dumps are available for progressive rehabilitation now as there is no further mining planned in this pit – refer to Section 1.4.1.2

Saraji South Mine (EPML00865013) Progressive Rehabilitation and Closure Plan

Relevant activity	Predicted duration	Availability for progressive rehabilitation
		- Price Pit spoil dumps are available for progressive rehabilitation now as there is no further mining planned in this pit - Progressive rehabilitation is maximised by scheduling rehabilitation as soon as practicable after land becomes available - Low-wall areas become available once mining in each pit is complete 86% of the spoil dump area is scheduled to be rehabilitated to revegetation by the end of mining at SSM
MIA and other infrastructure areas	Varying: with the latest utilised until the end of rehabilitation activities	Dependent on the use and location, or unless deemed suitable to be retained for the PMLU: the majority will be available for rehabilitation at the end of the major rehabilitation activities; some areas may be available earlier, such as at the end of mining
Mine dams	Varying: with the latest utilised until the end of rehabilitation activities	Available for rehabilitation when no longer required for water management
Train load-out; associated infrastructure; and rail line (BMA owned)	Utilised until the end of coal loading	Infrastructure is not currently being utilised but life-of-mine plans indicate the infrastructure may be utilised in the future
Roads; laydown and general disturbance	Varying: with the latest utilised until the end of rehabilitation activities	Dependent on the use and location, or unless deemed suitable to be retained for the PMLU: typically areas will be available for rehabilitation either at the end of mining or after the major rehabilitation activities are complete
Exploration	Throughout the operational life	Available for rehabilitation once exploration activities are complete
Diversions and crossings	Varying: with the latest utilised until the end of rehabilitation activities	Dependent on the location in relation to mining and closure activities: typically crossings will be available for rehabilitation at the end of the major rehabilitation activities; some may be available earlier, such as at the end of mining
TSFs and rejects	Complete	- OTD TSF is no longer being utilised and is available for progressive rehabilitation now - Ramp 67 TSF is located within a void which is being utilised for operational water storage as part of the BMA central region water network and is therefore only available for rehabilitation when water storage capacity is no longer

Relevant activity	Predicted duration	Availability for progressive rehabilitation
		Ramp 67/68 rejects is partly located within a void which is being utilised for operational water storage as part of the BMA central region water network and partly within spoil areas that are available for rehabilitation now
Residual voids	Utilised for mining or water storage until the end of mining	- All voids not currently being mined are utilised for water storage as part of the BMA central region water network - Available for improvement once mining, water storage and the PMLU low-wall spoil rehabilitation (RA1) is complete for each pit, and any partial backfill for flood mitigation is complete

Further details on the availability of areas for progressive rehabilitation are included in Section 1.4.5. Non-BMA owned infrastructure, where BMA is not liable for rehabilitation, is not covered in the PRCP.

1.4.1.1 EA progressive rehabilitation conditions

The SSM EA includes the following condition regarding the commencement of progressive rehabilitation:

- E4: “*Progressive rehabilitation must commence within two (2) years of when areas become available within the mining leases.*”

All areas are included in the PRCP schedule for rehabilitation as soon as practicable after land becomes available. For infrastructure and general disturbance areas being utilised throughout the mine life, rehabilitation is scheduled the year after the land becomes available to allow for final planning. Spoil dump areas are scheduled within two years after land becomes available to allow for final settlement, planning and availability of resources (as per EA condition E4).

1.4.1.2 Roper project

The Roper Pit and immediate surrounds, located at the southern end of SSM, was actively mined and used for tailings and rejects disposal until SSM was placed in care and maintenance in 2012. Various options for the restart of mining operations were considered from 2012 onwards and in 2022 mining activity commenced in the northern part of the mine. The current BMA life-of-mine plan indicates there is no future coal mining planned at Roper area. The Roper residual voids are currently, and will continue to be, utilised as part of the BMA central region water management network. The residual voids provide essential storage capacity during wet weather and provide water to sustain operations during prolonged periods of drought.

The Roper areas outside the Roper residual voids are therefore currently available for rehabilitation. The areas available for rehabilitation include: OTD TSF, mine affected water dams, spoil dumps, haul roads and drainage lines. The Roper residual voids utilised as part of the BMA central region water network are not currently available for rehabilitation, however, due to their interconnectedness to the surrounding available for rehabilitation areas, they will be considered as part of the detailed rehabilitation and management plan for the area.

The technical studies completed for the transitional PRCP have highlighted the complexity and interconnectedness of this area, which is adjacent to the MIA, and includes TSFs, rejects, mine affected water dams and voids. The study outcomes identified data gaps and associated uncertainties, which include, but are not limited to:

- Additional groundwater data and modelling required to produce outputs with an appropriate level of certainty (Section 6.1.1 and Appendix E)
- Geochemical data gaps (Section 6.1.3)
- Contaminant pathways (6.1.7.2)

- Tailings characterisation data gaps (Section 6.2)
- Understanding of the interconnectivity of the residual voids (Section 6.3.2)
- Modelled void lake levels due to appropriate alignment of the groundwater model and groundwater inflows not being achieved (Section 6.3.2)
- Surface water catchment drainage and diversion requirements/approvals for the western side of the spoil dumps, out-of-pit TSF and Murphy dams (Sections 6.1.7 and 6.3.2)
- Effect of large scale leucaena management methods unknown (Section 1.4.4)

Sourcing sufficient data to close the data gaps and undertaking the necessary ground works and technical studies to achieve a sufficient level of certainty in the models requires additional time beyond the development of this transitional PRCP. A Roper project that encompasses the Roper spoil dumps, residual voids and surrounding areas (Figure 14) has been included within the PRCP schedule.

Rehabilitation activities in this Roper project area will commence immediately to manage leucaena and to establish safe access for drilling of additional boreholes and data collection. Drilling of additional boreholes will enable sufficient groundwater and geochemical data to be sourced to allow further modelling and design work to be completed. Leucaena management will continue concurrently with the data collection. The Roper project rehabilitation deliverables and the time required to undertake the ground works and update the technical studies are detailed in Table 14.

Following the project period in the PRCP schedule, the Roper project area is scheduled to progress through the relevant rehabilitation milestones and milestone criteria to achieve the relevant PMLUs for each RA. A PRCP amendment would be submitted to the administering authority, if at that stage the rehabilitation and management criteria for the Roper area require changes to the PRCP schedule.

Table 14: Roper project rehabilitation deliverables

RM	Roper project rehabilitation deliverables	Time (years)
RM0.1	Ground works: a) Investigation and development of plan for large scale leucaena management b) Establish safe access to landforms for data collection and progressive rehabilitation activities	2
RM0.2	Progressive ground works and sufficient data collection for modelling: a) Ongoing leucaena management and earthworks b) Drilling and installation of additional groundwater bores and water monitoring c) Drilling and installation of geochemical boreholes and monitoring d) Additional tailings and rejects material testing e) Additional waste characterisation f) Additional tailings geotechnical characterisation g) On-going land contamination investigation	6
RM0.3	Updated modelling and landform: a) Flood modelling b) Hydrogeological modelling c) Water balance modelling d) Hydrogeochemical modelling e) Landform design iterations	1

RM	Roper project rehabilitation deliverables	Time (years)
RM0.4	Final landform, designs and updated plans a) Final landform design b) Cover design c) Water management plan d) Void closure plan e) Risk assessment	1

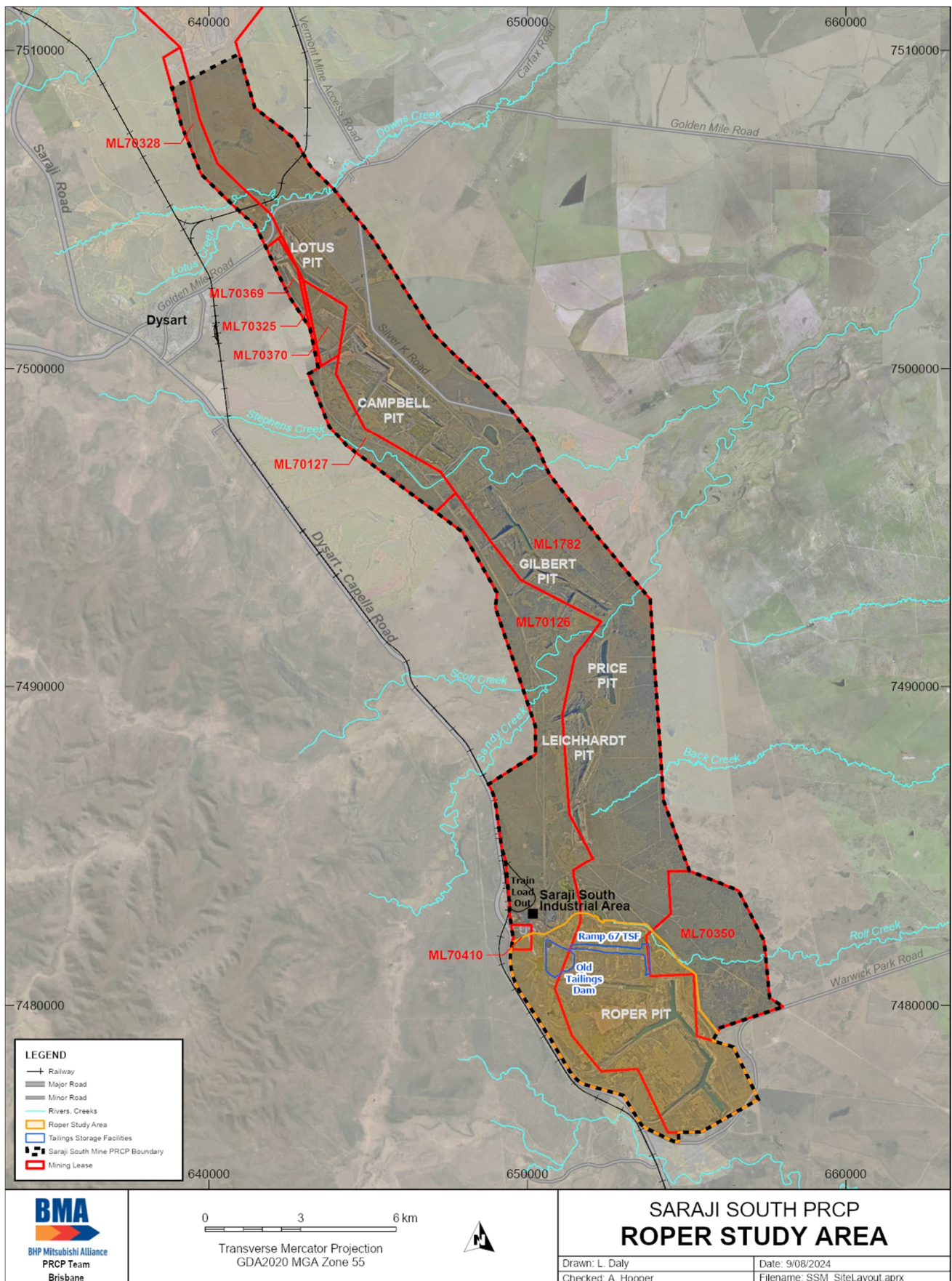


Figure 14: Roper project area

1.4.2 Rehabilitation areas and milestones

The rehabilitation areas (RA) and rehabilitation milestones (RM) included in the PRCP schedule for SSM are referred to throughout this PRCP.

A RA is defined in the PRCP Guideline “as an area of land in the post-mine land use to which a rehabilitation milestone for the post-mining use relates” and a RM is “each significant event or step necessary to rehabilitate the land to a stable condition (section 112 of the EP Act)”.

The SSM RAs, as well as the relevant activities associated with each RA, are detailed in Table 15 and shown in Figure 27. The RMs are detailed in Table 16. As required by the PRCP Guideline, only PMLU areas where disturbance has occurred or will occur, are mapped as a RA. Areas of ML1782, ML70328, ML70369, ML70126, ML70350 and undisturbed creek areas are expected to remain undisturbed as part of this transitional PRCP, and are therefore not mapped as a RA.

To support ongoing operations, exploration and minor ancillary activities may be required in areas not mapped as a RA. Minor ancillary activities can occur without a PRCP amendment and may include roads, access tracks and culverts, fences, underground services, low-impact telecommunication facilities, electrical sub-stations and switch yards, transmission grid works and supply network works, storage depots, pipelines and pumps, groundwater bores, gas drainage bores, monitoring and investigation works and exploration activities (as agreed with the administering authority for the SRM PRCP schedule). Disturbance must be rehabilitated in accordance with the provisions detailed in the *Eligibility criteria and standard conditions for exploration and mineral development projects* (DEHP, 2016) or its successor, with the exception that land must be rehabilitated to a stable condition and achieve the proposed PMLU.

Table 15: Rehabilitation areas and relevant activities for SSM

RA*	PMLU	Relevant activity
RA1	Woodland habitat	Spoil dumps
RA2	Watercourse	- Creek/surface water diversions - Watercourse crossings
RA3	Cattle grazing	- Roads - Laydown areas - MIA - Train load-out, rail and associated infrastructure - General infrastructure and disturbance
RA4	Woodland habitat	- Exploration - Roads - Laydown areas - General infrastructure and disturbance
RA7	Cattle grazing	Existing rehabilitation
RA10	Woodland habitat	Existing rehabilitation
RA12	Woodland habitat	Roper project - spoil dumps
RA13	Cattle grazing	Roper project - spoil dumps
RA14	Cattle grazing	- Roper project: - Roads

RA*	PMLU	Relevant activity
		- Dams - Laydown areas - General infrastructure and disturbance
RA15	Woodland habitat	• Roper project: - Roads - Laydown areas - General infrastructure and disturbance
RA16	Cattle grazing	• Roper project: - TSFs - Reject areas
RA17	Cattle grazing	• Roper project - existing rehabilitation
RA18	Woodland habitat	• Roper project - existing rehabilitation
RA19	Cattle grazing	• Roper project - certified rehabilitation

* BMA uses a consistent set of RAs across their assets, and as such some RA numbers are not relevant at SSM

Table 16: Rehabilitation milestones for SSM

RM	RM name
RM0.1	Project ground works
RM0.2	Project data collection
RM0.3	Project modelling
RM0.4	Project designs and plans
RM1	Infrastructure decommissioning and removal
RM2	Remediation and/or management of contaminated land
RM3	Landform development and reshaping
RM4	Surface preparation (cattle grazing)
RM5	Surface preparation (woodland habitat)
RM6	Surface preparation (watercourse)
RM7	Revegetation (cattle grazing)
RM8	Revegetation (woodland habitat)
RM9	Revegetation (watercourse)
RM10	Achievement of surface requirements (cattle grazing)

RM11	Achievement of surface requirements (woodland habitat)
RM12	Achievement of surface requirements (watercourse)
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA13, RA14, RA16)
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA12, RA15)
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2)
RM17	Achievement of post-mining land use to a stable condition (cattle grazing existing rehabilitation – RA7, RA17)
RM18	Achievement of post-mining land use to a stable condition (woodland habitat existing rehabilitation – RA10, RA18)

1.4.3 Improvement areas and milestones

The improvement area (IA) and management milestones (MM) included in the PRCP schedule for SSM are referred to throughout this PRCP.

An IA is defined in the PRCP Guideline as an “*area of land in the NUMA to which a management milestone for the NUMA relates*” and a MM is “*each significant event or step necessary to achieve best practice management of the area and to minimise risks to the environment (section 112 of the EP Act)*”.

The SSM IAs and associated relevant activities are detailed in Table 17 and the MMs are detailed in Table 18.

Table 17: Improvement areas and relevant activities for SSM

IA	NUMA	Relevant activity
IA1	NUMA	Residual voids
IA2	NUMA	Roper project - residual voids

Table 18: Management milestones for SSM

MM	MM name
MM1	Achievement of structural stability
MM2	Achievement of surface requirements
MM3	Achievement of sufficient improvement

1.4.4 Existing rehabilitation

Ongoing rehabilitation activities at SSM have occurred since 1986. Prior to 2020, the majority of rehabilitation was revegetated to achieve a cattle grazing PMLU. More recently, spoil dump rehabilitation has planned to achieve a woodland habitat PMLU by applying varied rehabilitation methods, including revegetation without the application of topsoil.

The PRCP schedule includes 1,166ha of existing rehabilitation as progressed, comprising of 979ha of existing cattle grazing PMLU, which includes 294ha of certified rehabilitation, and 187ha of woodland habitat PMLU. The existing rehabilitation progressing towards achievement of the PMLU is scheduled in the PRCP schedule for the next appropriate RM as shown in Table 19.

Several areas of existing rehabilitation have not been included in the schedule for the following reasons:

- Areas are planned to be dumped over in the current life-of-mine plans for additional spoil dump capacity, however once the final landform is available, the spoil will be progressively rehabilitated to achieve a sustainable woodland habitat PMLU
- Other areas will be re-disturbed by various mining activities, such as infrastructure. These areas are scheduled to be rehabilitated once the areas are no longer required for mining activities or infrastructure
- Some areas rehabilitated in the 1990s currently have extensive leucaena (*Leucaena leucocephala*) thickets. Rehabilitation seed mixes in the 1990s included leucaena as it was considered suited to the soils, provided soil stabilisation and was planted for cattle fodder (leucaena stems less than 2m high can be readily eaten by grazing livestock). However, if not controlled, leucaena can form dense thickets that hinder human and stock movements and exclude growth of other plants.
- A portion of historical rehabilitation requires substantial corrective action to achieve the nominated PMLUs, and in some case the planned PMLU has changed to better align with the landforms and surrounding PMLUs. These areas are scheduled to commence rehabilitation in the PRCP schedule over the first 10 years.

Table 19: Progression of existing rehabilitation to the next RM in the PRCP schedule

RA	Cattle Grazing (ha)		Woodland Habitat (ha)	
	RM10	Certified	RM8	RM11
RA7	361			
RA10			17	46
RA17	324			
RA18			124	
RA19		294		
Total	685	294	141	46

The existing areas of cattle grazing rehabilitation are predominantly on landforms with slopes $\leq 10\%$ and are dominated by exotic pasture grass (i.e. *Cenchrus ciliaris*) with scattered native trees species (i.e. *Acacia spp.* and *Corymbia spp.*). The existing areas of woodland habitat rehabilitation are predominantly on more recent final landforms with slopes up to 12%.

Representative areas of existing cattle grazing and woodland habitat rehabilitation and their associated monitoring results have been summarised in Table 20 and Table 21, respectively.

The rehabilitation methodology and RM most applicable to the implemented process for existing rehabilitation at SSM has included:

- Cattle grazing:
 - RM3: Reshaped to maximum slope of 12%, however most areas have a mean slope of 10%
 - RM4: Application of topsoil at minimum depth of 150mm
 - RM4: Application of ameliorants, such as gypsum and fertiliser
 - RM4: Shallow rip
 - RM4: More recent rehabilitation has included application of surface mulch, such as straw
 - RM7: Seed mixes were based on seasonal availability, no records are available on specific seed species
 - RM10: Sufficient groundcover to meet EA acceptance criteria as indicated by rehabilitation monitoring data

- Woodland habitat:
 - RM3: Reshaped to maximum slope of 25%, however most areas have a mean slope of 12%
 - RM3: Rock mulch on steeper areas
 - RM5: A thin veneer of topsoil (100mm - 150mm)
 - RM5: Application of ameliorants, such as gypsum
 - RM5: Deep rip
 - RM5: More recent rehabilitation has included application of surface mulch, such as straw
 - RM8: Seed mixes were based on seasonal availability, no records are available on specific seed species
 - RM11: Sufficient groundcover and species richness to meet EA acceptance criteria as indicated by rehabilitation monitoring data.

Routine rehabilitation monitoring will continue to be implemented to identify any maintenance/corrective actions required to enable the existing rehabilitation areas to achieve the milestone criteria.

Table 20: Representative areas of existing cattle grazing rehabilitation

Area	SSM03	NPM13
Image		
Next RM in PRCP schedule	RM10	RM10
Coordinates (MGA2020 Zone 55)	651389 E, 7478744 N	643713 E, 7498928 N
Mean slope (%)	12	9
Age (years)	33	11
Total groundcover (%)	94	94
Preferred pasture species	<i>Cenchrus ciliaris</i> (buffel grass*), <i>Megathyrsus maximus</i> var. <i>maximus</i> (Guinea grass*), <i>Melinis repens</i> (red natal grass*)	<i>Cenchrus ciliaris</i> (buffel grass*), <i>Clitoria ternatea</i> (butterfly pea*), <i>Megathyrsus maximus</i> var. <i>maximus</i> (Guinea grass*), <i>Melinis repens</i> (red natal grass*)
Dry matter yield (kg/ha)	6,617	4,750
Pasture condition	1	1
Land condition	B - Fair	A - Good
Land suitability class	3	4
Limiting factors	Strongly alkaline, strongly sodic. Low P	Sodic, very low P

* Exotic species

Table 21: Representative area of existing woodland habitat rehabilitation

Area	SSM17
	
Next RM in PRCP schedule	RM11
Coordinates (MGA2020 Zone 55)	651217 E, 7489803 N
Mean slope (%)	7
Age (years)	17
Total groundcover (%)	74
Tree canopy cover (%)	12
Tree species	<i>Acacia</i> sp., <i>Corymbia dallachiana</i> (Dallachy's gum), <i>Eucalyptus crebra</i> (narrow leaved ironbark)
Shrub species	<i>Acacia leiocalyx</i> (black wattle), <i>Acacia macradenia</i> (Zig-zag wattle), <i>Acacia salicina</i> (sally wattle), <i>Eucalyptus crebra</i> (narrow-leaved ironbark)
Grasses	<i>Cenchrus ciliaris</i> (buffel grass*), <i>Megathyrsus maximus</i> var. <i>maximus</i> (Guinea grass*), <i>melinis repens</i> (red natal grass*)
Other species	<i>Achyranthes aspera</i> (prickly-chaff flower), <i>bidens pilosa</i> * (cobblers pegs), <i>malvastrum americanum</i> (spiked malvastrum*), <i>parthenium hysterophorus</i> (parthenium*), <i>parkinsonia aculeata</i> (parkinsonia*)

* Exotic species

Existing rehabilitation within the Roper project area (RA17 and RA18) will be considered as part of the Roper project technical studies due to the interconnectivity of the area (Section 1.4.1.2). The PRCP schedule includes milestone criteria for detailed technical studies and closure design for the existing rehabilitation areas. During this period, the rehabilitation will continue to be monitored and maintained (as per Section 8), although the outcomes of this project may change the status of the rehabilitation and potentially require a PRCP amendment.

1.4.5 Availability for progressive rehabilitation

1.4.5.1 Spoil dumps

As indicated in Table 13, the spoil dumps are the area predominantly available for progressive rehabilitation during mining. As mining progresses down-dip and the pits get deeper, the spoil dumps increase in height to fit the increased volume of spoil material. Increasing the dump height maximises the material dumped in-pit and reduces out-of-pit dumping. Due to the large size of the SSM spoil dumps, the outside spoil dump areas (the areas to be rehabilitated) are only a small proportion of the operational dump surface as the dumps advance, as shown in Figure 15. Areas become available for rehabilitation as spoil dumps reach the final spoil dump extents. For deep mines such as SSM, the amount of area available for rehabilitation progressively throughout the mine life is limited due to:

- Dumping occurs over multiple dump faces at various bench heights, with multiple access ramps. The dump access ramps change location over time as the dumps progress. These dump access ramps, plus the coal access ramps, restrict the dump footprint available and results in the separate dump areas progressing at different rates. The access ramps also limit the area available for progressive rehabilitation until they are no longer required. Numerous coal access ramp voids are planned to be backfilled towards the end of mining. Once backfilled, these areas become available for rehabilitation.
- Dumps can only increase in height once mining has progressed sufficiently to ensure the lower dump benches have also advanced sufficient distance for geotechnical stability of the spoil. This limits progressive rehabilitation to the outside of the lower dump benches as more spoil is dumped above. Significant areas become available for rehabilitation as the final and highest dump bench is completed dumping.
- The spoil dump low-walls continually advance with the mining operation and increase in height with the spoil dumps. The low-wall PMLU area of each pit becomes available for rehabilitation once mining and final backfill of the void is complete.

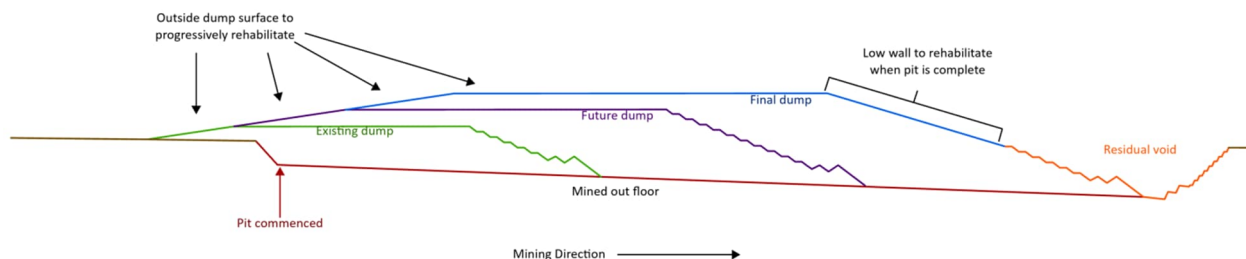


Figure 15: Indicative dump progression during life-of-mine (illustrative purposes only)

The spoil dump areas do not become available for progressive rehabilitation at a linear rate due to the mining and dumping sequence. Configuration of spoil dumps, ramp access, height and stability requirements to balance the required dump capacity all impact the release for rehabilitation areas. The area available for progressive rehabilitation is limited earlier in the schedule due to the mining sequence, with the majority of spoil dump areas becoming available for rehabilitation later in the mine life as dumps reach their maximum extents at a faster rate, and the low-wall areas become available once mining in each pit is complete.

However, by the end of mining in 2098, the vast majority of the spoil dumps (RA1, RA12, RA13) will have achieved the execution milestones in the PRCP schedule (86%) and have been rehabilitated to the point of revegetation (Table 22). Therefore 86% of the spoil dumps will only require monitoring and maintenance from this point to achieve the PMLU. After 2098, rehabilitation execution of the spoil dumps only remains for the low-wall and operational areas on the spoil dumps that are required until the end of mining e.g. haul roads and park-up areas.

Other areas are typically required to support mining operations, such as infrastructure areas, with limited area available for rehabilitation until mining is complete (Table 22). Areas associated with individual pits become available as mining finishes in each pit.

Table 22: PRCP schedule progressive rehabilitation summary

RA/ IA	Description	Total area (ha)	% of total site	RM 7-9 by 2098 (ha)	RM 7-9 by 2098 (%)
RA1	Spoil dumps	3,824	24	2,958	77
RA2	Creek/surface water diversions and crossings	261	2	197	75
RA3	Infrastructure areas – CHPP, MIA, workshop, dams, coal stockpiles, roads, general infrastructure and disturbance	1,070	7	0	0
RA4	Roads, laydown areas and general infrastructure and disturbance	1,549	10	543	35
RA7	Existing rehabilitation	361	2	361	100
RA10	Existing rehabilitation	63	0	63	100
RA12	Spoil dumps	658	4	658	100
RA13	Spoil dumps	519	3	519	100
RA14	Roads, dams, laydown areas and general infrastructure and disturbance	99	1	99	100
RA15	Roads, laydown areas and general infrastructure and disturbance	506	3	506	100
RA16	TSFs and rejects	158	1	158	100
RA17	Existing rehabilitation	324	2	324	100
RA18	Existing rehabilitation	124	1	124	100
RA19	Certified rehabilitation	294	2	294	100
IA1	Residual voids	1,481	9	538 (MM1/MM2)	36
IA2	Residual voids	454	3	0 (MM1/MM2)	0
PRCP schedule total		11,746	73	7,341	63
	Undisturbed and excised area	4,393	27	-	-
SSM total		16,139	100	-	-

2 COMMUNITY CONSULTATION

Legislative Requirement

In accordance with section 126C(1)(c)(iii) and (iv) of the EP Act, the rehabilitation planning part of the PRC Plan must include:

- details of the consultation undertaken by the applicant in developing the proposed PRC Plan, and
- details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.

PRCP Guideline (Section 3.5)

In developing the proposed PRC Plan, the community should at least be engaged on the plan for the mine, PMLUs or NUMAs, areas of disturbance, rehabilitation and management methods, progressive rehabilitation, and closure timeframes. Ongoing community consultation should continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

Community consultation carried out through different processes (such as an EIS) may be used to address the requirements in section 126C(1)(c) of the EP Act. The details of this consultation must be provided in the rehabilitation planning part of the proposed PRC Plan).

Transitional PRC Plans are still required to meet the legislative requirements in section 126C(1)(c) of the EP Act. All proposed PRC Plans must contain a community consultation plan regardless of whether the site has an existing EA.

To comply with section 126C(1)(c)(iii) of the EP Act, the PRCP must include details of the consultation undertaken by the applicant in developing the proposed PRCP (Section 2.4). This includes previous consultation undertaken as part of existing EA approvals or regular engagement processes (Section 2.2.1), and consultation undertaken as part of PRCP development (Section 2.2.2).

To comply with section 126C(1)(c)(iv) of the EP Act, and the PRCP Guideline, the PRCP must include a community consultation plan which details how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan (Section 2.3).

A community consultation register has been compiled to support the development of this PRCP – SSM *Community Consultation Register*, and is provided in Appendix G.

2.1 Stakeholders

The PRCP Guideline requires that the applicant must attempt to consult all relevant members of the community, noting that the community may include, but are not limited to:

- Affected landholders (such as underlying and adjoining land holders, and holders of land necessary for access to the land to which the proposed PRCP relates)
- Traditional Owners
- Local government
- Local community groups

The Queensland Government Information sheet *Community consultation for Progressive Rehabilitation and Closure Plan* (last revised on 16 February 2024) (DESI, 2024), states that community members to be included in consultation must have a genuine, demonstrable and legitimate interest in:

- The land where the activity will occur
- The land adjacent to where the activity will occur
- The land/amenities surrounding where the activity will occur that are likely to be impacted by the activity (e.g. groundwater/drinking water users within the surrounding area or community located upstream or downstream of the activity)

Genuine interest may include direct impact interest (e.g. underlying and adjacent land holders), cultural interest (e.g. Traditional Owners), land use interest (e.g. overlapping tenure holders, or local government), or heritage, environmental, recreational or health interests (e.g. state or local government, or relevant community groups).

The stakeholders identified as having a genuine, demonstrable and legitimate interest in the ongoing rehabilitation and closure planning at SSM are listed in Table 23, along with BMA's existing relationship and the stakeholders potential areas of interest with respect to the SSM PRCP.

2.2 Consultation to date

2.2.1 Pre-PRCP consultation

The following rehabilitation and closure-related engagement took place for SSM prior to development of the SSM transitional PRCP:

- Engagement with Barada Barna Aboriginal Corporation (BBAC) has been ongoing since 2021 on PRCP development and rehabilitation execution, specifically on provision of seed for rehabilitation and contracting opportunities for rehabilitation execution
- Engagement with affected (underlying) landowners has been undertaken to develop compensation, leasing and agistment agreements, as BMA must rehabilitate in accordance with the requirements of the EP Act which are satisfied through the PRCP
- During 2018 and 2019, BMA engaged with the administering authority to implement the current EA conditions in relation to PMLUs and the associated acceptance criteria, which were included in the EA Table E1: Rehabilitation Requirements
- BMA engaged with the administering authority in relation to how the PRCP Guideline elements (particularly regarding transitional arrangements) and the current EA conditions related to rehabilitation and closure would transition to PRCPs
- Since April 2021, information about the PRCP process, the schedule for development of PRCPs for BMA assets and PRCP progress briefings has been provided to IRC at routine meetings, noting the SSM PRCP would be submitted in October 2024
- BMA has engaged with nearby landholders on land management and lease/license conditions, and on operational, environmental management and/or water matters, as required

2.2.2 Transitional PRCP consultation

Consultation as part of the development of the SSM transitional PRCP has included letters sent between 15 June 2024 and 31 July 2024 via letter box drop, post or email to more than 6,500 premises in Moranbah and Dysart, including property owners, households, business and community groups. These stakeholders are listed in Table 23 and include:

- Barada Barna People, via BBAC, as the registered native title holders for the SSM area
- Private owners of freehold land within 5km of the SSM EA area, including licensees of BMA-owned land
- Dysart residents, business owners and community organisations via a letter drop to premises within the Dysart postcode
- IRC
- Members of the Dysart Smart Transformation Advisory Council (STAC)
- Isaac Business Chamber
- Owners and operators of utility assets within and adjacent to SSM
- Nearby mining tenement holders and petroleum (gas) tenement holders
- Queensland Government departments, Offices of the Ministers and Members of Parliament

In addition to the consultation letters, BMA distributed information about PRCPs to individuals, businesses and organisations via:

- BMA's Coal Connect, an online weekly newsletter to SSM's workforce and all internal coal personnel
- BMA's Community Connect, a bi-monthly newsletter distributed to more than 15,000 Moranbah and Dysart community members and SSM suppliers throughout the Bowen Basin

- BMA's Community Hotline for the general public

2.3 Community consultation plan

The PRCP Guideline requires the community consultation plan to include:

- Objectives of the community consultation
- Consultation process, including proposed frequency of consultation
- Information to be released for community consultation
- How community feedback will be considered in the PRCP

Whilst many stakeholders in the Isaac region are well-educated about mining operations, there is less understanding of planning for life-of-mine, rehabilitation and closure planning. The community consultation plan recognises the following social context:

- Talk of closure planning will lead to community concerns, requiring careful and consistent communication
- PRCP consultations by a range of companies for a variety of assets will represent considerable cumulative demands on stakeholders, and a coordinated, strategic approach will be required to manage consultation fatigue
- Community members are becoming increasingly aware of climate change and the impacts of resource activities and energy policies on the environment

Accordingly, community and stakeholder expectations with regards to mine rehabilitation are expected to increase over time and need to be continuously assessed.

2.3.1 Objectives

The objectives of the community consultation include:

1. To engage stakeholders in developing objectives and aspirations for PMLUs and landform, and social value opportunities to be considered in the PRCP
2. To support transparent access to information about the SSM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, SSM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes
3. To engage with utility owners and operators and adjacent mining and energy tenement holders, to provide information about SSM closure planning that supports them to manage their assets and interests

2.3.2 Consultation process

The consultation process to enable ongoing PRCP-related engagement is detailed in Table 24. The process includes the relevant stakeholders, engagement type and proposed consultation frequency to achieve the consultation objectives.

BMA continues to engage with neighbouring landholders on land management, lease/licence conditions, and operational matters, as required.

Some stakeholder titles (e.g. names of Queensland Government departments) may change over time and will be updated as necessary in future PRCP amendments.

2.3.3 Information to be provided

2.3.3.1 Consultation to date

The transitional PRCP consultation letters provided information about SSM and rehabilitation and closure planning and encouraged the stakeholders (Section 2.2.2) to contact BMA if they would like to discuss the PRCP. The information provided to stakeholders through the transitional PRCP consultation letters included:

- Introduction of Queensland Government requirements for mine rehabilitation and closure planning

- EP Act requirements for rehabilitation
- PRCP requirements
- PRCP submission date
- Location of SSM
- SSM EA details
- Approved activities at SSM
- MLs within SSM EA area
- Estimated mine life of SSM
- BMA's commitment to progressive rehabilitation
- Rehabilitation objectives and methods
- Progressive rehabilitation timeframes (in general terms)
- EA approved PMLU options
- Inclusion of residual voids as NUMAs
- BMA's commitment to future engagement in PRCPs
- An invitation to seek information or discussion about PRCPs
- Contact details for further information or discussion

The information provided to the community as part of the transitional PRCP consultation via Coal Connect, Community Connect and the Community Hotline included:

- Progressive rehabilitation as a key focus for BMA
- PRCP requirements and purpose
- Timing for the development of the SSM PRCP
- Life of BMA assets that are subject to transitional PRCPs
- Commitment to ongoing engagement
- Contact details for further information or discussion

Consultation and engagement conducted by BMA to date was to transition the PMLUs and NUMAs within the EA to the PRCP.

2.3.3.2 Ongoing consultation

Information to be released for community consultation, as part of future SSM PRCP implementation will include:

- The rationale and scope for PRCPs
- Approved mining activities, PMLUs and NUMAs for SSM
- On-site activities and areas of disturbance
- Proposed rehabilitation methods, schedule and milestones
- Progress against rehabilitation milestones
- Alignment with long-term transformation planning occurring through governments
- Opportunities for community consultation as part of the PRCP's implementation

Communication tools could include:

- A holding statement for general enquiries
- Frequently asked questions and answers and a PRCP fact sheet available to support consultation activities

- Face to face and virtual meetings, forums or workshops
- Updates and fact sheets about the SSM PRCP

Additional information to be shared with specific stakeholders is detailed in Table 24.

2.3.4 How feedback will be considered

The PRCP community consultation register (Appendix G) will be updated to include the consideration of issues raised and the outcomes of engagement as part of the community consultation activities outlined in Table 24. All stakeholder feedback recorded in the community consultation register will be considered in framing and detailing future PRCP amendments for SSM.

This may include feedback on, for example:

- Planned PMLUs and NUMAs
- Alternative PMLUs
- Vegetation species most suitable to the approved PMLUs
- Rehabilitation methods to protect cultural heritage and achieve optimal use for the PMLUs
- PRCP schedule
- Water management (e.g. availability for beneficial use as part of the PMLUs, or adjacent uses)
- Development of business capacity programs to equip local and Indigenous businesses for rehabilitation works.

The PRCP will be evaluated to ensure PMLUs and NUMAs are consistent with the outcomes of consultation with the community.

2.4 Community consultation register

The community consultation stakeholders, the consultation undertaken, and feedback received are documented in the community consultation register (Appendix G). The community consultation register is compliant with section 126C(1)(c)(iii) of the EP Act and includes:

- Identification of each community member/stakeholder
- Previous engagements with the community
- Consultation date(s)
- Description of consultation type
- Information provided to the community
- Issues raised/discussed by the community
- How issues have been considered
- Decisions/outcomes of engagement
- Commitments made by BMA

2.5 Feedback to date

All feedback received to date as part of the consultation for the PRCP, is documented in the community consultation register (Appendix G) and summarised in Table 23. There were no enquiries or feedback received following the transitional PRCP consultation letters apart from an acknowledgement of receipt of the letter. There were also no responses or enquiries to letters to Dysart premises or to the information provided via Community Connect and Coal Connect.

Table 23: SSM identified stakeholders, current BMA relationships, potential PRCP areas of interest, and consultation outcomes

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
Traditional Owners			
Barada Barna People (QCD380/08), represented by BBAC	- BMA has a constructive working relationship with Barada Barna People, who are the registered native title holders of land which includes SSM - BBAC and BMA meets regularly as part of the BBAC-BMA Relationship Committee - BMA holds a project-wide Native Title Project Agreement with BBAC on behalf of Barada Barna peoples. SSM falls within the Agreement area. The Agreement was signed in August 2024 - From a rehabilitation and closure perspective, BMA is working with BBAC specifically on provision of seed for rehabilitation and contracting opportunities for rehabilitation execution	- Aspirations around rehabilitation and potential commercial opportunities as a PMLU - How operational management and/or rehabilitation could contribute to future use of the areas - Recognition and management of cultural heritage impacts - Native Title and land acquisition interests - PMLUs, NUMAs and landforms - Future access to and ownership of land - Environmental management/stewardship - Employment and business opportunities in rehabilitation, environmental management and monitoring	Existing PMLUs and NUMAs were discussed with BBAC and they expressed their desire to be involved in the activities required to support execution of the rehabilitation and management milestones for PMLUs and NUMAs

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
Underlying landowners, nearby landowners and licensees of BMA land			
- Private landowners within 5km - Licensees and lessees - Department of Transport and Main Roads (DTMR) - IRC	- BMA has longstanding relationships with the private owners of land within SSM's EA area - BMA engages with nearby landowners and residents through community forums, letters, emails and letterbox drops, on an as-needed basis - BMA engages on an as-needs basis with licensees and lessees regarding land management, commercial arrangements and licence terms and conditions - BMA engages with DTMR on an as-needed basis with respect to land occupied by rail infrastructure - IRC is the owner of Golden Mile Road, Warwick Park Road, Silver K Road and Picardy Road within the SSM EA area,	- Environmental management /stewardship - PMLUs, NUMAs and landforms - PRCP schedule - Future access to and ownership of land when it is no longer required for mining - Water usage, quality and access to groundwater and surface water (e.g. water allocations, water pipelines, etc.) - Potential impacts on roads and road reserves - Potential impacts on rail infrastructure - Potential impacts on land, property and future business value relating to PMLUs, NUMAs and timing of impacts	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	engagement with IRC is discussed below		
Local Government			
IRC	- BMA has a long established and cooperative relationship with IRC - BMA provides regular updates on PRCPs to IRC, as part of biannual IRC-BMA meetings which discuss a range of topics, and as part of additional issue-specific meetings from time to time	- Local employment - Effects on Council services and infrastructure - Environmental management /stewardship - Rehabilitation progress - PMLUs, NUMAs and landforms - Potential impacts on environmental qualities, amenity or traffic conditions during closure or rehabilitation activities - Management of closure impacts on employment and businesses - Alignment of rehabilitation plans with local and regional planning goals - Economic transformation (towards post-mining) and community sustainability - Potential cumulative impacts of closure of multiple mining assets	- Transitional provisions for the PRCP were discussed. IRC understand the PMLUs as per the EA are being transitioned into the PRCP. - IRC requested further information and engagement to understand how BMA and IRC could work together on potential innovative approaches to end of life mines and long term futures of the local communities post mining. These innovative approaches would need to provide commercial viability as well as ecological and social functionality. IRC have been interested to understand the challenges to facilitate future changes.

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		in a similar timeframe e.g. job and population losses	BMA has committed to engage with IRC on this going forward
Residents, businesses and community groups			
Dysart residents, landowners, businesses and community organisations and groups	- BMA engages with Dysart residents, businesses and community organisations through stakeholder meetings, media and social media, and Community Connect, a regular BMA newsletter - Engagement activities with community members ranges from one-off responses to enquiries, to community events and forums, and ongoing engagement processes such as partnerships with community organisations and industry bodies	- Timing of closure - Rehabilitation obligations and progress - Environmental management /stewardship - Employment continuity - PMLUs, NUMAs and landforms - Management of closure impacts on employment and businesses - Economic and community sustainability - Local employment and business opportunities in rehabilitation works	No feedback was received in relation to PMLUs or NUMAs at SSM
Dysart STAC	The Smart Transformation Project including the Dysart STAC was established by BMA in 2019. Dysart STAC members meet every two months to	As above, with a particular focus on community and economic development and transformation	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	consider a range of issues and priorities related to the future and sustainability of Dysart's community and economy.		
Isaac Business Chamber	The Isaac Business Chamber was established in early 2024 and represents businesses across the IRC local government area. BMA has engaged with Isaac Business Chamber through community forums.	As above, with a particular focus on business and economic development opportunities associated with mining and/or rehabilitation works	No feedback was received in relation to PMLUs or NUMAs at SSM
Utility owners / easement holders with assets within the EA area			
- QR - Aurizon Network - DTMR - Ergon Energy - Powerlink including Q.E.C. Ltd - IRC	BMA has constructive working relationships and engages with utility owners and easement holders as required (issue-specific or transactional engagement) with respect to the following: - Norwich Park Railway (and loop) (operated by Aurizon Network, with infrastructure owned by QR and land owned by DTMR) - Dysart Middlemount Road (owned by IRC)	- Impact on assets/asset value - Remediation of impacts on assets - Any service disruptions and mitigations - Crossing/interface agreements - Timeframe for decommissioning utilities that service SSM - Cost of decommissioning utilities	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	- Road reserves for Warwick Park Road, Silver K Road, Picardy Road and Golden Mile Road owned by IRC - Powerlines (owned by Ergon Energy within Golden Mile Road reserve) - Powerlines (owned by Powerlink within Q.E.C. Ltd power easement, on land owned by BMA) - Stock route (classified as minor and unused) aligned with Golden Mile Road.		
SSM operations			
BMA workforce	BMA maintains ongoing communication with its workforce through 'toolbox' talks, email communications and a weekly digital newsletter, Coal Connect	- Timing of closure - Rehabilitation obligations - Employment continuity - Management of closure impacts on employment and businesses - Economic and community sustainability	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		Local employment and business opportunities in rehabilitation works	
BMA suppliers			
SSM suppliers	BMA has relationships with an extensive network of small business suppliers in the Isaac, Mackay and Whitsunday regions. BMA communicates with suppliers through the BMA community-related Local Buying Program (C-RES) portal, and via Community Connect.	- Loss of supply opportunities with closure - Opportunities to participate in supply chain for closure and/or rehabilitation works - Economic transformation (towards post-mining) - Economic and community sustainability	No feedback was received in relation to PMLUs or NUMAs at SSM
Adjoining/nearby resource interests			
- Lake Vermont (Bowen Basin Coal Pty Ltd) - Middlemount Coal Mine (Middlemount Coal Pty Ltd) - German Creek Mine (Anglo Coal (German Creek) Pty Ltd) - Dysart East Project (Bengal Coal Pty Ltd)	- BMA liaises with adjoining and nearby mining and resource interests on an as-needed basis - BMA also engages with nearby petroleum resource holders in accordance with <i>Mineral and Energy Resources (Common Provisions) Act 2014</i> (Qld) (MERC Act) requirements for petroleum overlap activities	- Future land use and ownership - Collaboration on good industry rehabilitation and closure practices - Cumulative impacts and opportunities of mine closures	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
- Queensland Coking Coal Pty Ltd (Vitrinite) - Scap Exploration Pty Ltd - Boardwalk Sienna Pty Ltd Adjacent and nearby Authority to Prospect (ATP) and Petroleum Commercial Area: - CH4 Pty Ltd (Arrow Energy) - Bow CSG Pty Ltd - AGL Energy Limited - Arrow CSG (ATP 364) Pty Ltd			
Queensland Government			
Queensland Government departments: - DoR – Deputy Director-General (DDG), Georesources - Department of Agriculture and Fisheries (DAF) – DDG, Fisheries and Forestry - DESI – Queensland Parks and Forests	- BMA has constructive working relationships with DoR - DoR's DDG Georesources has asked to be kept informed on PRCPs - Bundoorra State Forest is located 5 km south-west of ML70126. Coolibah Nature Reserve is located approximately 5km north-east of SSM, and Norwich Park Nature	- Legislative compliance - Resource development - Employment opportunities - Public interest - Environmental management - Economic transformation (towards post-mining) - Financial assurance	No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	Refuge is located adjacent to SSM's EA area. BMA has not engaged with DAF or DESI – Queensland Parks and Forests specifically regarding SSM in relation to state forests or nature reserves.	- Environmental risk management - Future land use and landform - Company responses to stakeholder views	
Offices of the Ministers for: - Resources and Critical Minerals - Environment and the Great Barrier Reef; and Science and Innovation - Energy and Clean Economy Jobs - Agricultural Industry Development and Fisheries; and Rural Communities - Regional Development and Manufacturing, and Water Members of Parliament - Member for Burdekin and Shadow Minister for Natural Resources and Mines	BMA conducts regular engagement with Ministers and Members of Parliament. Employment growth and sustainable community and economic development are key priorities for Queensland Government stakeholders		No feedback was received in relation to PMLUs or NUMAs at SSM

Stakeholder	Existing relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
- Shadow Minister for Environment and the Great Barrier Reef and Shadow Minister for Science and Innovation - Shadow Minister for Energy and Cost of Living - Shadow Minister for Water and the Construction of Dams - Shadow Minister for Regional Development and Manufacturing			

Table 24: Process to be followed for ongoing community consultation for SSM PRCP

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP	
- Barada Barna People - Private landowners within and nearby (within 5km) the SSM EA area - Licensees of land within or adjacent to the EA area - IRC	Meet with landholders, licensees, BBAC and IRC to provide an update on the PRCP and progress with rehabilitation, and invite their inputs and feedback on: - PMLUs, NUMAs and post-mining landforms, including any particular values or opportunities in specific disturbed areas - Rehabilitation methods which would optimise future woodland habitat and/or grazing opportunities, and potential land management requirements - Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management, or research partnerships - Rehabilitation methods, schedule and progress towards milestones	As required, to a schedule agreed with representatives
- Private landowners within and nearby (within 5km) the SSM EA area - Licensees of land within or adjacent to the EA area	Advise the landowners and licensees in writing regarding any proposed changes to the SSM PRCP that have potential to affect interests in freehold land within or adjacent to the EA area.	As required, as part of the PRCP amendment process
	Meet with landowners and licensees to discuss any proposed changes to the PRCP and progress with rehabilitation, and invite their inputs and feedback on: - Land use/management/rehabilitation issues as relevant to the private freehold land - Access to water resources - Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management, or research	As required, as part of the PRCP amendment process
	Correspond and if requested meet with landholder and licensees during the pre-closure, closure/decommissioning and rehabilitation periods, to reduce the potential for works to impact on their amenity, land use, property access or access to water.	5 years prior to the forecast cessation of mining, at least annually, or as agreed with the landowner

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP	
Barada Barna People	Meet with BBAC to provide an update on the PRCP and progress with rehabilitation, and invite inputs and feedback on: - Access to land within the EA area as provided in the Native Title Project Agreement - Involvement of businesses owned by Barada Barna People in rehabilitation works - Pipeline of opportunities relating to rehabilitation work and land management	As part of regular updates to a schedule agreed with BBAC
IRC	Meet with IRC as part of consultation on proposed amendments to the PRCP, to invite their inputs and feedback on: - Future use and management of land owned by IRC within the EA area - Impacts and opportunities pertaining to IRC assets within the EA area - IRC's strategic analysis and planning for the area - Challenges, opportunities and community aspirations of relevance to mine closure and rehabilitation - IRC's intended economic and social transition approaches - Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management or research	As required, to a schedule agreed with IRC
	Provide progressive rehabilitation information as part of regular meetings with IRC.	As required, to a schedule agreed with IRC
	Engage with IRC to seek inputs on: - Any impacts of SSM's closure and/or rehabilitation works on Council assets or services - Any impacts of SSM's closure and/or rehabilitation works on community amenity - Rehabilitation methods and potential land/water management requirements	5 years prior to the forecast cessation of mining, at least annually, or as agreed with representatives

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP	
BMA personnel	Keep the BMA workforce updated via internal newsletters/emails or toolbox talks if there are substantive changes to the PRCP, e.g., significant changes in rehabilitation milestones or plans for the cessation of mining at SSM, and including a communication channel for personnel to ask questions or contribute to discussions about PRCPs and rehabilitation.	Ongoing engagement process
	Commencing 5 years prior to the forecast cessation of mining, provide regular updates to BMA personnel on the implementation of closure, and seek personnel's feedback on rehabilitation progress.	5 years prior to the forecast cessation of mining, at least annually
Dysart residents, community members, business owners and community groups	Via workshops or focus groups, seek involvement in articulating community aspirations for rehabilitation, and economic transformation opportunities related to PMLUs or NUMAs.	As required, or as agreed with representatives
	Provide community updates if there are any substantive changes and associated PRCP amendments required, via mail-out letters.	As required, as part of the PRCP amendment process
	Provide updates and briefings on PRCPs to the Moranbah and Dysart STACs.	On request
- DAF - DDG - DESI - Regional Director, Central, Queensland Parks and Forests	Provide written updates on PRCP implementation and proposed amendments to the DDG, Fisheries and Forestry, inviting feedback on any considerations with regard to the Bundoora State Forest.	As required to address consultation requirements for amendment of the SSM PRCP
	Provide written updates on PRCP implementation and proposed amendments to the Regional Director Mackay, Queensland Parks and Forests (DESI), inviting feedback on any considerations with regard to the Coolibah Nature Reserve and Norwich Park Nature Refuge.	

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	2. To support transparent access to information about the SSM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, SSM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes	
Dysart residents, community members, business owners, community groups	Using community forums such as interagency meetings, community meetings, supplier networks, partnership meetings and business network meetings, provide regular community updates on SSM PRCP and implementation.	Ongoing engagement process
	Invite input to final planning for closure, including management of closure impacts, via a workshop, community forum or other means.	3 years prior to the forecast cessation of mining
SSM suppliers	Provide regular updates about business supply opportunities resulting from progressive rehabilitation work packages, including through the Isaac Business Chamber.	As required
	Participate in initiatives led by IRC, Isaac Business Chamber, industry or local communities which aim to harness social value from mine closure and rehabilitation planning, and/or work towards economic transformation.	As required, or as agreed with representatives
	Provide information about the pending closure of SSM and potential future supply opportunities as part of closure and rehabilitation to local businesses, Traditional Owner businesses and SSM suppliers.	3 years prior to the forecast cessation of mining, subsequent consultation to be agreed

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	2. To support transparent access to information about the SSM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, SSM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes	
Elected representatives and Queensland Government agencies	Provide updates via letters and/or meetings on PRCPs to: - DESI PRCP team - DESI – Regional Director, Central, Queensland Parks and Forests - DoR – DDG, Georesources - DoR – Director, Native Title Services and Coal Hub - DAF – DDG, Fisheries and Forestry - DTMR - Offices of the Ministers for: - Resources and Critical Minerals - Environment and the Great Barrier Reef; and Science and Innovation - Energy and Clean Economy Jobs - Agricultural Industry Development and Fisheries; and Rural Communities - Regional Development and Manufacturing; and Water - Queensland Parliament Member for Burdekin - Shadow Minister for Department of Resources - Shadow Minister for Environment and the Great Barrier Reef; and for Science and Innovation - Shadow Minister for Energy and Cost of Living - Shadow Minister for Water and the Construction of Dams - Shadow Minister for Regional Development and Manufacturing	As required, or as agreed with representatives

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	3. To engage with utility owners and operators, and adjacent mining and energy tenement holders, to provide information about SSM closure planning that supports them to manage their assets and interests	
QR and Aurizon Network	Maintain correspondence with QR and Aurizon Network regarding progressive rehabilitation activities as they affect rail assets or operation, and undertake consultation regarding the decommissioning of rail interfaces.	As required, or as agreed with representatives
Utility owners and operators: - QR - Aurizon Network - DTMR - Ergon Energy - Powerlink - IRC	Engage with utility owners and easement holders that have interests in land or infrastructure within the EA area to: - Inform them of closure timelines and rehabilitation activities relevant to land or infrastructure in which they have an interest - Seek inputs about potential impacts on utility/transport assets and/or service capacity, and any specific management measures to avoid impacts on utility assets and services	3 years prior to the forecast cessation of mining
	Maintain engagement regarding progressive rehabilitation and undertake consultation regarding crossing/interface agreements, as required if rehabilitation will affect utilities	Initiated 3 years prior to decommissioning

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	3. To engage with utility owners and operators, and adjacent mining and energy tenement holders, to provide information about SSM closure planning that supports them to manage their assets and interests	
Nearby mining interests: • Lake Vermont (Bowen Basin Coal Pty Ltd) • Middlemount Coal Mine (Middlemount Coal Pty Ltd) • German Creek Mine (Anglo Coal (German Creek) Pty Ltd) • Dysart East Project (Bengal Coal Pty Ltd) • Queensland Coking Coal Pty Ltd (Vitrinite) • Scap Exploration Pty Ltd • Boardwalk Sienna Pty Ltd Adjacent and nearby ATPs and Petroleum Commercial Area: • CH4 Pty Ltd • Bow CSG Pty Ltd • AGL Energy Limited • Arrow CSG (ATP 364) Pty Ltd	• Write to advise adjacent and nearby resource interests if there are any substantive changes to the closure and rehabilitation schedule in future iterations of the SSM PRCP	As required, as part of the PRCP amendment process

Relationship with PRCP schedule

SSM has transitional provisions and approved land outcomes identified in the EA. Community engagement on the proposed PMLUs and NUMAs within the EA being transitioned to the PRCP, and the proposed rehabilitation approach, has been undertaken prior to submission of the transitional SSM PRCP. Consultation will continue as per the process documented in the community consultation plan.

There was no feedback received following the distribution of the transitional PRCP consultation letters or to the information provided via Community Connect and Coal Connect.

3 POST-MINING LAND USES

Legislative Requirement

In accordance with section 126C(1)(d) of the EP Act, the rehabilitation planning part of the PRC Plan must state the extent to which each post-mining land use for land identified in the PRC PLAN schedule for the plan is consistent with:

1. the outcome of consultation with the community in developing the plan, and
2. any strategies or plans for the land of a local government, the State or the Commonwealth.

PRCP Guideline (Section 3.2)

A PMLU is defined under section 112 of the EP Act as the purpose for which the land will be used after all relevant activities for the PRC Plan carried out on the land have ended. Relevant activity for a PRC Plan is defined in the EP Act as the relevant activities to be carried out on land the subject of the plan. It is not the intention of this definition to include third-party activities or assets that continue to exist once mining activities have ceased, such as third-party pipeline easements, power easements or overlapping tenures for other EAs.

The rehabilitation planning part of the PRC Plan must include a detailed description of the nominated PMLU(s) for the site. The description must include (where relevant), but is not limited to:

- a description of the use of the land
- if applicable, the specific vegetation types (e.g. RE 13.2.9) or land suitability classification (e.g. Class 4)
- identification of any permanent or essential management infrastructure to be included as part of the PMLU
- completion criteria for measuring whether the PMLU has been successfully achieved

Where a PMLU has been previously addressed in a land outcome document and is able to be transitioned into the PRCP Schedule, the holder is not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those PMLUs.

However, the legislative requirements under section 126C(1)(d) of the EP Act still apply. All PMLUs transitioned into the PRCP Schedule must still meet the requirements of a PMLU explained in this section, particularly that the PMLU can be rehabilitated to a stable condition.

Where PMLUs have not been pre-approved, the applicant must include all of the requirements stated in this section.

3.1 Nominated PMLUs

A number of PMLUs are permitted for SSM under the EA (Table E1 in the SSM EA), of which the following are proposed as PMLUs at SSM:

- Cattle grazing
- Woodland habitat
- Watercourse
- Dryland cropping

The proposed PMLUs are illustrated in Figure 16 and have been recommended based on the closure landform, existing vegetation, ecological values, pre-mining and current land uses and the outcomes of the rehabilitation and closure studies supporting this PRCP. The PMLUs are underpinned by rehabilitation objectives that focus on achieving a safe, stable, non-polluting, and sustainable post-mining landscape (as defined in the EA).

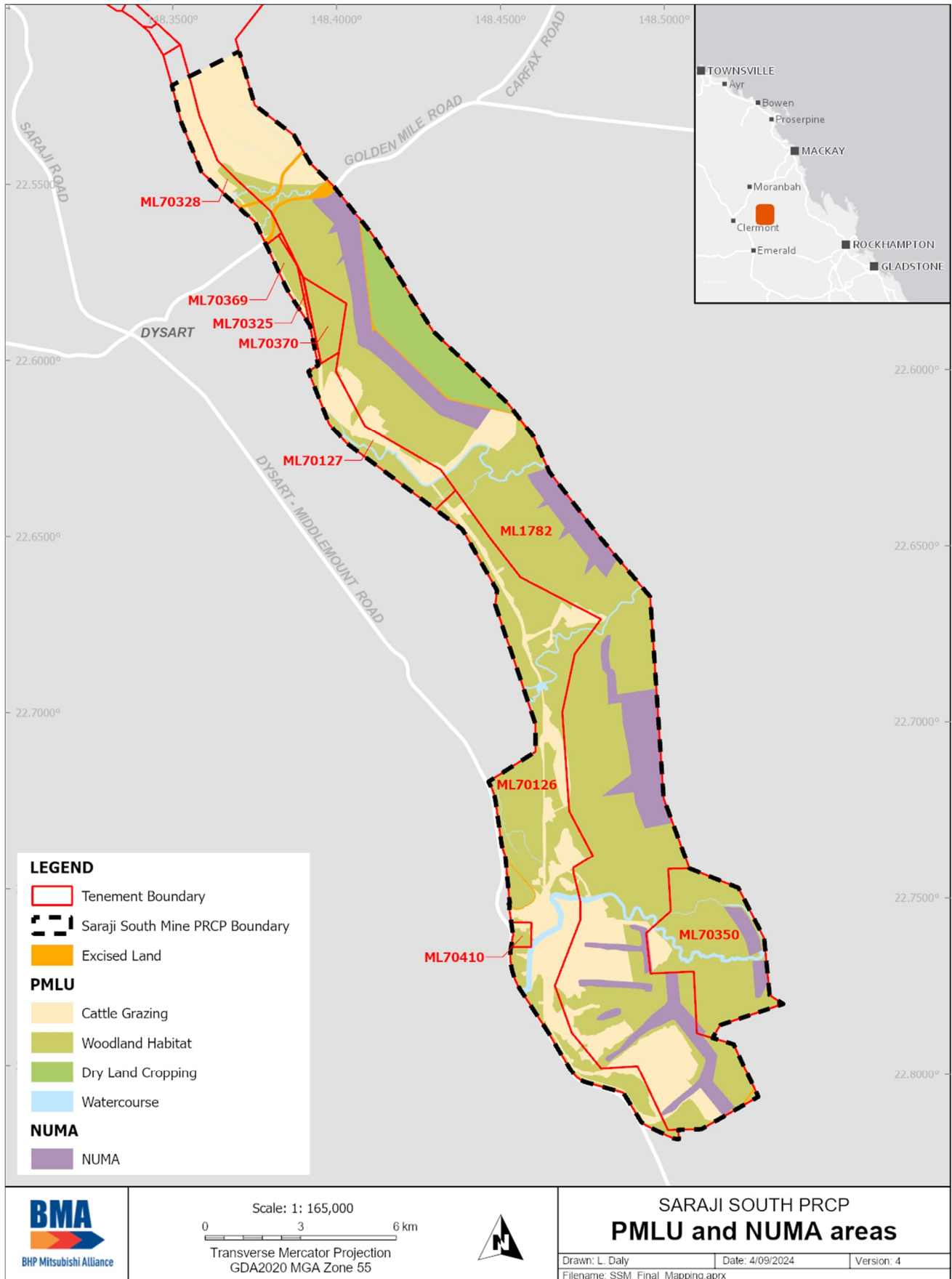


Figure 16: SSM PMLUs and NUMAs

3.1.1 Cattle grazing

3.1.1.1 Planned cattle grazing

The EA objectives, indicators and acceptance criteria for the planned cattle grazing PMLU are listed in Table 25. As the SSM EA is an approved LOD, BMA understands the legislative intent was to transition the relevant EA acceptance criteria to the milestone criteria for the final milestone of achievement of the PMLU to a stable condition of cattle grazing (RM13). The final milestone criteria for RM13 (Section 10.4) accords with the criteria imposed by the administering authority during assessment of the SRM PRCP. During that process, the administering authority modified and expanded the criteria originally proposed by BMA. Further context as to the inclusion of this criteria is outlined at Section Transitional Provisions.

At SSM, cattle grazing PMLU is predominately planned for existing cattle grazing rehabilitation, lower gradient areas disturbed by mining activities, areas that require shallow rooted species and/or areas where significant clearing occurred prior to mining.

Table 25: SSM EA PMLU objectives, indicators and acceptance criteria: cattle grazing

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of Safety	≥1.5
	Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	1. Groundcover >50% 2. 70% of slopes ≤20%
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: a) The EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or b) Local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
Able to sustain the agreed post-mining land use	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Land suitability class ≤3 or not different from pre-mining class if ≥4. Assessment completed in accordance with <i>LSA Framework for Open-Cut Coal Mine Rehabilitation 2018 (A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland)</i> (Short, 2018) unless otherwise agreed in writing between the

Goal	Objective	Indicator	Acceptance criteria
			administering authority and the environmental authority holder.
		Leucaena stem density	<250 stems >2m height per ha (1 per 40m ²), mean total area

Pre-mining cattle grazing land suitability class

The pre-mining land suitability assessment specified in the EA acceptance criteria is based on the five land suitability classes defined under the *Guidelines for Agricultural Land Evaluation in Queensland* (DSITI & DNRM, 2015). Land suitability decreases progressively from Class 1 (suitable land with negligible limitations) to Class 5 (unsuitable land with extreme limitations). The SSM pre-mining land suitability class desktop assessment results for cattle grazing are discussed in Section 1.2.6.1.

Post-mining cattle grazing land suitability class

The post-mining cattle grazing land suitability assessment referred to in the EA acceptance criteria was *A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland*, developed by Short (2018).

The PRCP milestone criteria for achieving the PMLU to a stable condition for cattle grazing (RM13) will be assessed according to the land suitability framework presented in the *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin: Technical Paper 1* (Short, 2023) from the Office of the Queensland Mine Rehabilitation Commissioner (OQMRC) (Table 26). This land suitability framework has minor changes from the rule-set referred to in the EA (Table 25) and will be adopted for the PRCP to align with the OQMRC leading practice paper. Land suitability decreases progressively from Class 1 (suitable - land capable of attaining maximum grazing productivity) to Class 5 (unsuitable - land that is not suitable for cattle grazing).

Rehabilitation activities will aim to achieve a land suitability class of 3 or better. However, monitoring of cattle grazing reference sites has shown that land in the broader area often decreases to class 4 and class 5 due to the limitations of water availability, soil nutrient (nutrient deficiency – phosphorus and/or nutrient availability and toxicity – acidity/alkalinity) or sub-soil erosion. Therefore, cattle grazing rehabilitation at SSM can also be class 4 for these same limitations, however the rehabilitation must also be assessed for Grazing Land Management ABCD land condition (Section 3.1.1.2).

Reference sites (Section 8.4.1) will also be assessed according to the land suitability framework (Table 26) to enable a comparison between the performance of cattle grazing rehabilitation and the representative cattle grazing land suitability class of the broader area.

Table 26: Regional land suitability framework for beef cattle grazing PMLU rehabilitation in the Bowen Basin (Short, 2023)

Limitation	Indicator	Suitable			Unsuitable	
		Class 1	Class 2	Class 3	Class 4	Class 5
Water availability	Soil water storage (mm)	>75	75 - 60	<60 - 40	<40 - 30	<30
Nutrient deficiency	Available-P (mg/kg) in 0 - 0.1m depth increment	>20	20 - 14	<14 - 8	<8 - 4	<4
Nutrient availability and toxicity	pH in 0 - 0.1m depth increment	7.3 - 6.6	< 6.6 - 6.0 >7.3 - 7.9	<6.0 - 5.6 >7.9 - 8.4	<5.6 - 5.0 >8.4 - 9.0	<5.0 >9.0
Surface condition	Surface condition	Fine (peds <10mm)	Coarse (peds >10mm)	Surface crust	Very hard setting	Massive
Salinity	ECe (dS/m) in effective rooting depth (ERD) (0-0.6m depth increment)	<2	2 - 4	>4 - 10	>10 - 16	>16
Rockiness	Gravel, 20 - 60mm (%)	<20	20 - 50	>50 - 70	>70 - 85	>85
	Cobble, 60 - 200mm (%)	<10	10 - 20	>20 - 50	>50 - 75	>75
	Stone, 200 - 600mm (%)	<2	2 - 10	>10 - 20	>20 - 50	>50
	Boulders, >600mm (%)	0	<2	2 - 10	>10 - 20	>20
Slope gradient	Slope gradient (%)	<5	5 - 10	<10 - 15	>15 - 20	>20
Microrelief	Vertical (m)	0	<0.2	0.2 - 0.4	>0.4 - 0.6	>0.6
Water erosion	Slope (%), ESP <6 (%) in 0-0.1m soil depth increment	<5	5 - 8	> 8 - 12	>12 - 18	>18
	Slope (%), ESP >6 - 14 (%) in 0-0.1m soil depth increment	<3	3 - 6	>6 - 10	>10 - 12	>12
	Slope (%), ESP >14 (%) in 0-0.1m soil depth increment	<1	1 - 2	>2 - 4	>4 - 6	>6
Sub-soil erosion	ESP (%) at 0.5m depth	<6	6 - 14	> 14 - 23	>23 - 34	>34
Potentially acid forming materials	Strongly acid conditions (pH < 4.5) within (x) m depth	>3	3 - 2	<2 - 0.9	<0.9 - 0.6	<0.6

3.1.1.2 Existing cattle grazing

For areas of existing progressing cattle grazing rehabilitation (RA7, RA17), the final milestone for achieving the PMLU to a stable condition for cattle grazing (RM17) includes a milestone criteria for the assessment of cattle grazing land condition as described in the *Queensland Reef Protection Regulations Farming in Reef Catchments Grazing Guide* (DES, 2022a).

Land condition means “the capacity of grazing land to respond to rain and produce useful forage” (DES, 2022a). Indicators of land condition include “the proportion of organic ground cover, density of desirable perennial pasture species (i.e. grasses that are perennial, productive and palatable (3P) for cattle), extent of erosion and presence of weeds” (DES, 2022a).

Land condition is classified into four broad categories under the Grazing Land Management ABCD land condition framework based on indicators associated with pasture and soil condition, as detailed DES (2022a) (Table 27). For cattle grazing rehabilitation to achieve the PMLU to a stable condition, land condition must be assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas. When land is in a Poor (C) or Degraded (D) condition, maintenance measures are required to improve the land condition.

Table 27: Grazing Land Management ABCD Land Condition Framework (DES, 2022a)

Land Condition	Land Condition Features
Good – A	A condition land has all of the following features: • most land types in good condition will typically have at least 50% and often above 70% ground cover at the end of the dry season • good density of perennial grasses dominated by those species considered to be 3P grasses for that land type, little bare ground (less than 30 % in most years) • few weeds and no significant infestations • good soil condition: no erosion, good surface condition
Fair – B	B condition land has at least one or more of the following features, but otherwise is similar to A condition land: • land types will typically have at least 50% ground cover and less than 70% in most years at the end of the dry season • some decline of grasses that are 3P grasses, increase in other species (less favoured grasses, weeds) and/or bare ground (more than 30% but less than 50% in most years) • some decline in soil condition, some signs of previous erosion and current susceptibility to erosion
Poor – C	C condition land has one or more of the following features, but otherwise is similar to B condition land: • land with poor or degraded condition will typically have less than 50% ground cover at the end of the dry season • general decline of grasses that are 3P grasses, large amounts of less favoured species and/or bare ground (greater than 50% in most years) • obvious signs of past erosion and/or current susceptibility to erosion is high
Degraded – D	D condition land has one or more of the following features: • generally less than 20% ground cover • general lack of any perennial grasses or forbs • severe erosion or scalding, resulting in hostile environment for plant growth

Land Condition	Land Condition Features
	often no long-term ability to carry stock

3.1.2 Woodland habitat

3.1.2.1 Planned woodland habitat

The EA objectives, indicators and acceptance criteria for a PMLU of woodland habitat are listed in Table 28. As the SSM EA is an approved LOD, BMA understands the legislative intent was to transition the relevant EA acceptance criteria to the milestone criteria for the final milestone of achievement of the PMLU to a stable condition of woodland habitat (RM14). The final milestone criteria for RM14 (Section 10.4) accords with the criteria imposed by the administering authority during assessment of the SRM PRCP. During that process, the administering authority modified and expanded the criteria originally proposed by BMA. Further context as to the inclusion of this criteria is outlined at Section Transitional Provisions.

At SSM, woodland habitat PMLU is planned for existing woodland habitat rehabilitation, spoil dumps, including the low-wall within RA1, and areas near existing vegetation communities.

Table 28: SSM EA PMLU objectives, indicators and acceptance criteria: woodland habitat

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5 unless an alternative is justified by an appropriately qualified engineer
	Rehabilitation is erosionally stable	Groundcover (steep slopes, >15%)	80%
		Groundcover (lesser slopes, ≤15%)	50%
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: - the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or - local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.

Goal	Objective	Indicator	Acceptance criteria
Able to sustain an agreed post-mining land use	Native bushland habitat characteristics	Species richness:	
		Trees Shrubs Grasses	≥2 ≥3 ≥4
		Tree canopy cover	≥16 %

3.1.2.2 Existing woodland habitat

For areas of existing woodland habitat rehabilitation (RA10, RA19), the final milestone criteria for RM18 (Section 10.4) is aligned to the criteria agreed with the administering authority following significant PRCP engagement for other BMA sites (Section Transitional Provisions).

3.1.3 Watercourse

The EA objectives, indicators, and acceptance criteria for a PMLU of watercourse are listed in Table 29. These criteria were developed specifically for diversions, although they can be applied to watercourse rehabilitation. As the SSM EA is an approved LOD, BMA understands that the legislative intent was to transition the relevant EA acceptance criteria to the milestone criteria for the final milestone of achievement of the PMLU to a stable condition of watercourse (RM15). The final milestone criteria for RM15 (Section 10.4) accords with the criteria imposed by the administering authority during assessment of the SRM PRCP. During that process, the administering authority modified and expanded the criteria originally proposed by BMA. Further context as to the inclusion of this criteria is outlined at Section Transitional Provisions.

The watercourses that transverse through SSM, and any associated diversions, are assigned a watercourse PMLU. These include Downs Creek, Lotus Creek, Stephens Creek, Scott Creek, Sandy Creek and Rolf Creek (Section 1.2.4). Watercourse PMLU is also planned for surface water diversions and various creek crossings in natural watercourse reaches.

The lateral limits of the watercourse PMLU were defined based on the following considerations:

- Aerial imagery of the creeks and drainage diversion/ structures and associated riparian vegetation (Section 1.2.8)
- Strahler stream orders (Section 1.2.4)
- Flood modelling (Section 6.1.2)
- Diversion designs (Section 6.1.7)

Table 29: SSM PMLU objectives, indicators and acceptance criteria: watercourse

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference.
Stable	Rehabilitation is erosionally stable	Geomorphic index (Index of diversion condition (IDC) method)	Greater or equal to upstream or downstream values.

Goal	Objective	Indicator	Acceptance criteria
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values.
Able to sustain an agreed post-mining land use	Riparian vegetation	Riparian vegetation index (IDC method)	Greater or equal to upstream or downstream values.

3.1.4 Dryland Cropping

The EA objectives, indicators and acceptance criteria for a PMLU of dryland cropping are listed in Table 30.

The SCL trigger map indicates there are SCL areas within SSM, predominately in the north and north-east of the site. As detailed in Section 1.2.10.1, an on-ground assessment has not verified the SCL trigger map areas are suitable SCL, however cropping is currently undertaken on ML1782 predominately within the nil surface area to the east of Silver K Road.

Dryland cropping PMLU is planned at SSM for this existing cropped area to the east of Silver K Road. Mining activities are not planned to disturb this area, therefore no RA is planned for this area (Figure 27).

Table 30: SSM EA PMLU objectives, indicators, and acceptance criteria: dryland cropping

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No Significant difference
Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
	Rehabilitation is erosionally stable	Percentage of cultivation at >1% slope gradient with functional contour banks	100% of rehabilitated areas
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: a) The EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones;

Goal	Objective	Indicator	Acceptance criteria
			Or b) Local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
Able to sustain the agree post-mining land use	Rehabilitation is suitable for sustainable dryland cropping	Land suitability assessment for dryland cropping	Land suitability class ≤ 3 or not different from pre-mining class ≥ 4 . Assessment completed in accordance with the <i>Regional Land Suitability Frameworks for Queensland 2013</i> unless otherwise agreed in writing between the administering authority and the environmental authority holder.

3.2 Community considerations

The proposed PMLUs of cattle grazing, woodland habitat, watercourse and dryland cropping as presented in the EA and this PRCP, is consistent with the outcomes of community consultation completed to date (Section 2). No concerns on the proposed PMLUs were raised during community consultation, including:

- Consultation with BBAC - the PMLUs have been discussed with the BBAC as part of ongoing consultation regarding the development of the PRCPs. This consultation included discussion on opportunity for BBAC's involvement in rehabilitation activities as it relates to the proposed PMLUs, specifically on the provision of seed and contracting opportunities for rehabilitation execution.
- Consultation with IRC – BMA has provided regular PRCP briefings to the IRC which have detailed that the proposed PMLUs as per the EA, are being transitioned into the PRCP. IRC and BMA have agreed to continue to engage on future opportunities, challenges and community aspirations, relevant to mine rehabilitation and closure as they develop.
- No feedback or enquiries in relation to PMLUs were received as part of the consultation.

3.3 Regional planning integration

The PMLUs at SSM consider the pre-mining and current land use, and already approved PMLUs in the SSM EA (Section 3.1).

Under the Isaac Regional Planning Scheme (Isaac Regional Council, 2021), SSM is located in a rural zone. This includes primary production uses (such as cropping, intensive horticulture, aquaculture, grazing, intensive animal industries, animal husbandry and animal keeping), renewable energy facilities and extractive industries, outdoor recreation and small-scale tourism facilities. The purpose of the rural zone includes providing “for other uses and activities that are compatible with: (i) existing and future rural uses and activities; and (ii) the character and environmental features of the zone...” (Isaac Regional Council, 2021).

Land use performance outcomes (PO11) for this rural zone include ensuring development:

- ‘(a) is consistent with the rural character of the locality;
- (b) supports the primary rural function of the zone;
- (c) protects rural, natural and scenic values of the locality; and
- (d) includes boundary realignments where used to align with mining or petroleum tenements’.

Concurrently, the Queensland Government - via the Mackay, Isaac and Whitsunday Regional Plan (DLGP, 2012), maps SSM in a regional landscape and rural production area, which includes land used for agriculture,

natural economic resources (including extractive resources), water catchment, traditional uses, conservation areas and native forests.

The defined uses for both of these plans are consistent with the PMLUs proposed for SSM.

Relationship with PRCP Schedule

The proposed PMLUs for SSM are consistent with pre-mining and current land uses, and PMLUs already approved as part of the EA. These PMLUs can also be aligned to future land use development outcomes defined as part of State and regional plans.

The PMLU extents consider the closure landform, growth media, pre-mining land uses, existing vegetation, ecological values, watercourses and surrounding public infrastructure.

4 NON-USE MANAGEMENT AREAS

Legislative Requirement

In accordance with sections 126C(1)(d), (g) and (h) of the EP Act, for each proposed non-use management area, the rehabilitation planning part of the PRC Plan must:

- *state the reasons the applicant considers the area cannot be rehabilitated to a stable condition*
- *include copies of reports or other evidence relied on by the applicant for each proposed non-use management area*
- *state the extent to which the proposed non-use management area is consistent with the outcome of consultation with the community in developing the plan, and*
- *state the extent to which the non-use management area is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.*

PRCP Guideline (Section 3.3)

A NUMA is defined in the EP Act as an area of land the subject of a PRC Plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC Plan carried out on the land have ended. Proposed NUMAs must be justified under the criteria set out in section 126D(2) of the EP Act.

The rehabilitation planning part of the PRC Plan must also include:

- a) information demonstrating that the proposed footprint of each NUMA is as small as practicable*
- b) an assessment of the NUMA location options, having regard to the constraint of the resource location, with an analysis of the potential environmental harm and sensitivity of the surrounding environment of each option*
- c) a description of the proposed location of each NUMA and the environmental values of the surrounding environment*
- d) evidence showing how the proposed location will prevent or minimise environmental harm.*

In accordance with section 126D(1)(c) of the EP Act, the applicant must develop and implement management milestones within the PRCP Schedule which achieve best practice management and minimise environmental harm for any NUMAs contained in the proposed PRC Plan. As part of the development of management milestones, the applicant must conduct a NUMA specific risk assessment to identify and quantify risks and associated controls. The risk assessment should have an overarching goal of identifying and controlling any significant risks to the community and the environment.

The proposed PRC Plan must include a detailed description of the nominated NUMA(s) for the site. The description must include, but is not limited to:

- description of the land at surrender*
- any relevant safety features*
- completion criteria for measuring whether the NUMA has achieved sufficient improvement.*

Where a NUMA has already been identified in a land outcome document and is able to be transitioned into the PRCP Schedule, the applicant is not required to comply with sections 126C(1)(g) or (h) or 126D(2) or (3) of the EP Act. NUMAs transitioned into the PRCP Schedule are not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those NUMAs. However, the legislative requirements under section 126C(1)(d) of the EP Act still apply.

Where a NUMA has not been pre-approved and is proposed as part of the transition into the PRC Plan, the applicant must include all of the requirements identified in this section.

As outlined in Section 754(3) of the EP Act and Section 6.3.2 of the PRCP Guideline “a NUMA will be taken to be pre-approved if a land outcome, the same or substantially similar to a NUMA, is contained in a land outcome document”. Residual voids are authorised under Schedule E (Condition E6 and E7) of the EA as the LOD. BMA has transitional arrangements for residual voids as pre-approved NUMAs.

As per the PRCP Guideline, if a NUMA has already been identified in a LOD, the applicant is not required to comply with Sections 126C(1)(g) or (h), or Section 126D(2) or (3) of the EP Act and is not required to complete the information requirements under Section 126C(1)(j) of the EP Act for the approved NUMAs. However, SSM is still required to meet the legislative requirements under Section 126C(1)(d) of the EP Act.

As the LOD does not state the area or the location of the proposed NUMAs, the PRCP Guideline requires this PRCP to include detail on how the total area will be minimised and how the location of the proposed NUMAs will minimise risk to the environment.

4.1 Nominated NUMAs

The SSM NUMAs include the residual voids of Lotus/Campbell Pit, Gilbert Pit, Price/Leichhardt Pit, Roper Pit and East Pit (Figure 16). Due to the pit progression down dip, the residual voids are located along the eastern extent of the mined out pits within ML1782 and ML70350.

The extent of the NUMAs is designed to achieve an area that is safe and structurally stable and includes: the residual void high-wall and end-wall below natural ground level and the associated wall set-backs at natural ground level to achieve a factor of safety (FoS) of 1.5; the residual void low-wall from 20m below ground level and the associated wall set-backs to achieve FoS of 1.5 (Lotus/Campbell, Gilbert, Price/Leichhardt); the residual

void low-wall below natural ground level and the associated wall set-backs to achieve FoS of 1.5 (East Pit, Roper Pit); the residual void floor; and a safety bund and fence. The total proposed NUMA area is 1,936ha.

The NUMAs will incorporate safety features to prevent access, including:

- A safety bund and fencing constructed at the NUMA extents to prevent human and livestock access
- Signage at regular intervals along the fence

The breakdown of the NUMA area into the high-wall, low-wall and void lake components are detailed in Table 31.

Table 31: Breakdown of SSM NUMA areas

Void	High-wall/end-wall void area (ha)	High-wall/end-wall set-back area (ha)	Low-wall void area (ha)	Low-wall set-back area (ha)	Void lake area (ha)
Lotus/Campbell	130	104	232	25	80
Gilbert	76	43	109	14	32
Price/Leichhardt	125	64	266	14	53
East	30	23	49	-	14
Roper	102	-	230	-	122

4.2 Minimising environmental harm

Technical studies undertaken to support this PRCP have assessed, refined and optimised the SSM NUMA locations and extent to minimise the potential for environmental harm. These studies resulted in the iterative refinement of the NUMA design as documented below.

The NUMA locations and extents in the preliminary closure landform were used as the basis for the following void studies:

- Void in flood plains modelling (Section 5)
- Initial void water balance modelling
- Initial void water quality modelling
- Initial void geotechnical assessment

Based on the outputs of these initial PRCP studies, the closure landform was redesigned to increase the distance of the void high-wall and end-wall from the approved extents and watercourses for Lotus/Campbell Pit, Gilbert Pit, Leichhardt Pit and East Pit, to achieve structural stability of $FoS \geq 1.5$ within the NUMA extents and to limit interaction with the floodplain.

The refined closure landform, including refined NUMA locations and reduced NUMA extent, was then used as the basis for the following studies:

- Updated void water balance modelling (Section 6.3)
- Updated void water quality modelling (Section 6.3)
- Updated void geotechnical assessment (Section 6.3)
- Groundwater modelling (Section 6.1.1)
- Rehabilitation flood modelling (Section 6.1.2)

The final NUMA locations and extent were further optimised based on the outcomes of all the final studies. This resulted in the final modifications to the closure landform to ensure the NUMAs minimise risk to the environment:

- Lotus/Campbell Pit: partial void backfill on the northern and southern end-walls to mitigate the risk of flooding into the residual void up to the 0.1% annual exceedance probability (AEP) (including climate change consideration of 20% increase in rainfall intensity) flood level (Sections 6.1.2 and 6.1.5.2)
- Gilbert Pit: partial void backfill on both the northern and southern end-walls and a landform along the north and south sections of the highwall to mitigate the risk of flooding into the residual void up to the 0.1% AEP (including climate change consideration of 20% increase in rainfall intensity) flood level (Sections 6.1.2 and 6.1.5.2)
- Price/Leichhardt Pit: partial void backfill on the northern end-wall to mitigate the risk of flooding into the residual void up to the 0.1% AEP (including climate change consideration of 20% increase in rainfall intensity) flood level (Sections 6.1.2 and 6.1.5.2)
- East Pit: partial void backfill on both the end-walls adjacent to Rolf Creek to mitigate the risk of flooding into the residual void up to the 0.1% AEP (including climate change consideration of 20% increase in rainfall intensity) flood level (Sections 6.1.2 and 6.1.5.2)

The studies presented in this PRCP are based on the NUMAs within the PRCP closure landform. The final NUMA locations and extents for Lotus/Campbell, Gilbert, Price/Leichhardt and East pits, do not present an unacceptable risk of environmental harm outside of the tenure boundary due to:

- Flooding into the residual voids being mitigated up to the 0.1% AEP flood level (Section 6.1.2)
- The residual voids acting as long-term groundwater sinks, which contain potential contaminant migration via groundwater within the tenure boundaries (Sections 6.1.1.2 and 6.3.2.3)
- Minimising potential for interconnectivity between the deeper Permian and shallower aquifers (Section 6.3.2.2)
- Long-term pit water levels remaining below the spill point, and therefore, minimising the risk of residual voids overtopping and releasing void water to surface waters and/or the receiving environment (Section 6.3.2.1)
- The design of the NUMA extent to achieve structural stability, resulting in no geotechnical damage beyond the NUMA (Section 6.3.1)

Further data and technical studies are required as part of the Roper project (Section 1.4.1.2) to enable an accurate assessment of the Roper area NUMAs, and the development of management strategies which best manage potential risks and minimises the potential of environmental harm.

Consideration has also been given to alternative NUMA solutions, such as partial or complete backfilling of the residual voids in excess of the backfill planned for flood mitigation. These considerations include the following:

- Complete backfilling of the residual voids will create flow-through or source conditions from the spoil and backfilled voids and increase the height of recovered groundwater, increasing the potential risk of interconnecting aquifers and impacting off-tenure areas such as downgradient Quaternary alluvium aquifers
- Partial backfilling of residual voids (i.e. reducing the depth of the residual void) also increases the height of groundwater recovery, increasing the potential for flow-through or source conditions and increasing the potential risk of interconnecting aquifers and impacting off-tenure areas. Environmental impact statement (EIS) studies completed within a similar nearby environmental setting for the Winchester South mine (Whitehaven Coal, 2022), indicated partial backfilling to reduce the depth of the residual void in the Bowen Basin environment, creates a surface lake of higher elevation, that also progresses towards brine levels of salinity over time. Saline residual void lakes of higher elevation have the potential to create additional complete exposure pathways to receptors through increased hydraulic head gradients to groundwater systems and through overtopping into surface water systems.

Retaining the residual voids as presented in this PRCP (i.e. with backfill required for flood mitigation), maintains the strength of the groundwater sinks: maximises the retention of groundwaters that have percolated through disturbed spoil profiles/other operational areas; minimises the potential for connection of aquifers of different

qualities; minimises the potential for overtopping during extreme weather events; and are key to managing the risk of potential environmental harm outside of the SSM tenure boundary associated with groundwater pathways.

4.3 Minimising NUMA area

The NUMA area proposed in this PRCP has been minimised from the original mine plans. The mine plans prior to any minimisation, indicate a final SSM void area of 2,687ha. The proposed PRCP NUMA area of 1,936ha represents a reduction in area of 750ha or 28%.

As detailed in Section 4.2, the development of the PRCP closure landform involved an iterative design process to allow the results of the supporting technical studies to be incorporated into the landform design to ensure the NUMAs minimise risk to the environment. The preliminary PRCP closure landform incorporated a number of key strategies to minimise the NUMA area at SSM, which included:

- Backfill of the pits during mining - spoil is dumped in the mined out pit void, resulting in 80% of the mined out pit void being progressively backfilled to ground level by the end of mining
- Backfill of as many ramp voids as practical - SSM has commenced backfilling ramp voids to minimise the final void area and this will continue throughout the life of the operation to maximise the backfill during mining
- Steepening the residual void high-walls and low-walls while maintaining the required geotechnical stability. Steepening the high-walls and low-walls is also part of the rehabilitation strategy to minimise risk to the environment by reducing the catchment area into the voids.

The final iteration of the closure landform submitted in the PRCP included further minimisation of the NUMA area by:

- Increasing the set-back of the high-wall and end-wall from the lease boundary and watercourses to achieve the required FoS
- Partial void backfill of:
 - Lotus/Campbell Pit: partial void backfill on the northern and southern end-walls
 - Gilbert Pit: partial void backfill on the northern and southern end-walls
 - Price/Leichhardt Pit: partial void backfill on the northern end-wall
 - East Pit: partial void backfill on both the end-walls adjacent to Rolf Creek
- Extending the PMLU on the low-wall into the residual void, 20m below ground level for Lotus/Campbell, Gilbert and Price/Leichhardt pits

4.4 Community considerations

Residual voids as NUMAs as presented in the EA and this PRCP, is consistent with the outcomes of community consultation completed to date (Section 2). No concerns on the proposed NUMAs were raised during community consultation, including:

- Consultation with the BBAC – the plan for residual voids as NUMAs has been shown to the BBAC as part of ongoing consultation in regards to the development of the PRCPs. This consultation included discussion of opportunity for BBAC's involvement in rehabilitation activities.
- Consultation with IRC – BMA has provided regular PRCP briefings to the IRC which have detailed the plan for residual voids as NUMAs. IRC and BMA have agreed to continue to engage on future opportunities, challenges and community aspirations, relevant to mine rehabilitation and closure, as they develop.
- No feedback or enquiries in relation to NUMAs were received as part of the consultation.

4.5 Regional planning integration

Both the local Isaac Regional Planning Scheme (Isaac Regional Council, 2021) and the broader Mackay, Isaac and Whitsunday Regional Plan (DLGP, 2012) identify mineral and extractive resource industries - in particular, coal and coal seam gas, as significant components of the current and future regional economic development.

Relationship with PRCP schedule

The proposed NUMAs for SSM are designed to be safe, structurally stable and minimise the risk of environmental harm. Retention of residual voids as pre-approved NUMAs, as part of the rehabilitated landscape, is consistent with the SSM LOD.

5 VOIDS IN FLOOD PLAINS

Legislative Requirement

In accordance with section 126D(3) of the EP Act, if land the subject of the proposed PRCP Schedule will contain a void situated wholly or partly in a flood plain, the schedule must provide for the rehabilitation of the land to a stable condition.

PRCP Guideline (Section 3.4)

Section 41C of the EP Regulation states the decision considerations for a void situated wholly or partly in a flood plain. A void is considered to be located in a flood plain if the flood plain modelling shows that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the level modelled as the peak water level 0.1% AEP for a relevant watercourse under the guideline Australian Rainfall and Runoff (2019)(ARR).

Where a land outcome document has a pre-approved land outcome for a void with a location specified, flood plain modelling is not required. If a void has been identified as a NUMA in a land outcome document but the location is not identified, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline. While the provision in the EP Act relating to voids located within a floodplain having to rehabilitate to a stable condition does not apply, the PRC Plan must include how the proposed location of the void minimises risks to the environment. Therefore, the flood plain modelling is required to support the assessment of the proposed location of the void.

If there are no land outcomes identified in a land outcome document, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline.

A voids in flood plain assessment has been undertaken by appropriately qualified persons (AQP) to support the development of this PRCP. The detailed report – *Norwich Park Mine Transitional PRCP Voids in Flood Plain Assessment* (SLR, 2024a), is provided in Appendix H.

5.1 Background

The SSM closure landform includes residual voids as pre-approved NUMAs for Lotus/Campbell Pit, Gilbert Pit, Price/Leichardt Pit, East Pit and Roper Pit (Figure 16). As the locations of these voids are not identified in the LOD, in accordance with the PRCP Guideline and transitional PRCP provisions, a voids in flood plains assessment has been undertaken.

5.2 Relevant watercourses

The voids in flood plains assessment must consider relevant watercourses. A 'relevant watercourse' is defined as s41C of the *Environmental Regulation 2019* (EP Regulation):

(a) a watercourse classified as stream order 4 or higher under the Strahler stream order classification system;
or

(b) if a watercourse mentioned in paragraph (a) is permanently diverted under—

(i) a condition, or proposed condition, of an environmental authority mentioned in the Water Act 2000, section 98; or

(ii) a water licence or proposed water licence under the Water Act 2000;

(iii) the watercourse as permanently diverted.

Three 'relevant watercourses' with a Strahler stream order of four or greater, have been identified with the potential to interact with the SSM residual voids. The identified 'relevant watercourses' that were modelled as part of the voids in flood plains assessment include:

- Stephens Creek
- Scott Creek
- Roper Creek

5.3 Voids in flood plains landform

The intent of the voids in flood plain modelling is to represent the flood plain within the tenure without 'artificial features', as defined by the EP Regulation. As operations at SSM commenced in 1979, prior to the availability of BMA LiDAR imagery, a single source of high-definition pre-mining topographical information was not available. The pre-mining digital elevation model (DEM) landform used for the purpose of voids in flood plains modelling was developed using a combination of BMA LiDAR datasets and publicly accessible, Geoscience Australia one second Shuttle Radar Topographic Mission Hydrological DEM topographical data. Where appropriate, terrain modifiers were used to assist with alignment of the different topographical datasets and to assist with definition of watercourses within areas of the DEM that relied upon the publicly accessible topographic data.

As required for this assessment, off-tenure artificial features that have the potential to impact the flood plain were assessed for their potential to influence flood hydraulics at SSM and where appropriate, have been included within the modelled landform. One off-tenure artificial feature, the township of Dysart, was assessed as potentially influencing flooding at SSM and was incorporated within the modelled landform.

Surrounding off-tenure roads and rail lines were not included within the model as they were assessed not to have a material effect on the 0.1% AEP flood levels within the SSM tenure.

5.4 Modelling

Hydrologic modelling was undertaken to estimate runoff hydrographs at various locations throughout the Stephens, Scott and Roper creek catchments. The model was developed using the Watershed Bounded Network Model which is an industry standard rainfall-runoff routing software package. As the catchments of Stephens, Scott and Roper creeks are tributaries of the Isaac River, a Watershed Bounded Network Model of the Isaac River was developed. The model domain included the Goonyella (130414A) and Deverill (130410A) stream gauges to allow calibration. Sub-models of the Isaac River model were developed for the catchments of Stephens and Scott creeks (for the purpose of this hydrologic modelling, referred to as the Norwich Park Sub-model) and Roper Creek Sub-model. These sub-models provided focus on the SSM area and its catchments, allowed delineation for the DEM, and application of Aerial Reduction Factors relevant to the site's catchment areas.

Hydraulic modelling of the catchment was developed for the purpose of assessing pre-mining flood extents. The industry standard hydrodynamic modelling software TUFLOW (build 2020-10-AA) was utilised for the hydraulic modelling. The hydraulic models developed as part of this assessment included the Norwich Park Model (Stephens and Scott creeks catchments) and the Roper Creek Model (Roper Creek catchment).

Further details of the voids in flood plain modelling are contained in Appendix H.

5.5 Results

The voids in flood plain modelling, identified the Lotus/Campbell and Gilbert residual voids encroach into the floodplains of Stephens and Scott creeks. The alignment of the Stephens Creek has been diverted around the mining activities to allow for coal extraction, the original alignment (as modelled within the voids in flood plain

assessment) is within the mined-out area and spoil dumps. The majority of the SSM residual voids remain outside of the flood plains. Noting the voids in flood plains modelling utilises the pre-mining topography.

The rehabilitation flood modelling of the diversion of Stephens Creek, (Section 6.1.2) demonstrates the final closure landform provides for flood protection for the residual voids up to and including a 0.1% AEP flood level. This final closure landform design, therefore ensures the proposed location of the residual voids minimises risks to the environment.

Relationship with PRCP schedule

The location and extent of the residual voids, combined with other aspects of the landform design, including increasing the set-back from the mining lease boundary and watercourses, partial backfill of final voids, and placement of spoil dump and landforms, provides protection to the residual voids from flood events up to and including a 0.1% AEP and minimises risks to the environment, as per the transitional requirements for voids in flood plains.

6 REHABILITATION AND MANAGEMENT METHODOLOGY

Legislative Requirement

In accordance with section 126C(1)(e) and (i), the rehabilitation planning part of the PRC Plan must:

- *For each proposed post-mining land use for land, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP Schedule.*
- *For each proposed non-use management area, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP Schedule for the area.*

PRCP Guideline (Section 3.6)

The proposed rehabilitation or management methodologies will underpin the development of the milestone criteria and support how the proposed PMLU will be achieved or the NUMA will be managed. As per section 126C(1)(j) of the EP Act, the administering authority requires information describing how the proposed rehabilitation or management methodologies have been developed and will be implemented.

This section identifies a number of studies or reports that must be provided in the proposed PRC Plan. If any of the required information outlined below is not relevant to the specific operation, the applicant must provide justification in the PRC Plan outlining why the information is not required.

PRCP Guideline (Section 3.6.1)

This section outlines the range of information that the administering authority considers is necessary to underpin the development of the rehabilitation or management methodologies applicable to new and existing mines for most domains. The applicant must include the information as appendices to the rehabilitation planning part.

6.1 General rehabilitation practices

6.1.1 Hydrogeology

PRCP Guideline (Section 3.6.1)

Assess the hydrogeology of the site and all connected strata, and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.

As mentioned in Section 1.2.5, a hydrogeological assessment including conceptual and numerical modelling, has been undertaken to support the development of this PRCP. The detailed report - *Saraji South Mine Transitional PRC Plan Hydrogeology Assessment* (SLR, 2024b) is provided in Appendix D.

The key hydrogeological units present within and immediately surrounding SSM are summarised in Section 1.2.5 and include:

- Cainozoic sediments:
 - Quaternary alluvium – unconfined aquifer (sporadically water-bearing strata of permeable unconsolidated sand or gravel) localised along watercourses, and regionally along the course of the Isaac River
 - Quaternary to Tertiary non-alluvial sediments and weathered units (collectively termed 'regolith') – unconfined unit with limited saturation at SSM and in the Roper project area
- Permian:
 - Low permeability interburden and overburden units with aquitard properties
 - Coal seams that exhibit water bearing properties associated with both primary porosity and the more dominant secondary porosity through cracks and fissures. The coal seams within the Moranbah Coal Measures are the primary aquifer at SSM
 - Whilst the coal bearing sequence at SSM is predominately German Creek Formation (Section 1.2.3) due to a facies change, they are collectively referred to as the Moranbah Coal Measures in relation to groundwater.

Additional details on the hydrogeological units, groundwater quality and groundwater use are contained in Section 1.2.5.

6.1.1.1 Groundwater modelling

To support the assessment of potential groundwater impacts, numerical groundwater modelling was undertaken in accordance with the Australian Groundwater Modelling Guidelines (Barnett, et al., 2012), the Murray Darling Basin Commission Groundwater Flow Modelling Guideline (Aquaterra, 2001), and the Independent Expert Scientific Committee Explanatory Note for Uncertainty Analysis (IESC, 2018). The numerical model was developed using a graphical user interface in conjunction with the modelling software MODFLOW-USG, which is distributed by the United States Geological Survey.

The numerical groundwater model presented within this PRCP, was built specifically to support the development of the PRCP. The development of the numerical groundwater model is documented within *Saraji South Mine Groundwater Modelling Technical Report* (SLR, 2024d) (Appendix E).

The objectives of the predictive groundwater numerical modelling were to:

- Assess the nature (timing and elevation) of void water level recovery (i.e. time to reach post-mining equilibrium and definition of that equilibrium level), and associated groundwater fluxes to/from voids.
- Assess the groundwater levels at post-mining equilibrium in all relevant hydrogeologic units, and associated impacts on current and potential future receptors (drawdown, water quality and groundwater flow direction).
- Assess impacts to alluvial and Tertiary hosted groundwater and any identified potential receptors.
- Assess the influence on potential groundwater receptors associated with surface drainage lines.

Climate change considerations have been included within the modelling and have been based on the *BMA Climate Change Adaption in Mine Water Planning and Hydrologic Assessments Guideline* (BMA, 2023). This included the review of three relevant climate models (ACCESS1-0Q, GFDL-CM3Q and MPI-ESM-LRQ) for both the 4.5 and 8.5 Representative Concentration Pathways (RCPs). From the climate model review, the following three climate scenarios (Table 32), representative of the modelled reasonable range of influence on the voids, were used to generate three sets of groundwater model predictions.

Table 32: Modelled climate scenarios as part of the groundwater assessment

Climate model	Intergovernmental Panel on Climate Change RCP Scenario
ACCESS1-0Q	4.5
MPI-ESM-LRQ	4.5
MPI-ESM-LRQ	8.5

The predominant identified influence from climate change on groundwater was associated with the void lake levels and their effect on groundwater hosted within the in-pit spoil prior to recovery. Upon stabilisation of the void lakes and groundwater elevations, the modelling identified negligible difference in hydrogeological conditions between the assessed climate scenarios. Therefore, the hydrogeological information presented within the PRCP is focused on the mid climate change scenario (MPI-ESM-LRQ 4.5). Additional information on the model results for the other climate change scenarios assessed are detailed in Appendix D.

Alignment of the void water balance model and the groundwater model was achieved through an iterative modelling approach, as there are no current commercial modelling packages that can undertake both the water balance and groundwater modelling. Due to the complexity of the groundwater connections within the Roper and East Pit residual voids, the alignment of the models commenced with a surrogate water balance model simulating the end of mining void lake and groundwater conditions, from which the results were applied with constant head boundary conditions to the groundwater model. The outputs of the groundwater model were input back into the surrogate water balance model and the process was repeated until alignment between the iterations had been achieved and thereby providing a refined starting point for the alignment of the actual residual void water balance model and the groundwater model. The alignment of the models then progressed through running of the groundwater fluxes to the residual voids within the water balance model, followed by re-running the output void lake levels in the groundwater model. This process was repeated until the variance between the model runs had sufficiently reduced.

The model alignment process showed the water balance and groundwater models within the area of the northern three residual voids (Lotus/Campbell, Gilbert and Price/Leichardt) were appropriately aligned for the purpose of developing this PRCP.

The area containing the Roper residual voids and East Pit residual voids had greater variability between the model runs due to the complexity of the groundwater connections between the residual voids. Within the time available under the transitional PRCP notice, additional alignment of the models could not be achieved with the available data. Additional data collection and further development of the closure landform design within the Roper project area (Section 1.4.1.2) will assist with further development and alignment of the models, including for the area containing the East Pit residual voids. The additional data collection and further development of the models as part of the Roper project is scheduled to be completed prior to the commencement of mining of East Pit.

During the iterative model alignment, the data was assessed and used to inform changes in the landform design. The landform changes included the backfilling the ends of voids for flood protection, and other works to further minimise the residual voids' catchments. The closure landform for the northern portion of the site (Lotus/Campbell, Gilbert and Price/Leichardt) establishes residual voids that provide competent long-term groundwater management for the surrounding mining disturbance areas. The network of residual voids, which provide the sink conditions, is an important control for post-mining water management. These residual void groundwater sinks capture leachate from spoil dumps, and other mining related disturbances and prevents the interconnection of groundwater aquifers hosting different water quality. Retaining the residual voids provides protection to the surrounding environment by capturing leachate and separating more saline deeper groundwaters aquifers from the shallower units.

Appendix E details the hydrogeological model development for the Roper area, however due to the additional data collection and studies required to inform the further development of the rehabilitation and management plan for the area, the results for the Roper voids are not presented within the hydrogeology section of the PRCP.

6.1.1.2 Residual void groundwater inflow

Groundwater levels and gradients surrounding the residual voids are controlled by the predicted residual void lake levels. The majority of the residual void lake inflows are sourced from surface water flows and direct precipitation, with groundwater inflows contributing only approximately 10% to 20% of the total volumetric inflow, except for East Pits where groundwater inflows represent approximately 50% (Appendix D). This is consistent with observations during mining, where groundwater inflows to the existing pits are/were passively removed via evaporation from the walls of the voids and do not require active pumping. Outflows from the established residual void lakes will generally be controlled by the evaporation.

The predicted equilibrium groundwater inflows to each of the residual voids for the three climate scenarios are presented in Table 33. Model results indicate that for most residual voids >79% of the groundwater inflows entering the residual voids comes via the spoil. Of the spoil sourced groundwater inflows to the residual voids, between 2% and 29% of the volume originates as local recharge applied to the spoil with the remainder coming from natural geological formations flowing through the spoil before entering the residual voids. Price/Leichardt is distinct, having a much lower contribution to the void from spoil, with around 50% of the total inflows coming from local recharge applied to the spoil and the other 50% originating from natural geological formations.

Table 33: Equilibrium groundwater inflow to the residual voids

Climate Scenario	Residual Void ⁴	Equilibrium Inflow Rate – Spoil (m ³ /day) ¹			Equilibrium Inflow Rate – Natural Geological Formations (m ³ /day) ³	Equilibrium Inflow Rate – Total (m ³ /day)
		From Natural Geological Formations into Spoil	From Local Recharge on Spoil	Total Inflow from Spoil to Residual Void ²		
Wetter	Lotus/Campbell	289.2	118.7	409.0	26.4	435.3
	Gilbert	201.6	62.5	265.5	30.6	296.1
	Price/Leichardt	53.3	66.1	119.9	120.6	240.5
	East Pit 1	346.0	7.9	353.9	12.6	366.5
	East Pit 2	102.0	5.8	107.8	12.4	120.3
Mid	Lotus/Campbell	295.6	118.7	415.3	27.7	443.1
	Gilbert	205.4	62.5	269.4	31.6	300.9
	Price/Leichardt	58.6	66.1	125.3	116.8	242.1
	East Pit 1	261.2	7.9	269.2	17.3	286.4
	East Pit 2	64.7	5.8	70.5	12.2	82.7
Drier	Lotus/Campbell	299.0	118.7	418.5	27.7	446.3
	Gilbert	208.2	62.5	271.8	30.8	302.7
	Price/Leichardt	60.0	66.1	126.6	111.6	238.2
	East Pit 1	202.8	7.9	210.8	18.1	228.9
	East Pit 2	21.3	5.8	27.1	7.0	34.2

1. Includes a component of groundwater from natural geological formations that moves into spoil, and a component of groundwater derived from local recharge on spoil, before discharging to the residual void lakes.
2. Any volumetric discrepancy between total inflow from spoil and the sum of the spoil inflow components is related to small ongoing residual changes in spoil storage occurring in the model as well as losses to evapotranspiration through spoil and rounding errors. Such discrepancies are typically less than 1% of the total spoil inflow.
3. Directly from natural geological formations into residual void lakes.
4. Due to the uncertainty within the models for the Roper residual voids, and the complex groundwater connections between the individual voids, the data produced by the model is not considered to be suitable to inform this transitional PRCP and therefore the results for the Roper residual voids are not included.

Post-mining and dewatering of the voids, groundwater recovery and void lake establishment occurs. The more dynamic void lakes, which are primarily established through rainfall derived sources such as surface runoff and direct precipitation, fluctuate in height depending on climatic conditions. Groundwater recovery occurs relatively slower surrounding the residual voids as it is governed by the height of the void lakes. During the initial period post-mining, the fluxes of groundwater to and from the voids are largely a function of the recovering groundwater levels within the spoil and the lake levels that fall and rise periodically. The numerical model predictions for groundwater recovery to levels that generate long term stable net inward hydraulic gradients (i.e. groundwater levels that are higher than the range of fluctuations in the residual void lake levels for the mid climate change scenario) sufficient to maintain groundwater inflows from the spoil to the voids post-mining are as follows:

- Lotus/Campbell residual void – 24 years
- Gilbert residual void – 6 years
- Price/Leichardt residual void – 0 years (model indicates no periods of net outflows)
- East Pit 1 residual void – 14 years
- East Pit 2 residual void – 39 years

The numerical model results for net fluxes between the residual void lakes and the groundwater hosted in natural geological formations in the recovery period immediately post-mining, indicate that outward fluxes from the void lakes to natural geological units only occurs within the first six years post-mining within the East Pit voids. Lotus/Campbell, Gilbert and Price/Leichardt voids maintain net inward fluxes from the natural geological formations post-mining.

As detailed in Table 33, once the groundwater and void lakes stabilise, the residual voids establish as long-term groundwater sinks to both the spoil and natural geological formations.

The residual void water quality modelling (Appendix M) indicates that the pH of the void water, once the lakes have established, will be relatively stable over time with slightly alkaline to alkaline conditions prevailing. TDS is modelled to increase within the void lakes over time because of evapo-concentration processes. Within the period immediately post mining (~39 years) where outflows from the void lakes may occur, modelled TDS concentrations within the void lakes are within or below the TDS ranges recorded within the regional Moranbah Coal Measures (average TDS of 7,982mg/L, ranging between 1,314mg/L and 19,200mg/L). Therefore, fluxes of water out of the void lakes to the groundwater aquifer that will be establishing within the in-pit spoil, will not adversely impact the groundwater quality within the spoil or the surrounding Permian hosted aquifers.

6.1.1.3 Groundwater levels

Modelled post-mining equilibrium groundwater levels are illustrated in Figures 7-13 to 7-18 of Appendix D.

Pre-mining groundwater elevations are not well understood as mining operations at SSM commenced in 1979 and prior to groundwater monitoring being undertaken. Therefore, pre-mining potentiometric surface maps cannot be generated due to the absence of data. However, based on the regional setting and lithology, pre-mining groundwater flows within the shallower hydrogeological units would likely have been a subdued reflection of surface topography with flows generally in a west to east direction. Permian hosted groundwater pre-mining would have also flowed generally in a west to east direction following the coal seam dip.

Post-mining, the groundwater model results indicate the water table will remain drawn down in the immediate vicinity of the Lotus/Campbell, Gilbert, Price/Leichardt and East Pit residual voids in the long term. The groundwater levels in the proximity of these residual voids will be driven by the ongoing groundwater discharge to the residual void lakes and the loss of water from the void lakes through evaporation. Long term, inwards groundwater flow gradients will be maintained for the majority of the tenure within the proximity of the northern

three voids post-mining. The Roper project area will be subject to additional technical studies to better understand and refine the rehabilitation and management plan.

The following summarises the model predicted post-mining stabilised groundwater levels for the coal seams at SSM:

- Where present within the SSM area, the Fort Cooper coal seams are predicted to remain dry.
- The Q seam is predicted to remain 'dry' in the long term across most of the SSM area, with saturation generally commencing immediately to the east of the EA boundary.
- The P Seam is predicted to remain 'dry' across much of the SSM area, however remains saturated along the eastern margin. Flow gradients towards the Gilbert, Price/Leichardt and East Pit residual voids is apparent.
- The H Seam remains unsaturated to the west of the Lotus/Campbell, Gilbert, Price/Leichardt and Roper residual voids. Saturation is generally present to the north, south and east of these voids with inward hydraulic gradients evident surrounding the East Pit residual voids and to the west of the Lotus/Campbell, Gilbert and Price/Leichardt residual voids.
- D Seam levels show saturation across most of the SSM area, and inward hydraulic gradients surrounding the Lotus/Campbell, Gilbert, Price/Leichardt and East Pit residual voids.

Predictive hydrographs (Appendix D, Figures 7 - 19 to 7 - 31), generated from the numerical groundwater model, have been used to evaluate changes in groundwater levels over time immediately adjacent and to the east of the residual voids. These predictive hydrographs indicate that groundwater levels within the saturated seams, to the east of the Lotus/Campbell, Gilbert and Price/Leichardt and East Pit residual voids, are above the predicted lake levels. The base of the unsaturated seams is also above the predicted lake levels. This confirms these residual voids will act as long-term groundwater sinks. The hydrographs also show the majority of groundwater drawdown is a result of dewatering undertaken during mining operations and associated lag effects.

Predictive hydrographs (Appendix D, Figures 7 - 33 and 7 - 34) for the water table at the identified potential GDE locations adjacent to the SSM area (Section 1.2.5.4), identified only two locations with groundwater within 20m of the ground surface along Stephens Creek up and down-gradient of SSM. Groundwater levels within the potential GDE locations at the beginning of the simulation were at least 13m below ground level. The modelled depths of groundwater (i.e. >10m) indicate there is a low probability for the locations to contain GDEs that are dependent on permanent access to groundwater. The hydrographs also indicate that water table drawdown in the vicinity of the potential GDEs is a result of the approved mining and not the proposed closure landform. Any facultative ecosystem use of temporary groundwaters hosted in the alluvial material located within the watercourses, are not anticipated to be adversely impacted as this temporary alluvial groundwater is recharged through losing streams during flows and this recharge will still occur during flow conditions.

Model results, for water supply bores with sufficient information to attribute a source aquifer, indicate that registered bores (RN38547, RN43061, RN89469, RN89470, and RN90014R) located in the Fort Cooper Coal Measures to the east of SSM, within ~3km of Lotus/Campbell, ~2km of Gilbert and ~2.5km of Price/Leichardt residual voids, have a relatively significant amount of drawdown in the long-term post-mining. This drawdown at the impacted registered bores takes hundreds of years for the maximum drawdown to occur and is associated with lag effects from mine dewatering and regional scale influences represented in the model (i.e. other mining activities). The maximum drawdown predicted at the registered bores is greater than the relevant 5m drawdown 'bore trigger threshold' for consolidated aquifers (i.e. the Fort Cooper Coal Measures) as per the *Water Act 2000*. These drawdown impacts to registered bores will need to be reassessed as part of on-going updates to the hydrogeological model. The model updates will account for actual mining progress/dewatering and the status of the bores at the time of drawdown, noting that impacts are currently predicted to occur well outside of the operational life of the bores. The water supply bores RN84538, RN136092, and the unregistered House Bore were located outside of the model boundary, and therefore were not included in the model assessment.

The predictive groundwater model results indicate the northern residual voids (Lotus/Campbell, Gilbert, Price/Leichardt) and the East Pit residual voids within the proposed final closure landform, create long-term groundwater sinks that capture seepage from the spoil dumps, and other operational areas within the proximity of the residual voids. The residual voids provide an important landscape feature that provides for the management of groundwater in the post-mining landscape. The residual voids collect and contain groundwater seepage from the mining disturbed areas and prevent future interconnection of groundwater aquifers with

different water quality. Removing, partially or completely, residual voids from the proposed closure landform has the potential to cause environmental harm through release of contaminants to groundwaters or the interconnection of aquifers. Further backfilling of the residual voids, particularly to above the coal seams or above surrounding groundwater levels, would increase the void lake level elevation and would also increase the potential for outflows. Therefore, changes to the landform that reduce the residual voids further than already proposed, has the potential to result in poorer environmental outcomes if beneficial evaporative control of groundwater gradients is lost.

The groundwater levels for the Roper residual voids will be reassessed as part of the technical studies and model updates for the Roper project as discussed in Section 1.4.1.2.

6.1.1.4 Flow path simulation

To assist with the understanding of potential contaminant migration patterns through groundwater, an analysis of the water movement within the closure landform, based on the numerical groundwater model prepared to support the development of this PRCP, has been undertaken. The simulation was undertaken over a 578-year groundwater recovery period post-mining. The simulation was undertaken by placing a number of particles within the model surface in the recovery groundwater model and the mod-PATH3DU code (developed by Papadopoulos & Associates Inc., 2018) used to simulate particle pathways along the groundwater flow field during recovery. The mod-PATH3DU code automatically moves the particles from the model surface to the shallowest saturated layer at the commencement of the simulation.

The predicted movement of water particles in the 578-year recovery simulation are shown in Figure 7-37 of Appendix D. The model results indicate that particles located within the shallower groundwater units generally move towards the deeper Permian, and in the proximity of the northern three voids, towards the residual voids.

Flow path simulation within the southern portion of SSM confirms the complexity of the groundwater system and the interconnection of the residual voids. The flow path simulation indicates that East Pit residual voids receive inflows that originated within the Roper area. Further data collection and technical studies are required as part of the Roper project to improve the understanding of groundwater aquifers and to inform the development of a detailed rehabilitation and management plan.

6.1.1.5 Post-mining conceptual site model

An evaluation of the groundwater source-pathway-receptor (SPR) linkages for SSM based on the modelling results for the post-mining environment where groundwater conditions have stabilised (with the exception of the Roper area), has identified the following key features:

- Void lake formation, with lake levels stabilising below the pre-mining groundwater elevations and any shallow post-Permian strata, including the base of surficial weathering and shallow hydrostratigraphic units (i.e. alluvium and Tertiary sediments/Regolith)
- Continued groundwater drawdown within the Moranbah Coal Measures and the Fort Cooper Coal Measures, associated with evaporative discharge from the void lakes, resulting in continued inwards hydraulic flow gradients in the coal measures
- Voids continue to capture any seepage from spoil emplacements
- Little to no impact on surficial aquifers, with predicted water level influence showing decline caused by approved mining impacts prior to closure
- Little to no impact on environmental receptors, with predicted water level influence showing decline caused by approved mining impacts prior to closure
- No impact on anthropogenic receptors, with predicted water level influence dominated by approved mining impacts prior to closure, and showing recovery post-mining

A visual representation of the post-mining conceptual site model is provided in Figure 17.

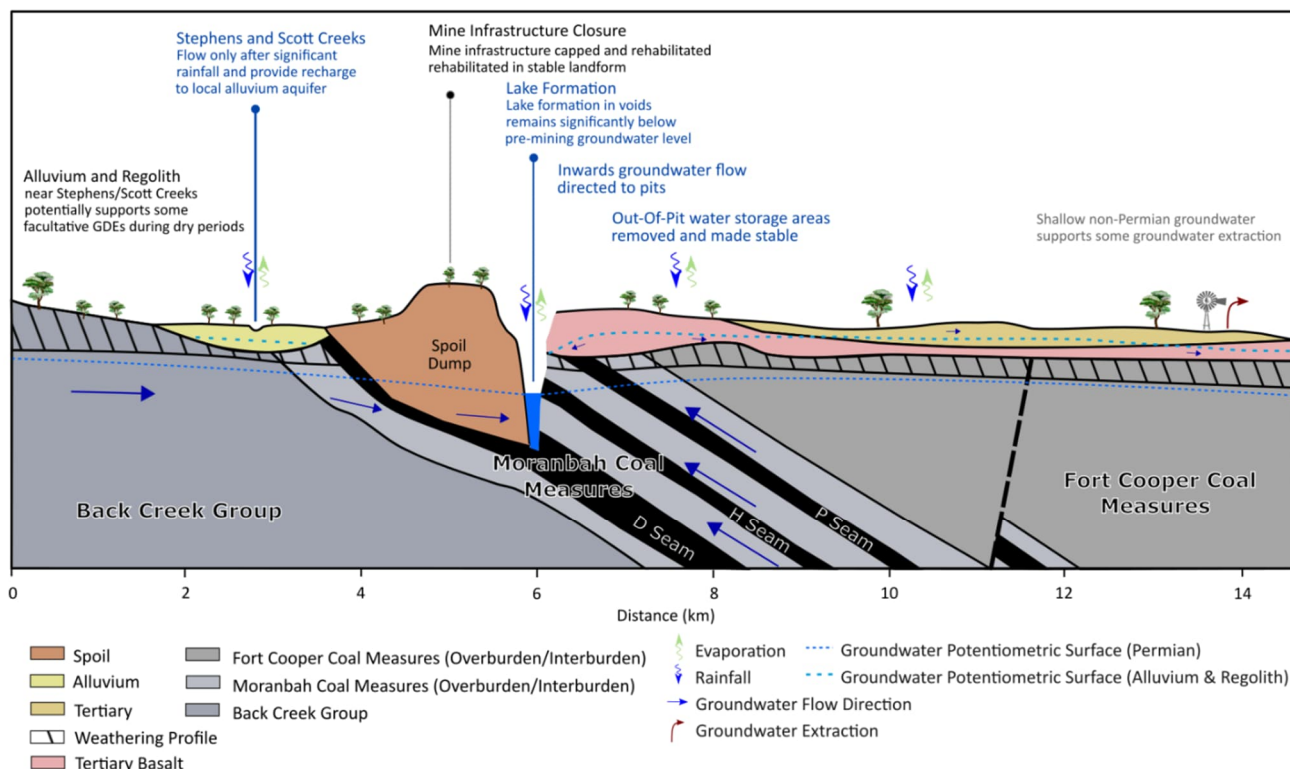


Figure 17: SSM post-mining conceptual site model (SLR, 2024a)

Relationship with PRCP schedule

Within the residual voids in the northern portion of the site (Lotus/Campbell, Gilbert and Price/Leichardt) and in the area immediately surrounding the East Pit residual voids, groundwater will flow to the residual voids, which act as groundwater sinks. It is not anticipated that groundwater in these areas will require any active management post-mining. Confirmation of groundwater quality, and the relationship between the void lakes and groundwater elevations to demonstrate the development of the residual voids as sinks, will be completed through groundwater monitoring and predictive groundwater modelling.

Further data collection and technical studies are required in the Roper area, as part of the Roper project, to improve the alignment and uncertainties currently in the groundwater model for this area and allow informed rehabilitation and management activities to be undertaken.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1			IA2		
MM1		MM2		MM3	

The following PRCP Conditions will contribute to achievement of PMLU to a stable condition:	
PRCP11	With respect to groundwater: a) The monitoring bores listed in Table 74: Groundwater monitoring locations must be installed by 2050; and b) Following monitoring bore installation, groundwater quality must be monitored six monthly at, but not limited to, bores specified in Table 74: Groundwater monitoring locations; and c) The holder must develop site-specific groundwater quality limits for the bores listed in Table 74: Groundwater monitoring locations; and d) The groundwater model and water balance model must be recalibrated and predictions rerun at least every 5 years commencing from 2050.
PRCP12	With respect to groundwater the following must be demonstrated prior to surrender: a) Groundwater quality results for compliance bores have not exceeded the limits in site-specific groundwater quality limits, for 3 consecutive results within the 5-year period immediately prior to surrender; and b) There is no environmental harm beyond the boundaries of the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410); and c) Predictive groundwater modelling as per the Australian Groundwater Modelling Guidelines (current version), undertaken at the completion of all mining, confirms the network of residual voids will collectively develop into groundwater sinks and prevent environmental harm through the release of contaminants from the void lakes beyond the tenure boundaries post-closure.
The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM0	0.1 Ground works: • Establish safe access to landforms for data collection and progressive rehabilitation activities. 0.2 Progressive ground works and sufficient data collection for modelling: • Drilling and installation of additional groundwater bores and water monitoring 0.3 Updated modelling and landform: • Hydrogeological modelling • Water balance modelling 0.4 Final landform, designs and updated plans: • Water management plan
The following milestone criteria will contribute to achievement of sufficient improvement:	
MM1	IA1.10 Residual voids collectively act as groundwater sinks within the relevant mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary post closure as demonstrated by groundwater modelling defined in condition PRCP12.
MM3	IA3.1 Certification from an AQP that: • The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling • The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary

6.1.2 Flooding

PRCP Guideline (Section 3.6.1)

Section 3.4 of this guideline requires flood plain modelling for the purpose of voids located within a flood plain being rehabilitated to a stable condition. In addition to this, the applicant must also assess the flooding susceptibility and influence across the site. If flooding is a consideration, develop a hydrologic model of the catchment and a hydraulic model of the proposed mining area. Knowledge of flooding is integral to the rehabilitation planning process, including the placement and design of mine domains.

A rehabilitation flood assessment, including consideration of flow alteration, modelling flood levels for a range of design storm events and development of a flooding risk profile, has been undertaken to support the development of this PRCP. The detailed report – *Rehabilitation Flood Modelling, Saraji South (Norwich Park) Mine* (WMS, 2024), is provided in Appendix I.

The flood modelling was undertaken on an iterative approach with the closure landform design development. Information from the initial round of rehabilitation flood modelling was used to inform further development of the closure landform design. The final closure landform design included refinements comprising of partial backfill of the residual voids, increased stand-off distances from tenure boundaries/watercourses and removal of culverts and other infrastructure from watercourses/floodplains. Upon finalising the landform design, the flood modelling was re-run and the flood risk profile and other interpretations amended to reflect the final closure landform design, which is presented within this PRCP.

6.1.2.1 Flood modelling

The hydrologic modelling for Stephens, Scott, Downs and Roper creeks undertaken to support this PRCP utilised the existing flood modelling for SSM (WRM, 2020), which was completed using industry standard software TUFLOW and XP-RAFTS. A review of the models by WMS indicated that they were fit for purpose and were used as the starting point for this assessment. As no previous flood modelling for Rolf Creek in the proximity of SSM was available, a new XP-RAFTS/TUFLOW model was developed for this assessment.

An assessment of Roper Creek utilising the existing modelling identified: no significant PRCP landform features present within the 0.1% AEP flood extent; the catchment is predominantly outside of the EA area; and Roper Creek runs to the south and not through the EA area. Therefore, flooding associated with Roper Creek does not present an unacceptable risk to the post mining landform/land uses and was not further considered within the rehabilitation flood modelling assessment.

TUFLOW 2D hydraulic models were developed to determine flood behaviour around the closure landforms. TUFLOW (version 2023-03-AA) is an industry standard software hydraulic modelling package. Hydraulic models incorporating the closure landform design were developed for Stephens, Scott, Downs and Rolf creeks and run for the 39%, 2%, 1%, 0.1% AEP and probable maximum flood (PMF) events.

To evaluate alteration of flows, hydraulic models were also developed for the pre-mining landform for Stephens, Scott, Downs and Rolf creeks. The pre-mining landforms utilised were consistent with those developed for the voids in flood plain modelling (Section 5). Due to the age of operations at SSM (commenced 1979), a combination of BMA lidar and the publicly accessible one second Shuttle Radar Topographic Mission Hydrological DEM topographical data (Geoscience Australia) were utilised to develop the pre-mining DEM. The resolution of the publicly accessible topographical data from pre-1979 is low but represents the best information available. Terrain modifiers were read into the model to better define watercourses due to the low resolution of the available pre-1979 topographic data.

Climate change considerations, in-line with the *BMA Climate Change Adaption in Mine Water Planning and Hydrologic Assessments Guideline* (BMA, 2023), were included within the model through running of the following three climate change scenarios for the 2061 to 2099 period for both the 1% AEP and 0.1% AEP:

- RCP 2.6 50th percentile (6% rainfall intensity increase)
- RCP 4.5 50th percentile (11% rainfall intensity increase)
- RCP 4.5 90th percentile or RCP 8.5 50th percentile (20% rainfall intensity increase)

Further details on the model set up, assumptions, sensitivity testing, hydraulic roughness catchments, critical duration assessment, etc. are detailed in Appendix I.

6.1.2.2 Flood levels and rehabilitation domains

The modelled flood heights in the proximity of the residual voids indicate that all the residual voids are immune from flood ingress up to and including the 0.1% AEP, including upper climate change scenario RCP 4.5 P90 (20% rainfall intensity increase). This was achieved through the iterative landform design process that included the placement of backfill in the ends of select residual voids and alteration/inclusion of other landforms that minimise the potential for environmental harm caused via inundation of the residual voids.

The probable maximum precipitation (PMP) modelled events do indicate flood water ingress into residual voids. However, the modelled inflows to the voids in a PMP event will not exceed the residual void's storage capacities, overtop the voids, interconnect different hydrogeological units, or alter the long-term sink behaviour of the voids. The modelled PMF event represents an extreme case of flooding where there would be significant impact to the wider region, not just SSM, including damage to regional infrastructure and widespread inundation. The loss of some floodwater to the residual voids in a PMF scale event would not adversely impact environmental flows or surrounding land users.

The modelling has identified several locations where floodwaters spill from the watercourses and interact with the rehabilitation landforms. The flood water interaction with the spoil dumps is generally at the extremity of the flooding extent and therefore generally have relatively low velocities and flood heights. Landform design considerations, including for those areas subject to inundation, are detailed in Section 6.1.5.

Figures showing the modelling results, including flood levels, stream powers and velocities, are contained in Appendix I.

6.1.2.3 Alteration of Flows

For the assessment of downstream pre- and post-mining flow alteration, peak flows and total volumes for the closure landform and the pre-mining landform scenarios were extracted. For this comparison a location immediately upstream of the confluence with the Isaac River was utilised. As the mine site is located within the upper portion of the catchments, a comparison of flows immediately below the mining disturbance exaggerates the influence of the closure landform due to the relatively small upstream catchments. For Rolf Creek the upstream catchment is located wholly within the EA, and therefore, there is no upstream catchment. For the purpose of this, pre and post-mining flow assessment, downstream locations immediately upstream of the Isaac River have been used, which is more representative of the change in flows to downstream receptors.

Peak flows and total volumes through the selected downstream locations are summarised in Table 34.

Table 34: Peak flow comparison between the pre-mining condition and closure landform, immediately prior to the confluence with the Isaac River

Model	Event	Peak flow (10 ² m ³ /s)			Total volume (GL)		
		Closure landform	Pre-mining condition	% change	Closure landform	Pre-mining condition	% change
Stephens Creek	39% AEP	7	7	0	350	351	0
	2% AEP	28	28	0	1,265	1,271	0
	1% AEP	39	39	0	1,884	1,895	-1
	0.1% AEP	63	63	0	2,821	2,839	-1
	0.1% AEP CC RCP8.5 P90	76	76	0	3,440	3,461	-1
Scott Creek	39% AEP	9	9	0	337	336	0
	2% AEP	34	34	0	1,314	1,310	0
	1% AEP	48	48	0	1,856	1,857	0
	0.1% AEP	77	77	0	2,962	2,965	0
	0.1% AEP CC RCP8.5 P90	97	97	0	3,601	3,603	0
Downs Creek	39% AEP	3	3	0	47	48	-2
	2% AEP	6	6	0	103	105	-2
	1% AEP	9	9	0	187	191	-2
	0.1% AEP	16	17	-6	230	236	-3
	0.1% AEP CC RCP8.5 P90	22	23	-4	284	291	-2
Rolf Creek	39% AEP	0.6	0.6	0	31	23	-9
	2% AEP	4	4.3	-7	77	85	-9
	1% AEP	6.4	7.1	-10	134	148	-9
	0.1% AEP	12.1	13.1	-8	170	188	-10
	0.1% AEP CC RCP8.5 P90	15.6	17.1	-9	213	236	-10

The assessment of changes to downstream flows between pre- and post-mining landforms indicate the following:

- Stephens and Scott creeks, which carry the largest flows through the site, have negligible changes to flows and volumes. These creeks support the largest catchments and the reduction in catchment within the post-mining landform does not materially impact the overall volumes and flows.
- Downs Creek comparison indicates a maximum decrease in flows of 6% and volume of 3%, which occur during the modelled 0.1% AEP event. For smaller rainfall events, where there is a smaller flood extent and the post-mining landform presents less restriction to flows, the change in flows is negligible and volumes only decrease by 2%.
- As the entire upper catchment of Rolf Creek is located within the EA and includes the Roper and East Pit residual voids, the percentage decrease in flows and volumes are magnified by the relatively smaller volumes and overall catchment size. Volumes and flow rates within Rolf Creek are an order of magnitude smaller than Scott and Stephens creeks. The pre- and post-mining flows and volumes decrease by up to 10% within Roper Creek, which is consistent with the catchment lost to the residual voids in the post-mining landform. As noted within Section 1.4.1.2, the Roper area requires additional data collection and technical studies to enable development of the detailed rehabilitation and management plan and design for the area. Any changes to the catchments of the Roper residual voids as part of the detailed rehabilitation and management plan would alter the flows and volumes within Rolf Creek in the post-mining environment.

Flows upstream of the mine site within Stephens, Scott and Downs creeks are considered unaltered by the final closure landform. As the headwaters of Rolf Creek are located within the EA area, there is no upstream catchment/flows from the mine site for Rolf Creek.

6.1.2.4 Flood risk profile

A flood risk profile was developed based on the rehabilitation flood modelling results. Details of the flood risk profile are contained in Appendix I and the SSM PRCP risk assessment is summarised in Section 7.

Through the iterative closure landform and modelling approach, the closure landform was developed to minimise the potential for environmental harm and to create a stable landform. Changes to the closure landform through this iterative approach included the placement of backfill in the ends of residual voids where flood waters up to a 0.1% AEP plus climate change could enter, and changes to the landforms to direct floodwaters away from the residual voids. As a result of this process, the flood risk profile identified low risk levels associated with flooding and the SSM closure landform. Therefore, no critical controls are required.

Relationship with PRCP schedule

The interaction between flooding and the proposed final closure landform presents a low risk. The closure landform provides an appropriate level of protection from inundation to the residual voids, flooding does not adversely impact on the stability of the final closure landform and cumulative flows from the catchments into the Isaac River are similar to pre-mining conditions.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA17		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1	IA2
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The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule		
MM1	MM2	MM3

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM0	0.3 Updated modelling and landform: Flood modelling
RM1	1.5 With the exception of 1.2, 1.3 and 1.4 above, the following are complete: - All surface water drainage infrastructure removed - Mine water dams are decommissioned - Watercourse crossings and culverts removed. 1.6 Assessment of mine water dams is completed by an AQP and identified sediment and water management actions are completed.
RM3	<u>Watercourse (RA2)</u> 3.11 Disturbed natural watercourse bed and banks returned to a profile similar to the pre-disturbance condition.
RM15	15.4 Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method). 15.5 Assessment by an AQP that the watercourse diversion has an Index of Diversion Condition (IDC) score >10.
The following milestone criteria will contribute to achievement of sufficient improvement:	
MM1	IA1.1 Void backfill will be completed at the end of mining for flood mitigation at: - The northern and southern end-walls of Lotus/Campbell void - The northern and southern end-walls of Gilbert void - The northern end-wall of Price/Leichhardt void - The end-walls adjacent to Rolf Creek of East Pit voids. IA1.2 Highwall landforms must: - Prevent surface flow of floodwater into the void - Be geotechnically stable when floodwater is against the creek-side batter - Prevent seepage flow of floodwater into the void - Not be constructed with dispersive material - Have maximum 30% slopes with rock for scour protection. IA1.3 The final design for highwall landform must be completed by an AQP based on the latest flood modelling and materials data prior to construction. IA1.4 Final residual voids are not subject to inundation from floodwaters up to and including the 0.1% AEP. IA1.9 Residual voids must not overtop.
MM3	IA3.1 Certification from an AQP that:

	- The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling - Voids retain flood immunity, supported by flood modelling re-run at end of life and calibrated against the final landform - The highwall landform has been constructed in accordance with the final design - The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary.
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6.1.3 Waste characterisation

PRCP Guideline (Section 3.6.1)

Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility.

All mined material should be classified on its propensity to be potentially acid or non-acid forming, to generate neutral metalliferous or saline drainage, and its susceptibility to weathering.

A material characterisation assessment has been undertaken to support the development of this PRCP. The detailed report – *Saraji South Mine PRCP Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste* (BHP, 2024), is provided in Appendix J.

6.1.3.1 Background

SSM has three main types of mineral waste:

- Spoil (overburden and interburden) includes weathered waste (Tertiary and Permian-age) and fresh (unweathered) waste (all Permian-age). Based on highwall drilling data, weathered (i.e. oxidised) materials comprise a significant proportion of spoil, with the proportion of weathered to fresh varying from pit to pit (weathered spoil proportion ranging from 15% to over 50%). Therefore, weathered materials comprise a significant proportion of spoil. Spoil comprises several subtypes of material, the most relevant from a geochemical perspective being carbonaceous spoil (approximately 7% of all present and future spoil) and non-carbonaceous spoil (approximately 93% of all present and future spoil) subgroups. For the geochemical assessment, spoil samples have been sourced from drillholes (as drill core).
- Tailings were generated at the CHPP from historical processing of ROM coal and typically represent the clay, silt and fine sand fractions of ROM waste. Throughout operations at SSM, tailings have been disposed into OTD TSF and Ramp 67, both located within the Roper project area. SSM coal is currently processed at SRM, and no further tailings are planned to be disposed at SSM for the foreseeable future.
- Rejects were generated at the CHPP from historical processing of ROM coal and typically represent coarser and rockier seam roof, partings and floor material. Rejects were trucked to Ramp 67/68 (primarily) for disposal. This rejects dump is located within the Roper project area. An insignificant volume of rejects (up to 0.02Mm³) are currently located on ROM pads at the Lotus-Campbell spoil area. SSM coal is currently processed at SRM, and no further rejects are planned to be disposed at SSM for the foreseeable future.

Coal is generally not considered mineral waste, with the exception of small quantities of sub-economic seams that may report to the spoil dump, and remnant coal exposed on pit high-walls (such as in residual voids).

Within the Roper area, only limited geochemical data is available for the tailings disposed within OTD TSF. Safe access to the in-pit Ramp 67 tailings and Ramp 67/68 rejects has not been possible to allow collection of samples and data analysis of this material. The limited available geochemical data held for the tailings and rejects indicates that there is a potential for geochemical risks to exist that would require implementation of appropriate controls and management for closure. Further technical studies are required to characterise the tailings and rejects to allow the geochemical risks to be appropriately understood. Therefore, the available geochemical data is insufficient to inform closure planning within the Roper area. The material in this area has

been excluded from the waste characterisation assessment for this transitional PRCP, however pending safe access to the tailings and rejects, additional geochemical data collection will be undertaken as part of the Roper project included in RM0 (Section 1.4.1.2).

Mineral waste (and coal) samples from outside the Roper area, have undergone environmental geochemical characterisation and assessment with regard to their potential to generate acid and metalliferous drainage (AMD), which comprises acid drainage (AD), neutral and metalliferous drainage (NMD) and/or saline drainage (SD) (salinity due to sulphate derived from sulphide oxidation). Additionally, samples have been assessed with regard to their potential to generate salinity (non-oxidative) and, for spoil materials, their sodicity and dispersion potential. With respect to AD, each sample has been broadly characterised as either non-acid forming (NAF) or potentially acid forming (PAF). Residual voids and spoil dumps are the mine domains representing potential sources of AMD/salinity at SSM, and which have a direct relevance to mineral waste characterisation and management at SSM at closure.

6.1.3.2 Geochemical assessment of mineral waste

The geochemical characteristics of each waste type (and coal) have been assessed with respect to their ability to generate AMD by leveraging on historical geochemical data (defined as pre-2019), augmented with data acquired through an aggressive sampling and analytical program (2019 - 2024) designed to close identified knowledge gaps and fulfil the PRCP requirements. Overall, the geochemical data available to assess the geochemical properties of key mineral waste types and associated landforms at SSM include:

- 1,105 samples of interburden, overburden, roof/floor and partings tested to assess the AMD hazard; and 1,497 samples tested to define the salinity hazard, with a subset of overburden/interburden samples assessed for dispersivity and sodicity. The overburden/interburden samples were selected from drill cores that are representative of the vertical and lateral geological (lithological) variability encountered at SSM.
- 45 samples of 'aged' rejects tested to assess AMD and salinity hazard. Samples are representative of 'aged' rejects located at Lotus-Campbell spoil area.
- 68 coal samples tested to assess the AMD hazard; and 95 samples tested to define the salinity hazard. The coal samples were selected from drill cores that are representative of the vertical and lateral geological (lithological) variability encountered at SSM.

The environmental testing protocol included a variety of analytical techniques that are consistent with industry and regulatory accepted guidelines (e.g. Global Acid Rock Drainage Guide (INAP, 2009)).

6.1.3.3 Geochemical classification of mineral waste

The test work results were used to understand the geochemical properties of each individual material type (source) and assign a geochemical classification. This data (and AMD classifications) was then used to infer the geochemical hazard posed by each mineral waste type in their relative proportions within each landform. In context, essentially all mineral waste on site is spoil. Rejects comprise less than 0.01% of mineral waste.

The key findings from the geochemical assessment are summarised as follows:

Spoil

- Approximately 89% of spoil samples were classified as NAF or were expected to be NAF (and have been classified as UC(NAF)). Spoil material represented by these samples have very low to low sulphur concentration, excess acid neutralising capacity and have a low potential to generate AMD. Eleven percent of spoil samples were classified as PAF and typically had higher (but still low to moderate) sulphur concentration and generally slightly lower acid neutralising capacity compared to NAF samples. However, the majority of the PAF samples in the spoil are associated with coal seam floor, roof and partings, which mostly report to the CHPP as rejects – or they are spoil samples located very close to coal seams.
- Soluble multi-element results indicated that, under controlled laboratory conditions, leachate from NAF spoil has low concentration of soluble metals and metalloids, while the few PAF samples encountered can mobilise moderate soluble metal concentrations of Al, Co, Fe, Mn, Ni and/or Zn. If the samples

tested are representative of the spoil produced at SSM (past, current and future), as a bulk source material, spoil is expected to have low capacity to generate AMD.

- Spoil is expected to generate contact water that is non-saline to slightly saline (i.e. EC less than 900µS/cm; but mostly less than 450µS/cm), almost entirely as the result of non-oxidative processes (i.e. from the dissolution of salts and not oxidation of pyrite). Spoil is also sodic to strongly sodic with potential for dispersion (based on the high sodicity values). Emerson aggregate class testing found that about 15% of the spoil samples tested displayed 'some dispersion'. The remaining bulk of the samples had Emerson aggregate class values suggesting the samples were non-dispersive.

Rejects

- Aged rejects generally have low to low-moderate total sulphur and generally low to moderate acid neutralising capacity values, resulting in about 53% of samples being classified as NAF or were expected to be NAF (and have been classified as UC(NAF)). Of the remaining 47% of rejects samples, almost all had a degree of uncertainty surrounding their classification and were conservatively classified as UC(PAF). Only one reject sample was classified as PAF. Regardless of the classification, the generally low sulphur concentrations in rejects samples indicate that the sulphate loads from sulphide oxidation would likely be low and, overall, aged rejects have a low-moderate potential to generate AMD.
- Under controlled laboratory conditions, aged rejects subjected to freshwater (deionised water) leaching are expected to contain low to moderate concentrations of soluble metals and metalloids. Peroxide leaching – which is designed to promote oxidation and AMD conditions – undertaken on two UC(PAF) and one PAF-- low capacity aged rejects samples showed that, when oxidised, these types of samples produced moderately to weakly acidic leachate with high soluble metals and metalloid concentrations. The results indicate that PAF rejects, when oxidised, have the potential to generate low pH leachate (AD) with elevated sulphate and soluble metal and metalloid concentrations.
- Aged rejects currently on site are expected to generate contact water that is moderately saline to saline (i.e. EC less than 4,000µS/cm; but mostly less than 2,000µS/cm), with the salinity mostly as the result of oxidative processes (i.e. from the oxidation of pyrite to produce sulphate).

Coal

- The assessment has shown that coal samples have variable geochemical properties, with approximately half of the samples conservatively classed as 'PAF'. Similar to other source material tested, coal samples with potential for AMD can release moderate concentrations of metals and metalloids in contact with water, under controlled laboratory conditions. Based on the geochemical properties and samples assessed, it is expected that as a bulk source material, coal will have a moderate capacity to generate AMD.

6.1.3.4 Geochemical risk of final landforms and residual voids

Final closure landforms outside of the Roper project area comprise spoil landforms and residual voids. Based on operational practices and life of asset waste management, at closure it is expected that:

- Spoil landforms will comprise spoil only (overburden, interburden). Lotus-Campbell spoil landform will also contain less than 0.01% rejects.
- High-walls will comprise overburden, interburden and coal seams (including seam roof, partings and floor).
- Pit floors will comprise coal (conservatively).

A geochemical source hazard assessment was applied to the source material types comprising carbonaceous and non-carbonaceous spoil, rejects and coal (where relevant). The source hazard score is a formula devised by the authors that leverages on the geochemical test work results to estimate the propensity (ability) to generate AMD, the AMD capacity (severity) and the quantity (volume/%) of material that could produce AMD within each landform. The AMD score for each landform was then used to estimate the likelihood of each landform to generate AMD.

The potential environmental risk posed by each landform (containing variable proportions of each mineral waste type) was determined for each landform using a SPR approach – whereby the environmental geochemical risk

is determined taking into account the geochemical source hazard of the landform, the plausible environmental and human health receptors of AMD from the landform and the plausible pathways between the source (landform) and the receptor. The outcome of this assessment informed development of appropriate management and rehabilitation measures for relevant landforms at closure.

Potential pathways and receptors for AMD and salinity have been identified for all final landforms at SSM, except the Roper area. Details on the identification of pathways and receptors are found in Section 6.1.1 (Hydrogeology) and Appendix D.

For the purpose of this SPR assessment, the following mechanisms for AMD and salinity to enter plausible pathways and report to plausible receptors have been identified:

- Source - spoil landforms:
 - Surface water run-off (pathway) from a nominated spoil landform reports to a nominated creek (receptor)
 - Seepage from a nominated spoil landform enters a shallow permeable strata (pathway) and reports to a nominated creek (receptor)
 - Seepage from a nominated spoil landform enters groundwater (pathway) and reports to a nominated residual void (receptor)
- Source – high-wall and floor
 - Run-off from high-wall of residual void (pathway) reports to nominated residual void (receptor)

The outcomes of the SPR are summarised below:

- Spoil landforms: With respect to AMD, the overall SPR risk rating from final spoil landforms is Low. With respect to non-oxidative salinity the overall SPR risk from final spoil landforms is also rated as Low.
- Residual voids: The final receptor for seepage from the spoil landform and run-off from the high-wall (of each void) is the void lake/residual void. The AMD assessment has found that it's unlikely that undiluted salinity or AMD from a flooded post-closure residual void floor would impact on residual void water quality to any significant degree, as other processes such as evapo-concentration are the key drivers of void lake water quality (SLR, 2024b). Therefore, the AMD SPR risk rating on the overall water quality of the residual voids is Low.

Water reporting to residual voids is expected to remain within the residual voids (excluding evaporative loss). Modelling undertaken by SLR (2024a) shows that seepage from the void lake (of each void) into groundwater, if any, would be limited.

6.1.3.5 Management and rehabilitation measures

The geochemical characterisation, SPR, and residual risk assessment conducted in support of this PRCP informed the following mineral waste management and rehabilitation measures with regards to AMD and salinity management:

- Residual voids: will remain as NUMAs.
- Spoil dumps: will be reshaped, covered with topsoil or alternative growth media and seeded. No specific AMD management measures are proposed for the spoil as operational mixing is expected to be sufficient to manage the small quantity of interburden/overburden that has been characterised with at potential for AMD. Monitoring in accordance with the PRCP schedule will be conducted to ensure that spoil landforms can achieve their nominated PMLU.
- Top of ramp ROM pads at Lotus-Campbell pit (comprising rejects): will be covered by spoil and become part of the Lotus-Campbell spoil landform.
- Main ROM pad: remove remnant coal and rejects from the ROM Pad and dispose within spoil. The former ROM pad will be reshaped, covered with topsoil, ripped and seeded.
- Coal stockpile: remove remnant coal from the coal stockpile pad and dispose within spoil. Cover with topsoil material, rip and seed.

Relationship with PRCP schedule

The geochemical risk of the spoil dumps and residual voids has been assessed as Low. The management and rehabilitation measures proposed in this PRCP manage the risk associated with mineral waste during rehabilitation and closure. The Roper project will undertake further data collection and technical studies to better understand the geochemical characterisation of materials in the Roper area, including tailings and rejects.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1								IA2							
MM1						MM2						MM3			

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM0	0.1 Ground works: - Establish safe access to landforms for data collection and progressive rehabilitation activities. 0.2 Progressive ground works and sufficient data collection for modelling: - Drilling and installation of geochemical boreholes and monitoring - Additional tailings and rejects material testing - Additional waste characterisation 0.3 Updated modelling and landform: - Hydrogeochemical modelling 0.4 Final landform, designs and updated plans: - Cover design
RM2	2.1 Contaminated Land Investigation Document completed in accordance with the <i>Environmental Protection Act 1994</i>, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2.2 The Contaminated Land Investigation Document confirms the area within the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) does not present an unacceptable risk to the post-mining land use. 2.3 Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future <i>Environmental Protection Act 1994</i> compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM3	<u>Tailings Storage Facilities and rejects (RA16)</u> 3.7 Tailings and rejects to be capped with at least 2m of competent benign spoil. 3.8 Landforms to be non-ponding
The following milestone criteria will contribute to achievement of sufficient improvement:	
MM1	IA1.10 Residual voids collectively act as groundwater sinks within the relevant mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary post closure as demonstrated by groundwater modelling defined in condition PRCP12.
MM3	IA3.1 Certification from an AQP that: - The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling - The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary.

6.1.4 Soil and capping material

PRCP Guideline (Section 3.6.1)

The rehabilitation and management methodology should include that soil assessment activities are supplemented by additional surveys conducted at appropriate intervals to assess soil resources in planned disturbance areas. In addition to the assessment of soils, the proposed rehabilitation methodologies in the rehabilitation planning part must also address topsoil management. Topsoil management must ensure sufficient topsoil quantity and quality is available in those instances that waste rock or tailings cannot support the proposed PMLU. Integrated soil and waste rock characterisation and mapping should form the foundation of the rehabilitation strategies. The available soil resources and capping material should be assessed prior to the commencement of operations.

A growth media assessment has been undertaken to support the development of this PRCP. The detailed report – *Saraji South Mine Material Characterisation Study* (Landloch, 2023b), is provided in Appendix F. Soil surveys have been conducted for the proposed mining footprint (Section 1.2.6).

6.1.4.1 Quality of available resources

The quality of the stockpiled topsoil is more representative of the material available for rehabilitation once topsoil is stripped and mixed in stockpiles, compared to undisturbed in situ soil (Landloch, 2023b). The key chemical and physical properties of the stockpiled topsoil within the soil management groups available for rehabilitation at SSM is summarised in Table 35. The characterisation of these materials show that amelioration will be required for them to be suitable to support a PMLU (Section 6.1.4.3).

Permian spoil has been used as a growth media in rehabilitation at SSM and other BMA sites. It has been found that with amelioration, this material can provide a suitable substrate for native woodland species, and it will continue to be used as a growth media, where suitable. Fresh Permian spoil is also considered a resource for rehabilitation to provide the rock component to increase batter slope resistance to erosion and to stabilise steeper areas. The key chemical and physical properties of the fresh Permian spoil are summarised in Table 35, however Landloch (2023) recommend discrete testing should be conducted prior to rehabilitation, which will be completed by an AQP as part of their growth media assessment (Section 6.1.4.3).

Table 35: Key physiochemical properties of stockpiled soil management groups and spoil material

Rehabilitation resource	Properties
Clay topsoil	- Slightly to strongly alkaline (pH 7.9 – 8.8) - Low to moderate salinity (EC 0.11 – 0.39dS/m)

Rehabilitation resource	Properties
	• Non-sodic to sodic (ESP 1.4 – 10.6%) • Low to very low available nutrients (N,P,K) • Clay content >35% • Low permeability, indicating that movement of water to depth will be limited without management • Dispersive to slaking (2 – 5 Emerson Aggregate Test)
Sand/loam topsoil	• Generally neutral (pH 6.6 – 7.4) • Very low salinity (EC <0.05dS/m) • Non-sodic to sodic (ESP 3.9 – 10.2%). • Low to very low available nutrients (N,P,K) • Low CEC and ability to retain nutrients (<4meq/100g). • Clay content of less than 25% • Moderate permeability, indicating that movement of water to depth will be reasonably rapid • Slightly dispersive (3b Emerson Aggregate Test)
Permian spoil (including rock)	• Neutral to strongly alkaline (pH 6.5 – 9.6) • Moderate to extreme (EC <0.3 – 2.5dS/m) • Low to very low available nutrients (N,P,K) • Sodic to strongly sodic (ESP 10 - 40%) • Low to adequate nutrient holding capacity (EC) • Moderate permeability, indicating that movement of water to depth will be reasonably rapid • Rock content up to 74%

6.1.4.2 Quantity of available resources

The rehabilitation at SSM requires growth media to support vegetation establishment for the planned PMLUs. There is sufficient quantity of suitable topsoil available on-site for rehabilitation of disturbed areas to cattle grazing, woodland habitat and watercourse PMLUs. The volume of topsoil available for rehabilitation includes the volume of topsoil currently stockpiled at site (4,509,586m³, as at May 2023) and the future topsoil to be stripped (estimated at 3,511,718m³ for the future mining areas), totalling 8,021,305m³. There is also suitable Permian spoil which can ameliorated to develop an alternative growth media. An alternative growth media may be used on some woodland habitat areas where it is assessed by an AQP to be suitable to achieve the PMLU.

The volume of growth media resources required for rehabilitation of each PMLU is shown in Table 36. These volumes include existing and future disturbance areas for the whole site, only where topsoil needs to be replaced. Required volumes do not include:

- Disturbed areas such as exploration, cleared and existing rehabilitation which already have topsoil
- Low-wall PMLU spoil areas which are planned to utilise ameliorated Permian spoil as an alternative growth media with rock on the surface where suitable

Therefore, the areas in Table 36 do not align to the total area of the RAs. The volume shown for watercourse is conservative as it assumes all diversion and crossing areas require topsoil. Excess topsoil volume will be utilised in areas where there will be a beneficial outcome, such as cattle grazing areas.

Table 36: SSM required growth media volumes for PMLUs

PMLU	Area (ha)*	Cover depth (m)	Volume Required (m ³)
Cattle Grazing	1,091	0.15	1,637,001
Woodland Habitat	4,141	0.10	4,141,432
Watercourse	95	0.15	141,896
Total	5,327		5,920,329

**Only includes areas where topsoil has been removed and needs to be replaced*

Rock will be utilised on the steeper final landform slopes to improve the erosion resistance (Section 6.1.5.3). Rock will be sourced from the mined fresh Permian overburden and interburden, with sufficient quantity available on-site for the planned rehabilitation. Rock will be used directly on rehabilitation areas or stockpiled when required to ensure sufficient quantity for the planned rehabilitation.

6.1.4.3 Resource management

During mining operations, topsoil is stripped according to the recommended depths from the pre-mining soil surveys. The topsoil is either used direct on rehabilitation areas or stockpiled progressively for later use in rehabilitation. Topsoil is stripped with caution to ensure as little contamination with subsoils occurs as possible. The location of current topsoil stockpiles are shown in Appendix F. Stockpile locations and volumes will vary throughout the life of the operation as stockpiled topsoil is used on rehabilitation and new stockpiles are created as mining advances. The spatial location of stockpiles is recorded in a geographic information system and a volume inventory is maintained.

An assessment of the growth media (topsoil or Permian spoil) characteristics will be completed by an AQP (as per condition A5 of the EA) prior to rehabilitation, to determine the amelioration requirements and surface treatments. The assessment will consider the growth media qualities, rock, landform and revegetation plan for the proposed PMLU (Section 6.1.8). After application of the required ameliorants, areas will be ripped along the contour to key in the growth media with the underlying spoil, reduce compaction, improve water infiltration and create surface roughness to slow surface runoff.

The recommended amelioration and surface treatments will be undertaken as part of the rehabilitation execution activities. The growth media depth, potential amelioration options and the surface treatments to support the establishment of vegetation for each PMLU, are shown in Table 37. Opportunities to utilise other amelioration and surface treatment methods may be investigated.

The relationship between soils and vegetation ecosystems for the PMLUs is detailed in Section 6.1.8.

Table 37: Growth media ameliorant options and surface treatments for the SSM PMLUs

PMLU	Growth media	Ameliorant options	Surface treatments
Cattle crazing	Topsoil – minimum depth of 150mm is sufficient to store moisture and nutrients to initiate and sustain pasture growth	- Elemental Sulphur - Manures - Urea - Diammonium phosphate - Superphosphate	- Ameliorate growth media as recommended by an AQP (if required) - Rip along contour - Direct seed as per seed mixes and rates for cattle grazing

PMLU	Growth media	Ameliorant options	Surface treatments
		- Fertiliser - Gypsum - Incorporated organic matter - Surface mulching (e.g. hay mulch)	revegetation (Section 6.1.8.5)
Woodland habitat	Topsoil – minimum depth of 100mm to support establishment of woodland species and to limit the effects of competition from exotic pasture species Or Permian spoil – minimum depth of 300mm	- Elemental Sulphur - Manures - Superphosphate - Fertiliser - Gypsum - Incorporated organic matter - Surface mulching (e.g. hay mulch)	- Ameliorate growth media as recommended by an AQP (if required) - Deep rip along contour to incorporate rock - Direct seed as per seed mixes and rates for woodland habitat revegetation (Section 6.1.8.6)
Watercourse	Topsoil - minimum depth of 150mm to encourage a vegetative cover to provide erosion resistance	- Elemental Sulphur - Manures - Superphosphate - Gypsum - Incorporated organic matter - Surface mulching (i.e. hay mulch)	- Ameliorate growth media as recommended by an AQP (if required) - Rip along contour as required - Direct seed as per seed mixes and rates for watercourse revegetation (Section 6.1.8.8)

Relationship with PRCP schedule

There is a sufficient quantity of suitable quality topsoil available on-site to use as the growth media for rehabilitation of disturbed areas to cattle grazing, woodland habitat and watercourse PMLUs. Suitable Permian spoil may also be ameliorated to develop an alternative growth media for woodland habitat PMLU.

An assessment of the growth media characteristics will be completed by an AQP prior to rehabilitation, to determine the amelioration and surface treatments required to achieve the planned PMLU.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM4	4.1 Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. 4.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP and reviewed and endorsed by a third party AQP, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 4.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 4.2. 4.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM5	5.1 Topsoil placed at minimum depth of 100mm or alternative growth media at minimum depth of 300mm, in areas where topsoil has previously been removed. 5.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP and reviewed and endorsed by a third party AQP, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 5.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 5.2. 5.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM6	6.1 Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. 6.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP and reviewed and endorsed by a third party AQP, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 6.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 6.2. 6.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.

6.1.5 Landform design

PRCP Guideline (Section 3.6.1)

The final landform design must be based on the proposed PMLUs and NUMAs and demonstrate that the land will be safe and structurally stable.

A landform design assessment has been undertaken to support the development of this PRCP. The detailed report – *Erosion and Landform Evolution Simulations to Support Waste Landform Design: Saraji South Mine* (Landloch, 2024), is provided in Appendix K.

Landform design considers the landform development and reshape after the removal of infrastructure, and prior to placement of growth media and seed.

The final closure landform design has been refined based on the outcomes of the studies undertaken to support this PRCP. The major refinements included changes to the mining limits to ensure geotechnical stability of the residual voids is achieved (Section 6.3.1), residual void extents to mitigate the risk of flooding (Section 6.1.2) and spoil dump slope angles for erosional stability based on the materials available on site (Section 6.1.5.3).

6.1.5.1 3D design

The conceptual 3D closure landform design for SSM is provided in Figure 18.

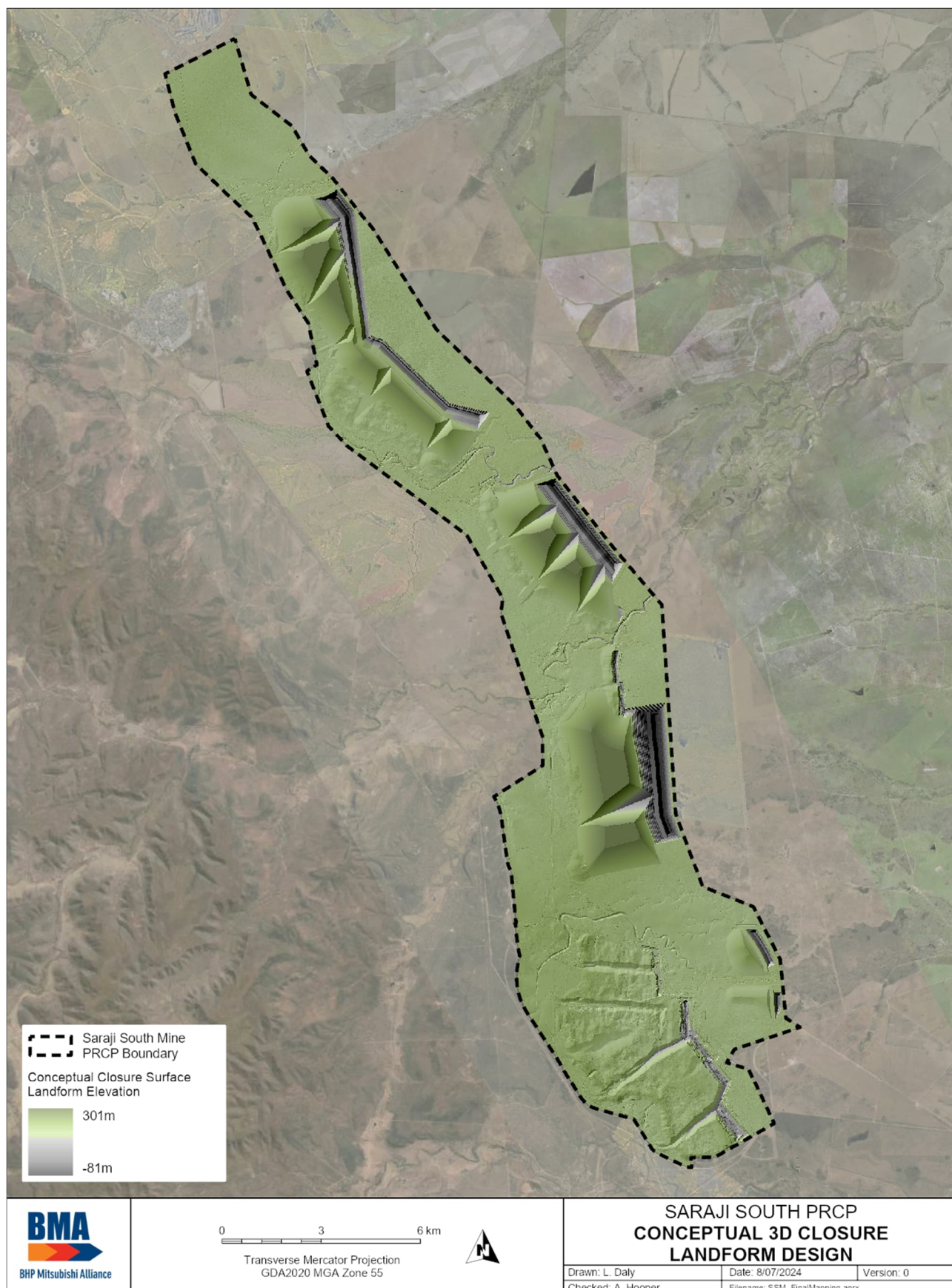


Figure 18: Conceptual 3D closure landform design

6.1.5.2 Method of determining landform design

The relevant activities (Section 1.4.1) considered when determining the landform design are detailed in Table 38.

Removal of infrastructure (Section 6.5) and contaminated land requirements (Section 6.5.3) will be completed where required, prior to reshaping of the final landform. After reshaping of the final landform, the required growth media and ameliorants are applied to support the PMLU (Section 6.1.4), the area is seeded (Section 6.1.8), and monitoring and maintenance completed to ensure rehabilitation is tracking to a stable condition (Section 8).

Table 38: Landform structures at SSM and proposed designs

Landform structure	Landform design
Spoil dumps	- Maximum dump heights varying from 50m up to 120m above ground level to fit the waste scheduled to be mined 20m dump lift heights - Dump slopes within PMLU areas to be reshaped to be free-draining with maximum 15% slopes or up to maximum 30% slopes with rock on the final landform surface (refer to erosion modelling Section 6.1.5.3) - Runoff to be restricted from the top of the landform onto the batter slopes to manage erosion - Spoil dumps achieve FoS ≥ 1.5
TSFs and rejects	- Covered by a non-ponding landform (Section 6.1.6) - Minimum 2m spoil cover (Section 6.1.6) - Area will be reshaped with maximum 12% slopes - Landform achieves FoS ≥ 1.5
Infrastructure and general areas – MIA, buildings, stockpile areas, laydown areas, roads, mine dams, drains, exploration	- Area will be reshaped with maximum 12% slopes for cattle grazing PMLU - Area will be reshaped with maximum 15% slopes for woodland habitat PMLU
Residual voids	- Set-back from the high-wall and end-wall crest to achieve structural stability of FoS ≥ 1.5 within the NUMA extents or a minimum of 50m where against the tenure boundary (Section 6.3.1) - Set-back from the low-wall crest to achieve structural stability of FoS ≥ 1.5 within the NUMA extents or a minimum of 25m for erosion protection of PMLU (Section 6.3.1) - The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the tenure boundary - Low-walls are free draining into the void lake with a maximum of 37 degree slopes - Flood mitigation to a level 1m above the 0.1% AEP (including climate change consideration of 20% increase in rainfall intensity) flood levels where required to prevent flood ingress (Section 6.1.2):

Landform structure	Landform design
	- Lotus/Campbell Pit: partial void backfill on the northern and southern end-walls - Gilbert Pit: partial void backfill on the northern and southern end-walls - Price/Leichhardt Pit: partial backfill on the northern end-wall - East Pit: partial backfill on the end-walls adjacent to Rolf Creek
High-wall landform	• The functional requirements include: - Prevention of surface flow of floodwater into the void - Geotechnically stable when floodwater is against the creek-side batter - Prevention of seepage flow of floodwater into the void - No greater maintenance post-closure than other land with similar use, therefore utilise the same geometry, materials and rehabilitation treatments • The standard design for preliminary planning includes: - Key trench through any permeable layer on the ground surface - Not to be constructed out of dispersive material - Maximum 30% slopes with rock for scour protection - Minimum height to include appropriate freeboard for flood heights and materials - Minimum crest width of 10m • The final design will be completed by an AQP based on the latest flood modelling (flood duration against the landform, maximum water levels, flow velocity and bed shear stress), and materials data prior to construction

Materials available for landform rehabilitation

The landform at SSM utilises materials available on-site that will achieve the required landform stability. Rock will be utilised on the steeper final landform slopes to improve the erosion resistance (Section 6.1.5.3). Rock will be sourced from the mined overburden and interburden, with sufficient quantity available on-site for the planned rehabilitation. Rock will be used directly on rehabilitation areas or stockpiled when required to ensure sufficient quantity for the planned rehabilitation.

Growth media details to support revegetation are included in Section 6.1.4.

Hydrological and hydrogeological assessments

Except for the catchment into the residual void, the final closure landform will predominately be water shedding. Rehabilitation will include:

- Reshaping of the rehabilitated spoil dumps with no permanent water management on slopes
- Reshaping of the rehabilitated mine water dams to be free-draining
- Removal of any road culverts and fill material from within the watercourse extents

Free draining is considered to be where the landform sheds the majority of the surface flows from the landform and towards the local drainage lines, and where any residual collection of water on the landform does not persist for more than one month under typical dry weather conditions.

A rehabilitation flood assessment, including hydrologic and hydraulic modelling has been completed for the closure landform (Section 6.1.2). The flooding risk profile developed as part of this assessment identified the risks to the landform from flooding to be low with mitigation measures in place. Mitigation includes partial final void backfill and landforms to mitigate the risk of flood waters entering the residual voids up to the 0.1% AEP (including climate change consideration of 20% increase in rainfall intensity) flood level as detailed in Table 38. Landforms are permanent structures that will be constructed with the same materials, procedures and geometry as other spoil landforms and require no more maintenance than other rehabilitated areas. These landforms will be designed by an AQP based on the latest flood modelling and materials data prior to construction.

The flood water interaction with the spoil dumps is at the extremity of the flooding extent with relatively low velocities and flood heights (Section 6.1.2). Outer landform slopes that interact with flood waters up to a 0.1% AEP will incorporate controls, if required, to minimise potential instability of the landform from interaction with floodwaters.

A hydrogeological assessment (Section 6.1.1), including numerical modelling, and pit lake water balance modelling (Section 6.3.2.1) identified that the Lotus/Campbell, Gilbert, Price/Leichardt and East Pit residual voids will act as groundwater sinks once the pit lakes and groundwater have stabilised. Therefore, groundwater in the proximity of these residual voids will remain depressed and will not impact on the landforms outside of the residual voids. The Roper residual voids will be subject to further technical studies and modelling as part of the Roper project (Section 1.4.1.2).

6.1.5.3 Long-term landform stability

Material testing, erosion modelling and landform evolution modelling of the rehabilitated spoil dumps has been completed (Landloch, 2024) to establish the slope profiles for the materials at SSM to ensure long-term landform stability (Appendix K).

The landform study included:

- Simulations of runoff and erosion for a range of spoil dump landform options using the Water Erosion Prediction Program (WEPP)
- Derivation of parameters for the SIBERIA landform evolution model
- Landform evolution simulations using SIBERIA for the 3D landform of the SSM rehabilitated spoil dumps, which were designed based on the WEPP results.

The runoff and erosion simulations using the WEPP model and the landform evolution simulations using the SIBERIA model indicate that the proposed spoil dumps and slope profiles (Table 38) at SSM can be expected to be stable over the long-term, provided the target levels of groundcover are achieved. Total groundcover manages erosion risk, which includes a combination of rock, vegetation and organic litter cover. In the WEPP and SIBERIA models, the rock cover component is incorporated into the material parameters and a range of vegetation cover is modelled. Vegetation cover includes plants, plant litter, tree leaf litter, twigs and woody debris that protect the soil surface from erosion.

The modelling in Appendix K gives an indication of the vegetation cover to meet target erosion rates for the representative materials modelled, but it does not determine the exact vegetation cover required. The results in Appendix K demonstrate that rockier materials require lower vegetation cover to achieve the target erosion rates on the same slopes. Exact vegetation cover varies with the rock component and therefore varies for the materials across the site.

The Roper spoil dumps have not been modelled in Appendix K. The existing landform aligns to the same stable slope profiles as modelled for the rest of the site. Any landform changes required as part of the detailed rehabilitation and management plan for Roper project area will align to the modelled stable slope profiles, or if required, additional modelling will be undertaken.

To establish vegetation cover as soon as possible and limit the window of erosion risk, the following measures are planned:

- Ripping along the contour to key the growth media with the underlying spoil, reduce compaction, improve water infiltration and create surface roughness to slow water flow (Section 6.1.4.3)
- Application of seed at the optimal time where there is sufficient soil moisture in the profile to assist germination and sustain establishment (Sections 6.1.8.5, 6.1.8.7 and 6.1.8.9)
- Inclusion of a sterile cover crop in the seed mix, which establishes quickly on the exposed surfaces and works to provide a root system that will stabilise the surface (Sections 6.1.8.5, 6.1.8.7 and 6.1.8.9)
- Surface mulching where appropriate, to provide instant groundcover (e.g. hay mulch) (Section 6.1.4.3)
- Monitoring as scheduled and maintenance as required (Section 8).

6.1.5.4 Method of construction

The majority of the spoil dumps are dumped within the mined-out pits and comprise of dragline spoil piles at the base of the dump (~80m high) with haul trucks dumping ~20m lifts above the dragline spoil, or solely haul truck dumping in ~20m lifts where only truck and shovel mining is undertaken.

6.1.5.5 Quality assurance/quality control

The proposed actions referenced in Table 38 are the key controls that will be put in place to manage the landform risks associated with achieving the PMLUs. Designs will be completed for each rehabilitation area prior to execution of the rehabilitation activities and earthworks, and included as part of the rehabilitation workpack, or current work process, at the time of execution.

Quality assurance and quality control (QA/QC) activities are built into all necessary execution and verification activities of these controls. Monitoring and reporting processes verify controls and ensure that controls are executed effectively (Section 8).

6.1.5.6 Trial methodology

Modelling has indicated the proposed landforms will be stable and monitoring will verify if the landforms are on a trajectory towards achievement of the milestone criteria and eventual certification, or whether corrective actions, maintenance or changes to the rehabilitation methodology is required. No trials are planned for SSM for landform design.

6.1.5.7 Limitations and assumptions

The limitations and assumptions of the final closure landform design include:

- The final closure landform is dependent on the mining schedule, which can change due to increased geological knowledge as mining progresses, and market factors and technology. These changes may result in differences to the landform, such as varying heights or ramp locations, but the key considerations to ensure long-term stability, such as slope profiles and materials, will be maintained in the final closure landform design.
- The landform has been designed with maximum dump heights to ensure all modelling is conservative. It is not expected that all areas of the spoil dumps will reach these heights
- A swell factor of 25% has been assumed for the dump scheduling. This is a standard factor based on experience in the Bowen Basin
- Angle of repose of the spoil material is 37°
- Landform evolution modelling has been completed up to 300 years based on the best available inputs at this time and the material testing completed at SSM to date. It is expected materials with higher levels of rock will become available as mining progresses, requiring lower levels of vegetation cover to limit erosion to target levels.
- Due to the size of the spoil dumps and dumping in lifts, the majority of settlement of the 'constructed' landforms is expected to occur during placement with only minor settlement expected after

rehabilitation. According to ACARP project C19022 (Williams, 2015), spoil settlement consists of three components: self-weight settlement (80% occurs during placement and decreases exponentially with time); collapse settlement (most occurs during placement); and degradation settlement (variable timeframe depending on material, but most may occur during placement and approaches a limit over time). The landform will be monitored to ensure a free-draining landform is maintained where required.

Relationship with PRCP schedule

The final closure landform design has been refined based on the outcomes of the studies undertaken to support this PRCP and minimise risk. Dump slopes have been designed based on the materials available on-site and the erosion modelling. The closure landform design, including the spoil dumps, residual voids and other disturbed areas, achieves a safe and stable landform.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1		IA2	
MM1	MM2		MM3

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM0	0.3 Updated modelling and landform: - Landform design iterations. 0.4 Final landform, designs and updated plans: - Final landform design
RM3	3.1 Erosion and sediment control systems are installed as per the construction design and verified by an AQP. <u>Spoil Dumps (RA1, RA12)</u> 3.3 Landforms are constructed such that there will be no runoff from landform tops onto batter slopes. 3.4 Landforms reshaped with maximum 30% slopes. 3.5 Tertiary spoil to be covered with minimum 1m Permian spoil for slopes >5% and for slopes >15% at least 0.5m of the upper 1m Permian cover is to be competent rock. 3.6 Permian spoil to be covered with minimum 0.5m competent rock on >15% slopes. 3.7 AQP¹ certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5. <u>Tailings Storage Facilities and rejects (RA16)</u> 3.7 Tailings and rejects to be capped with at least 2m of competent benign spoil. 3.8 Landforms to be non-ponding. 3.9 Landforms are reshaped with slopes not exceeding 12%.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
	3.10 AQP certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5. <u>Watercourses (RA2)</u> 3.11 Disturbed natural watercourse bed and banks returned to a profile similar to the pre-disturbance condition. <u>Other areas</u> 3.12 Landforms are reshaped with slopes not exceeding 12% (RA3, RA13, RA14). 3.13 Landforms are reshaped with slopes not exceeding 15% (RA4, RA15).
RM10	10.3 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 10.4 Despite criteria 10.3, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: • Do not exceed 1m in depth at any point; and • Do not expose environmentally problematic materials; and • The cause of the gully is known and has been resolved; and • Have established and persistent vegetation cover at the head of the gullies; and • Are in a stabilised state, demonstrated by monitoring data over a 2-year period; and • Do not provide a safety hazard within the context of the PMLU; and • Do not impact the stability or performance of engineered drainage features.
RM11	11.4 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 11.5 Despite criteria 11.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: • Do not exceed 1m in depth at any point; and • Do not expose environmentally problematic materials; and • The cause of the gully is known and has been resolved; and • Have established and persistent vegetation cover at the head of the gullies; and • Are in a stabilised state, demonstrated by monitoring data over a 2-year period; and • Do not provide a safety hazard within the context of the PMLU; and • Do not impact the stability or performance of engineered drainage features.
RM12	12.4 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
	12.5 Despite criteria 12.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: - Do not exceed 1m in depth at any point; and - Do not expose environmentally problematic materials; and - The cause of the gully is known and has been resolved; and - Have established and persistent vegetation cover at the head of the gullies; and - Are in a stabilised state, demonstrated by monitoring data over a 2-year period; and - Do not provide a safety hazard within the context of the PMLU; and - Do not impact the stability or performance of engineered drainage features.
RM13	13.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 13.5 AQP certifies that: - There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and - Mass movement is absent; and - All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 13.6 Despite criteria 13.5, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: - Do not exceed 1m in depth at any point; and - Do not expose environmentally problematic materials; and - The cause of the gully is known and has been resolved; and - Have established and persistent vegetation cover at the head of the gully; and - Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and - Do not provide a safety hazard within the context of the PMLU; and - Do not impact the stability or performance of engineered drainage features.
RM14	14.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 14.2 AQP certifies that: - There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and - Mass movement is absent; and - All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 14.3 Despite criteria 14.2, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: - Do not exceed 1m in depth at any point; and - Do not exposed environmentally problematic materials; and - The cause of the gully is known and has been resolved; - Have established and persistent vegetation cover at the head of the gully; and - Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and - Do not provide a safety hazard within the context of the PMLU; and - Do not impact the stability or performance of engineered drainage features. 14.4 Rehabilitation is assessed as geotechnically stable by an AQP with FoS$\geq$1.5 (RA1, RA12).

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM15	15.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 15.2 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 15.3 Despite criteria 15.2, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: • Do not exceed 1m in depth at any point; and • Do not exposed environmentally problematic materials; and • The cause of the gully is known and has been resolved; and • Have established and persistent vegetation cover at the head of the gully; and • Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and • Do not provide a safety hazard within the context of the PMLU; and • Do not impact the stability or performance of engineered drainage features. 15.4 Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method).
RM17	17.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 17.3 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 17.4 Despite criteria 17.3, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: • Do not exceed 1m in depth at any point; and • Do not exposed environmentally problematic materials; and • The cause of the gully is known and has been resolved; and • Have established and persistent vegetation cover at the head of the gully; and • Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and • Do not provide a safety hazard within the context of the PMLU; and • Do not impact the stability or performance of engineered drainage features.
RM18	18.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 18.4 AQP certifies that: • There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and • Mass movement is absent; and • All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

	18.5 Despite criteria 18.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: • Do not exceed 1m in depth at any point; and • Do not exposed geochemically and highly saline problematic materials; and • The cause of the gully is known and has been resolved; • Have established and persistent vegetation cover at the head of the gully; and • Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and • Do not provide a safety hazard within the context of the PMLU; and • Do not impact the stability or performance of engineered drainage features.
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The following milestone criteria will contribute to achievement of sufficient improvement:

MM1	IA1.1 Void backfill will be completed at the end of mining for flood mitigation at: • The northern and southern end-walls of Lotus/Campbell void • The northern and southern end-walls of Gilbert void • The northern end-wall of Price/ Leichhardt void • The end-walls adjacent to Rolf Creek of East Pit voids. IA1.2 Highwall landforms must: • Prevent surface flow of floodwater into the void • Be geotechnically stable when floodwater is against the creek-side batter • Prevent seepage flow of floodwater into the void • Not be constructed with dispersive material • Have maximum 30% slopes with rock for scour protection. IA1.3 The final design for highwall landform must be completed by an AQP based on the latest flood modelling and materials data prior to construction. IA1.4 Final residual voids are not subject to inundation from floodwaters up to and including the 0.1% AEP. IA1.5 The high-wall, end-wall and low-wall achieve a FoS ≥ 1.5 within the NUMA extents as determined by an AQP. IA1.6 A minimum distance of 50m is to be designed between the residual void crest and the toe of the safety bund, where against an external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary. IA1.7 The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary. IA1.8 Low-walls are free-draining into the void lake with a maximum 37 degree slopes.
MM2	IA2.4 A minimum distance of 25m is to be designed between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform in IA2.1.
MM3	IA3.1 Certification from an AQP that: • The residual void is safe to humans and livestock • Voids retain flood immunity, supported by flood modelling re-run at end of life and calibrated against the final landform • The highwall landform has been constructed in accordance with the final design

	• Appropriate safety infrastructure at the geotechnical set-back distance has been installed to prevent access to the NUMA • The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary • Erosion of the landform within the NUMA area will not negatively impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU.
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6.1.6 Cover design

PRCP Guideline (Section 3.6.1)

A cover design is required for the surface treatment of a mine landform or other waste material. Hence, the cover system design must be appropriate for the type(s) of waste the project will generate and reflect a risk-based approach. Where waste has the potential for AMD, neutral mine drainage or saline mine drainage, an appropriate cover system must be designed.

The cover design should include:

- identification and specification of the objectives of the cover system
- a detailed description of the design including the thickness of each layer
- a detailed description of construction methodology including any proposed staging of the cover system
- a quantitative assessment that identifies the location and quantity of proposed capping material available on-site
- proposed QA/QC for the construction of the cover system including the timely implementation of corrective actions where deviations from the design are identified.

As detailed in the PRCP Guideline, a cover system is required where there is potential for materials to cause AMD, NMD or SD, to ensure contaminants are not released to the receiving environment.

The SSM TSFs and rejects dump are located within the Roper project area detailed in Section 1.4.1.2. There is insufficient geochemical (Section 6.1.3) and tailings geotechnical characterisation data (Section 6.2) to accurately assess the risks associated with the tailings and rejects areas and enable the detailed design of a suitable cover in this transitional PRCP. Cover designs will be developed as part of the technical studies and detailed rehabilitation and management plan for the Roper project. The conceptual cover design for tailings and rejects is a non-ponding landform with at least 2m of spoil cover.

As detailed in Section 6.1.3, no specific management measures are required for the spoil dumps.

Relationship with PRCP schedule

Detailed cover designs for the TSFs and rejects dump will be developed as part of the technical studies and detailed rehabilitation and management plan for the Roper project.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM0	0.1 Ground works: • Establish safe access to landforms for data collection and progressive rehabilitation activities.
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	0.2 Progressive ground works and sufficient data collection for modelling: • Drilling and installation of geochemical boreholes and monitoring • Additional tailings and rejects material testing • Additional waste characterisation • Additional tailings geotechnical characterisation 0.3 Updated modelling and landform: • Hydrogeochemical modelling 0.4 Final landform, designs and updated plans: • Cover design
RM3	<u>Tailings Storage Facilities and rejects (RA16)</u> 3.7 Tailings and rejects to be capped with at least 2m of competent benign spoil. 3.8 Landforms to be non-ponding 3.9 Landforms are reshaped with slopes not exceeding 12% 3.10 AQP certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5

6.1.7 Water management

PRCP Guideline (Section 3.6.1)

The rehabilitation planning part must include a description of the following:

- a description of the contaminants that pose a risk to environmental values of the receiving environment
- source, pathway and fate of contaminants that have the potential to impact environmental values
- infiltration and seepage intervention and collection controls
- surface water diversions and long-term management requirements
- dewatering requirements
- ongoing water management and reduction requirements (i.e. treatment).

The closure landform design for SSM is intended to provide landforms that are suitable for and meet the nominated PMLU and NUMA milestone criteria without the need for ongoing active water management or dewatering.

The key objectives for post-mining water management, which are discussed in more detail in the relevant sections of this PRCP, have been taken into account during the development of the closure landform (excluding the Roper area) and include:

- With the exception of the catchment of the residual voids, the closure landform surfaces will be predominantly free-draining where appropriate to prevent impacts, with runoff allowed to flow to the surrounding watercourses (Section 6.1.5)
- All mining-related dams will be decommissioned and removed, and the rehabilitated areas will be free-draining (Sections 6.1.5 and 6.5)
- Final residual voids will remain as NUMAs and will establish into a network of groundwater sinks that provide for the capture of groundwater seepage from mining disturbed areas and prevent the release of contaminated waters off-tenure and the future interconnection of aquifers (Section 6.3)
- Rehabilitated closure landforms provide residual void flood protection up to and including a 0.1% AEP flood event including a climate change increase of rainfall intensity of 20% (Section 6.1.2 and 6.1.5)
- The acid neutralising capacity of the spoils is sufficient to neutralise acid forming materials within the spoil dumps (Section 6.1.3)

- Modelling of flow paths through particle tracking simulations within groundwater over a 578-year recovery period, within and surrounding the mining operations, indicate the groundwater within the tenure will migrate toward the residual voids (NUMAs) and not into receiving environments (Section 6.1.1)
- Contaminated land investigations (RM2) will be undertaken to confirm the suitability of the site for the PMLUs and provide additional information on source areas, preferential pathways and potential risks associated with migration of contaminants.
- Forward work plans and any required realignment and rehabilitation works will be undertaken to render the creek/surface water diversions at SSM to a suitable condition, supporting their progression to a relinquishable state (Section 6.1.7.4)
- Conceptual site models that assess SPR linkages have been prepared for relevant technical studies including hydrogeology (Section 6.1.1), waste characterisation (Section 6.1.3) and voids (Section 6.3) and show a low likelihood of complete exposure pathways to off-tenure receptors.

The currently available data in the Roper area is insufficient for reliable water modelling to support the development of a detailed, risk driven, water management plan for the area. The complexity of the area that supports residual voids, TSFs, rejects, mine affected water dams, diversions, spoil dumps, and neighbours the MIA, requires a competent understanding of each aspect and how they interact to allow establishment of a stable post-mining environment that adequately manages water. The Roper project (Section 1.4.1.2) will undertake further technical studies to enable the development of a water management plan as part of the detailed rehabilitation and management plan for the area. The following water management plan addresses the SSM site outside of the Roper area.

6.1.7.1 Contaminants and sources

Since SSM operations commenced in 1979, heavy industrial type activities including operation and maintenance of the processing facilities, vehicles and other plant infrastructure required to support the extraction and processing of coal, have occurred on the site. These heavy industrial type activities include the storage, use and disposal of a variety of hazardous materials. The assessment of the industrial and associated areas, when they are available for rehabilitation, is required to identify and direct contaminated land assessment and remediation works.

Due to the nature and duration of heavy industrial works at SSM, it is considered likely that contaminated land will be present, which will require investigation and some remediation/management to render the area suitable for the intended PMLUs.

The predominant hazardous materials identified to have a potential to cause contamination at SSM and impact PMLUs and/or the receiving environment include:

- Hydrocarbons: including diesel, oils, greases, methyl isobutyl carbinol and other solvents
- Aqueous Film-Forming Foam: historical use of products containing Perfluoroalkyl and Polyfluoroalkyl Substances species of concern
- Nitrogen: associated with explosive production
- Carbonaceous materials
- Metals: associated with leachate from coal and industrial operations

Current operational water management includes the segregation of mine affected water from mine operational areas, from non-mine affected areas. Water from mine operational areas is collected within on-site mine dams and residual voids for recycling within BMA's operations or released under the conditions of the EA. Mine affected water includes pit water, TSF water and runoff from areas such as the MIA. Mine affected water dams have the potential to accumulate contaminants and therefore are a potential secondary source of contamination. Contaminants of concern within the dams include those potential contaminants listed above, as well as salinity. All mine affected water dams will be assessed for potential accumulation of contaminants and appropriately decommissioned to form free-draining areas.

As detailed within the *SSM Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste* (BHP, 2024) (Appendix J), the AMD and non-oxidative salinity overall SPR risk ranking within the closure

landform for the spoil dumps and residual voids is Low (Section 6.1.3.4). The spoil at SSM has been identified to contain moderate to high acid neutralising capacity, which can assist with the in-situ neutralisation of AMD sources. In addition, the depth to groundwater and the results of hydrogeological particle tracking indicates that potential contaminated seepage that enters the groundwater will migrate towards and be captured within the residual voids, and hence will remain within the tenure within NUMAs (noting the Roper project area requires further technical studies). Surface water monitoring – as per the operational EA requirements, and Section 8.5 of this PRCP will identify any potential geochemical risks from site and progressively rehabilitated landforms.

Contaminated land investigations will be undertaken to assess areas for potential contamination (RM2). These investigations will assess for potential contaminants that are utilised or generated during operations and will provide an assessment of the risk presented to achievement of the PMLUs and the receiving environment. Contaminated land works are regulatory functions under the EP Act and therefore, contaminated land works that are completed for regulatory purposes, such as under RM2, are required to be completed by persons deemed suitably qualified under the EP Act. Contaminated Land Investigation Documents prepared for submission to the administering authority will be reviewed by a statutory contaminated land auditor prior to submission, to confirm the completed assessments are in accordance with legislative and other requirements.

6.1.7.2 Pathway of contaminants

The final landform surfaces will generally be free draining directly to the surrounding watercourses. Any contaminants present at the surface of the closure landform have the potential to be mobilised through surface water runoff, generation of airborne particulate and through direct contact with the PMLUs. Contaminated land assessments (RM2) at required areas when they become available for rehabilitation, will inform required remediation/management works to mitigate identified unacceptable risks associated with potential pathways through surface contamination.

Prior to rehabilitation, the mine affected water dams, and other associated infrastructure within the mine water management system, will be assessed for potential contaminants, remediated where required and decommissioned. The surface of mine dam rehabilitation areas will be free-draining and will not present an unacceptable risk of contaminant mobilisation.

Modelling of flow paths (noting the Roper area requires further technical studies to confirm potential contaminant pathways), through groundwater particle tracking, indicates that groundwater within the tenure, including those areas containing the MIA, mine dams and spoil dumps, will migrate towards the residual voids post-mining. During the initial stabilisation phase of the groundwater and pit lakes, the more dynamic climate influenced pit lakes (when compared to groundwater) may result in some variability in the flux between groundwaters and pit lakes. Outflows (mainly within the first 39 years post-mining) are predominantly into the spoil dumps, prior to the recovery of groundwater within the spoil. Flow path modelling indicates that these events do not result in loss of groundwaters beyond the tenure, with groundwaters returning to the residual voids (Sections 6.1.1 and 6.3).

6.1.7.3 Fate of contaminants

Any contamination remaining post-mining will not present an unacceptable risk to the proposed PMLU or adversely impact environmental values. Contamination that presents an unacceptable risk to the nominated PMLUs, or the receiving environment will be subject to remediation to reduce the level of contamination to an acceptable level and/or implementation of engineering controls that minimise the potential for migration of contaminants and complete exposure pathways.

6.1.7.4 Water storages

All mine water storages, that are not beneficial to the PMLU and do not have a landowner agreement to retain, will be decommissioned and rehabilitated. No residual mine water storages are currently contained in the closure landform. All dams used to store mine affected water will be subject to investigation for potential contamination, and where required, remediation/management as part of the decommissioning.

6.1.7.5 Surface water diversions and management requirements

SSM has four current watercourse diversions – Downs Creek, Lotus Creek, Stephens Creek and Rolf Creek, which were designed and constructed to enable open-cut mining; plus an equalisation channel between Scott and Sandy creeks to mitigate flood risk of the main haul road. Each creek diversion was assessed against the EA watercourse PMLU goals of being safe, stable, non-polluting and self-sustaining. The assessments concluded that three of the SSM diversions, Downs Creek, Lotus Creek and Stephens Creek, in their current alignment, are expected to progress towards the EA PMLU goals and acceptance criteria. The equalisation channel is planned to be backfilled to natural ground level.

Rolf Creek (including the upstream unmapped extent) was assessed as requiring realignment and rehabilitation. Therefore a diversion concept design, based on both the Department of Natural Resources, Mines and Energy (DNRME) (2019) and ACARP (2014) guidelines, has been developed: *PRCP Concept Design Report – Rolf Creek East* (Engeny, 2024), provided in Appendix L. The western extent of the conceptual surface water diversion is located within the Roper project area (Section 1.4.1.2) and is subject to further technical studies which may optimise the diversion alignment.

A surface water diversion to divert an unnamed/unmapped tributary east of East Pit was approved as part of the East Pit EIS (BMA, 2006), and this conceptual surface water diversion has been incorporated into the PRCP final landform.

The diversion details and forward work plan commitments for relinquishment of these creeks are summarised in Table 39. Prior to commencing any creek diversion rehabilitation construction works, all applicable environmental approvals, including under the *Water Act 2000*, will be obtained.

Table 39: SSM surface water diversion details and forward work plans

Details	Downs Creek	Lotus Creek	Stephens Creek	Scott and Sandy Creeks	Rolf Creek
Water licence	402409	402409	0426519F	46304F	34744F
River catchment	Isaac River, Fitzroy Basin	Isaac River, Fitzroy Basin	Isaac River, Fitzroy Basin	Isaac River, Fitzroy Basin	Isaac River, Fitzroy Basin
Upstream catchment area (km ²)	24	15	582	473	510
Year of construction	2007	2007	1992	Between 1983 and 1989	Early to mid-1990's
Diversion length (km)	1.1	1.0	2.7	0.3	2.8
Diversion assessment outcome	Diversion in its existing alignment achieves or will continue to progress towards the defined EA watercourse PMLU goals. Diversion will be relinquished in its existing alignment following implementation of the forward work plan commitments.	Diversion in its existing alignment achieves or will continue to progress towards the defined EA watercourse PMLU goals. Diversion will be relinquished in its existing alignment following implementation of the forward work plan commitments.	Diversion in its existing alignment achieves or will continue to progress towards the defined EA watercourse PMLU goals. Diversion will be relinquished in its existing alignment following implementation of the forward work plan commitments.	Equalisation channel planned to be backfilled to natural ground level.	At closure, the existing diversion alignment is not expected to achieve a watercourse PMLU. Diversion requires implementation of the forward work plan commitments.
Operational phase	Routine monitoring and maintenance of the diversion during the operational phase of the mine.	Routine monitoring and maintenance of the diversion during the operational phase of the mine.	Routine monitoring and maintenance of the diversion during the operational phase of the mine.	Routine monitoring and maintenance of the equalisation channel during the operational phase of the mine.	Routine monitoring and maintenance of the diversion during the operational phase of the mine.

Details	Downs Creek	Lotus Creek	Stephens Creek	Scott and Sandy Creeks	Rolf Creek
Forward work plan - diversion construction	N/A	N/A	N/A	N/A	When surrounding rehabilitation activities are planned, progress concept design (Appendix L) to functional design, including undertaking site specific investigations to ensure the design addresses key risks. Construction of the diversion in line with the final functional design, developed based on DNRME (2019) and ACARP (2014) guidelines.
Forward work plan – infrastructure	N/A	N/A	Removal and rehabilitation of in-stream and adjacent mine infrastructure areas including the haul road, culverts and levee banks.	Removal of the existing haul road culverts. Backfilling and rehabilitation of the equalisation channel.	Removal and rehabilitation of any current or future mine infrastructure near the diversion. Backfilling of Browns Dam to make free-draining.
Forward work plan – final landform	N/A	N/A	N/A	N/A	Re-grade, topsoil and revegetate adjacent spoil dumps.

6.1.7.6 Ongoing water management

On completion of rehabilitation works, ongoing water management/dewatering is not envisaged to be required for areas outside of Roper project area, due to the following:

- The surface of the closure landform, other than the catchment into the residual voids, will generally be free-draining where required to prevent impacts and surface flows will not contain concentrations of contaminants that have the potential to cause environmental harm
- Contamination will be remediated and/or appropriately managed as part of RM2
- The residual void network will contain groundwater seepage from the mining disturbed areas of the site, and will not overtop or allow interconnection of groundwater aquifers of different water quality
- Creek diversions will be realigned where required and rehabilitated to form a stable landform that allows relinquishment of the water licences

As detailed in Section 6.1.7, the Roper project will undertake further technical studies to enable the development of a water management plan which best manages potential environmental risks associated with the post-mining environment in the Roper area.

Relationship with PRCP schedule

The closure landform design with residual voids will provide a landscape that does not require ongoing active water management. The creek diversions will be realigned, where required, and rehabilitated to form a stable watercourse PMLU that allows for relinquishment of the water licences. Roper project area will be subject to additional technical studies in the PRCP schedule, that will provide additional information to support rehabilitation and management activities.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1								IA2							
MM1				MM2						MM3					

The following PRCP Conditions will contribute to achievement of PMLU to a stable condition:

PRCP13	With respect to surface water: - The holder must install monitoring equipment at the relevant surface water monitoring locations specified in Table 73: Surface water monitoring locations and undertake at least 1 year of surface water quality monitoring prior to the completion of surface preparations for the entire site; and - Surface water quality must be monitored at the locations specified in Table 73: Surface water monitoring locations at least once per month when flows at the downstream gauging station record 1m³/second, when safe to collect samples.
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The following PRCP Conditions will contribute to achievement of PMLU to a stable condition:	
	c) The holder must develop site-specific surface water quality limits for the watercourses listed in Table 73: Surface water monitoring locations.
PRCP14	With respect to surface water the following must be demonstrated prior to surrender: a) Surface water quality must not exceed the limits specified in site-specific surface water quality limits within the 5-year period immediately prior to surrender; b) If the surface water quality exceeds criteria a), the applicable upstream/reference site must be compared to the downstream site result; and quality result measured at a downstream site must be equal to or less than the quality result measured at the applicable upstream/reference site.
PRCP15	Where the surface water quality at the downstream site exceeds the upstream site result as per PRCP14b), an AQP must complete an assessment of the cause of the exceedance and risk of rehabilitation not achieving a stable condition (PRCP 14) within the schedule timeframe and: a) Where there is a low risk to achieving a stable condition from the mining tenure (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), then no further action is to be taken; or b) Where there is a risk greater than low to achieve a stable condition, then an assessment of potential environment harm and any changes or rectification actions to rehabilitation activities must be determined and implemented.
PRCP16	The assessment/s under PRCP15 must be completed and provided to the administering authority within 3 months of receiving the relevant sampling results.
PRCP17	Despite PRCP14, PRCP15a) can be triggered 3 times over 5 consecutive years prior to surrender.
PRCP18	If PRCP15b) is triggered the 5-year timeframe under PRCP14a) is reset.
The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM0	0.1 Ground works: • Establish safe access to landforms for data collection and progressive rehabilitation activities. 0.2 Progressive ground works and sufficient data collection for modelling: • Drilling and installation of additional groundwater bores and water monitoring • Ongoing land contamination investigation. 0.3 Updated modelling and landform: • Water balance modelling 0.4 Final landform, designs and updated plans: • Water management plan
RM1	1.5 With the exception of 1.2, 1.3 and 1.4 above, the following are complete: • All surface water drainage infrastructure removed • Mine water dams are decommissioned • Watercourse crossings and culverts removed.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
	1.6 Assessment of mine water dams is completed by an AQP and identified sediment and water management actions are completed.
RM2	2.1 Contaminated Land Investigation Document completed in accordance with the <i>Environmental Protection Act 1994</i>, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2.2 The Contaminated Land Investigation Document confirms the area within the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) does not present an unacceptable risk to the post-mining land use. 2.3 Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future <i>Environmental Protection Act 1994</i> compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.
RM3	<u>Watercourse (RA2)</u> 3.11 Disturbed natural watercourse bed and banks returned to a profile similar to the pre-disturbance condition.
RM10	10.2 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits (RA3, RA13, RA14, RA16).
RM11	11.3 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits (RA1, RA4, RA12, RA15).
RM12	12.3 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits.
RM13	13.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 13.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: • Requirements of any Site Management Plan have been met; • Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and • There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM14	14.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 14.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: • Requirements of any Site Management Plan have been met; • Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and • There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM15	15.4 Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method). 15.5 Assessment by an AQP that the watercourse diversion has an Index of Diversion Condition (IDC) score >10. 15.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 15.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: • Requirements of any Site Management Plan have been met; • Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and • There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM17	17.6 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: • Requirements of any Site Management Plan have been met; • Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and • There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM18	18.6 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: • Requirements of any Site Management Plan have been met; • Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and • There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
The following milestone criteria will contribute to achievement of sufficient improvement:	
MM3	IA3.1 Certification from an AQP that: • The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling • The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary

6.1.8 Revegetation

PRCP Guideline (Section 3.6.1)

The revegetation plan must propose activities that will establish self-sustaining vegetation communities that are appropriate for the intended PMLU (e.g. natural ecosystems, grazing, forestry and some agricultural and other land uses). Revegetation should, therefore, not only establish a ground cover, but also, in some domains, establish associated fauna habitat and other ecological services.

The rehabilitation planning part must include details of the site preparation required for rehabilitation activities.

6.1.8.1 Revegetation objectives

The revegetation objectives of the planned cattle grazing, woodland habitat and watercourse PMLUs are consistent with the rehabilitation milestone criteria:

- Cattle grazing:
 - Achieve >50% vegetation groundcover
 - Good density of 3P grasses
 - Appropriate management of restricted invasive plants
 - Establishment of cattle grazing pasture with land suitability class ≤ 3
- Woodland habitat:
 - Achieve groundcover $\geq 50\%$ on slopes $\leq 15\%$, or $\geq 80\%$ on slopes $> 15\%$
 - Establishment of a hybrid ecosystem on spoil dumps based on the representative REs surrounding the site (RE 11.4.2, RE 11.4.13, RE 11.5.2, RE 11.5.3 and RE 11.10.7) (Section 1.2.8), or a target RE for areas generally surrounded by vegetation communities
 - Appropriate management of restricted invasive plants
- Watercourse:
 - Achieve riparian vegetation index $\geq$ upstream or downstream values
 - Establishment of watercourse vegetation with species richness of native trees and shrubs, tree canopy cover and recruitment
 - Appropriate management of restricted invasive plants

There are no revegetation objectives for the planned NUMAs.

The above revegetation objectives for groundcover consider groundcover to be anything in contact with the soil surface, for example live cover, standing dry cover, organic litter (including leaves, hay, woody debris) or rocks.

No infrastructure is proposed to support the revegetation plan.

6.1.8.2 Species of conservation significance

SSM has no obligations under the EA requiring specific inclusion of species of conservation significance in the revegetation planning. Nonetheless, areas adjoining undisturbed Endangered or Of Concern REs (Section 1.2.8) or threatened species habitats (Section 1.2.9) will be rehabilitated to a woodland habitat PMLU wherever possible. This approach will provide connectivity between rehabilitated areas and existing vegetation and habitat values. Similarly, areas rehabilitated to a watercourse PMLU will connect existing riparian habitat values for several conservation significant species.

6.1.8.3 Fauna habitat and use requirements

There are no obligations under the EA to establish fauna habitat and/or fauna use in the rehabilitation areas for SSM. However, areas adjoining undisturbed threatened fauna species habitats (Section 1.2.9) will be rehabilitated to a woodland habitat PMLU wherever possible, and disturbed areas of watercourses will be rehabilitated to a watercourse PMLU.

Woodland habitat and watercourse revegetation rehabilitation will include a combination of *Eucalyptus*, *Corymbia* and non-Eucalyptus framework tree species and woody understorey species that will provide broad habitat values for highly mobile fauna taxa including birds and mammals (e.g. kangaroos and wallabies), as well as longer term foraging and shelter opportunities for common fauna species and several species of conservation significance (e.g. koala, echidna).

6.1.8.4 Revegetation seed provenance

The provenance (where the seed comes from) is considered important for all species. Seeds will be sourced as locally as possible from natural populations. Although the local provenance boundary locations may differ between species, seed should ideally be obtained from the Brigalow Belt North bioregion.

Proof of provenance will be sought from the seed suppliers along with germination and viability certificates for all purchased seeds.

6.1.8.5 Cattle grazing revegetation species and seeding rates

Areas of cattle grazing are predominately planned for the lower gradient areas disturbed by mining activities, areas that require shallow rooted species and/or areas where there was significant clearing prior to mining (RA3, RA13, RA14 and RA16).

The growth media for cattle grazing will be pre-stripped topsoil, spread over rehabilitated landforms at a depth $\geq 150\text{mm}$, and ameliorated as recommended by an AQP (refer to Section 6.1.4).

The recommended revegetation species mix for cattle grazing PMLU is based on seeding native and naturalised exotic species that are preferred, palatable and productive (3P) grasses and legumes cognisant of grazing best management practice (DES, 2022a; Future Beef, 2022). Preferred pasture species have been recommended based on species known to occur on SSM, as well as a selection of pasture species suitable for the soil management group described in Section 6.1.4.

The recommended species list and seeding rates are detailed in Table 40. A seeding rate of 16kg/ha of coated pasture seed and 4kg/ha of uncoated legume seed is recommended for a cattle grazing PMLU. All seed mixes will also include 5kg/ha of Japanese millet (*Echinochloa esculenta*) or similar as a sterile cover crop to protect soils from erosion. The cover crop will establish quickly on the exposed surfaces to provide vegetative cover and a root system that will stabilise the surface and prevent erosion until preferred species have established.

Species availability may vary, however at least four preferred pasture grass species and two legumes listed in Table 40 are required. The cattle grazing seed mix composition and seeding rates may be adjusted by an AQP based on the results of ongoing rehabilitation monitoring (Section 8).

Pasture seed mixes are recommended to be sown in the warmer months of the year from September to March, when the probability of rainfall is highest. Seeding may be undertaken at other opportune times, such as for unseasonal climatic conditions.

No seeding of *Leucaena* (*Leucaena leucocephala*) is proposed at SSM.

Table 40: Recommended species list and seeding rates for cattle grazing PMLU

Scientific name	Common name	Clay topsoil	Sand /loams topsoil	Seeding rate (kg/ha)
Grass species				
<i>Astrebla lappulacea</i> , <i>A. squarrosa</i> , <i>A. elymoides</i>	Mitchell grasses (curly, bull and hoop)	✓	-	2 ^c (per species)
<i>Bothriochloa bladhii</i>	forest blue grass	-	✓	4 ^c
<i>Bothriochloa insculpta</i> cvv. Bisset*	Bisset creeping blue grass	✓	✓	4 ^c
<i>Chloris gayana</i> cvv. <i>Callide</i> *	Callide Rhodes grass	✓	✓	4 ^c
<i>Chloris gayana</i> cvv. <i>Katambora</i> *	Katambora Rhodes grass	✓	✓	4 ^c
<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	Queensland blue grass	✓	-	4 ^c

Scientific name	Common name	Clay topsoil	Sand /loams topsoil	Seeding rate (kg/ha)
<i>Digitaria brownii</i>	cotton panic	-	✓	2 ^c
<i>Heteropogon contortus</i>	black spear grass	✓	✓	2
<i>Megathyrsus maximus</i> var. <i>pubiglumis</i> *	green panic	-	✓	4 ^c
<i>Panicum coloratum</i> var. <i>makarikariense</i> *	bambatsi Panic	✓	-	4 ^c
<i>Setaria incrassata</i> *	purple pigeon	✓	-	4 ^c
<i>Urochloa mosambicensis</i> *	Sabi grass	-	✓	4 ^c
Grass species - Total seed weight coated				16^c
Legume species				
<i>Chamaecrista rotundifolia</i>	Wynn cassia	-	✓	2
<i>Macroptilium bracteatum</i> *	burgundy bean	✓	-	2
<i>Rhynchosia minima</i> var. <i>australis</i>	rhynchosia	✓	✓	2
<i>Rhynchosia minima</i> var. <i>minima</i>	rhynchosia	✓	✓	2
<i>Stylosanthes hamata</i> *	shrubby stylo	-	✓	2
<i>Stylosanthes seabrana</i> *	stylo	✓	-	2
Legume species - Total seed weight uncoated				4
Cover Crop				
<i>Echinochloa esculenta</i>	Japanese millet	✓	✓	5 ^c

^c Assumes seed is coated. If not coated, use half prescribed rate; * Naturalised exotic pasture species

6.1.8.6 Woodland habitat revegetation

Areas of woodland habitat PMLU are planned on landforms associated with the spoil dumps (RA1 and RA12) and areas near existing vegetation communities (RA4 and RA15).

The approach to woodland habitat revegetation and the monitoring method discussed in Section 8.2, has considered the following OQMRC publications:

- *Evaluating methods for assessing native ecosystem mine rehabilitation success* (Spain, Nuske, & Gagen, 2023)
- *Native ecosystem rehabilitation in Queensland Implications for leading practice* (OQMRC, 2023).

The spoil dumps are elevated, sloped anthropogenic landforms comprised of mudstones, claystones, siltstones and sandstones (Section 6.1.5). These landforms vary from pre-mining landforms and do not align with any specific land zone under the RE framework (Wilson & Taylor, 2012).

Woodland habitat revegetation of the spoil dumps aims to achieve a 'hybrid' ecosystem (Spain C. , Nuske, Gagen, & Purtill, 2023). This will be achieved through revegetation with key framework tree, shrub and grass species known to occur within representative REs within and surrounding SSM, as well as species that are better adapted to the macro climatic (i.e. drought, fire, flooding rains, climate change) and micro climatic factors associated with the final landform (i.e. growth media, physical and chemical variation, variation in slope, aspect, altitude).

For RA4 and RA15, where the final landform will be similar to pre-mining landform, revegetation aims to achieve woodland habitat similar to the surrounding vegetation communities.

The growth media for woodland habitat at SSM includes pre-stripped topsoil and Permian spoil as discussed in Section 6.1.4. Woodland habitat growth media will be ameliorated, as recommended by an AQP, prior to deep ripping and seeding (Section 6.1.4). Where topsoil is being used, the depth will be a minimum of 100mm to limit the effects of competition on woodland species due to the potential loads of exotic pasture species (i.e. buffel grass) (Emmertson et al., 2016a) and to provide the best chance of successful establishment of woody species (Emmertson et al., 2016b; Spargo & Doley, 2016).

The representative REs known to occur within or surrounding SSM (Section 1.2.8) on hilly, rocky terrain and/or substrates with poorer soils that best align with the woodland habitat rehabilitation landforms include:

- RE 11.4.2 *Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains
- RE 11.4.13 *Eucalyptus orgadophila* open woodland on Cainozoic clay plains
- RE 11.5.2 *Eucalyptus crebra*, *Corymbia* spp., with *E. moluccana* woodland on lower slopes of Cainozoic sand plains and/or remnant surfaces
- RE 11.5.3 *Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces
- RE 11.10.7 *Eucalyptus crebra* woodland on coarse-grained sedimentary rocks.

The woodland habitat revegetation species are known to occur in the representative REs based on their listing in the relevant Regional Ecosystem Technical Descriptions (Queensland Herbarium, 2018).

The species selection for the woodland habitat revegetation areas has also considered ecological functional groupings according to the role or function they perform in both rehabilitation and non-mined environments (Emmertson et al., 2016a; Emmertson et al., 2016b) (Table 41). Short lived wattles (*Acacia* spp.) have been excluded from the species mix as they are unlikely to provide the necessary structure and longer-term ecological function. Intermediate lifespan wattles have been limited in the seed mix. Framework tree species and shrubby understorey species are maximised to provide longer-term ecosystem resilience, structure and function (Emmertson et al., 2016b). Competitive pasture species have also been excluded from the seed mix and only non-aggressive and native grass species have been recommended (Emmertson et al., 2016b).

Table 41: Life form and functional groups assigned to species based on their structural form or ecological function

Life form and functional group	Code	Explanatory notes
Framework trees		
Eucalypt/ bloodwood (<i>Corymbia</i>) species	E/C	<i>Eucalyptus</i> spp., <i>Corymbia</i> spp., and occasionally <i>Angophora</i> spp. (of any height) which can form an upper storey and often form recognisable vegetation communities but may exist within other communities
Non-eucalypt, non-acacia species	NE/NA	Non-eucalypt, non-wattle species (of any height) which can form recognisable communities, or which may exist in isolation and can become part of the upper storey

Life form and functional group	Code	Explanatory notes
Long lived acacias	LLA	Wattle species which may form recognisable communities or exist as part of the upper storey in other communities (e.g. <i>Acacia shirleyi</i> , <i>Acacia rhodoxylon</i>)
Woody understory components		
Shrubby understory	SU	A shrub is defined as: a woody plant that is multi-stemmed from the base (or within 200mm from ground level) up to 8m in height or if single stemmed, less than 2m tall (Eyre, et al., 2015). Therefore an understory shrub may include species that are sometimes regarded as small trees
Groundcover shrubs	GCS	Shrubs which form a groundcover
Vines/creepers	V/C	Vines or creepers that are perennial and have a woody component
Intermediate lifespan acacias	ILA	Sub-dominant wattles (<i>Acacia</i> spp.) which do not form a community in undisturbed natural ecosystems but can become dominant in rehabilitation areas
Short lifespan wattles	SLA	Wattles prevalent as an understory in eucalypt communities with some level of disturbance and relatively short lived (≤ 10 years)
Introduced woody perennials	IWP	Introduced woody species potentially becoming weeds in some circumstances
Groundcover components		
Competitive pasture grasses	CPG	Aggressive introduced pasture grass species (considered to detract from ecosystem values)
Introduced grasses	IG	Less competitive naturalised species (less aggressive than the CPG group)
Native grasses	NG	Perennial and annual native grasses. Includes grass like plants (e.g. genera include: <i>Cyperus</i> , <i>Dianella</i> and <i>Lomandra</i>)

6.1.8.7 Woodland habitat seed species and seeding rates

The recommended woodland habitat species are listed in Table 42 along with the associated life form and functional group, preferred growth media and recommended seeding rates.

For RA1 and RA12, the woodland habitat revegetation plan includes 6kg/ha of framework tree species, 4kg/ha of woody understory species and 10kg/ha of grasses. Planting will also include the addition of a sterile cover crop (e.g. Japanese millet or similar) seeded at 5kg/ha to provide initial groundcover.

Seed availability may vary, however seed mixes should ensure that at least six species from each of the main revegetation groups (i.e. framework tree species, woody understory species and grasses) listed in Table 42 are sown at the overall recommended rate to achieve the required species richness. If recommended species are not available, substitute species from RE 11.4.2, RE 11.4.13, RE 11.5.2, RE 11.5.3 or RE 11.10.7 should be used.

For RA4 and RA15, the revegetation seed mix is to be recommended by an AQP based on the location of the rehabilitation in relation to the surrounding vegetation community, and should consider the species and the rates

listed in Table 42. Minimal disturbance is planned for some areas of RA4 and RA15, therefore seed application may not be required in all areas.

Revegetation species and rates for woodland habitat may be adjusted by an AQP, to ensure continuous improvement of the rehabilitation outcomes, based on the results of ongoing monitoring (Section 8).

The preferred seeding timing for woodland habitat is either April/May or September/early October when there is sufficient soil moisture in the profile. Sowing in cooler months offers longer periods of surface moisture resulting from rain events, as well as reduced grass competition. Seeding may be undertaken at other opportune times, such as for unseasonal climatic conditions.

Table 42: Recommended species list and seeding rates for woodland habitat PMLU

Species* name	Common name	Life form and functional group code	Clay topsoil	Sand/loam topsoil, ameliorated spoil	Seed rates (kg/ha - uncoated weight)
Framework tree species					
<i>Acacia rhodoxylon</i>	rosewood	LLA	-	✓	0.3 – 1
<i>Allocasuarina luehmannii</i>	bull oak	NE/NA	-	✓	0.3 – 0.5
<i>Alphitonia excelsa</i>	red ash	NE/NA	✓	✓	0.3 – 0.5
<i>Angophora leiocarpa</i>	smooth barked apple	E/C	-	✓	0.3 – 0.5
<i>Atalaya hemiglauca</i>	whitewood	NE/NA	✓	✓	0.3 – 0.5
<i>Callitris glaucophylla</i>	cypress pine	NE/NA	✓	✓	0.3 – 0.5
<i>Casuarina cristata</i>	belah	NE/NA	✓	✓	0.3 – 0.5
<i>Corymbia citriodora</i> subsp. <i>citriodora</i> **	lemon scented gum	E/C	✓	✓	1 – 2
<i>Corymbia clarksoniana</i>	Clarkson's bloodwood	E/C	✓	✓	0.3 – 0.5
<i>Corymbia dallachiana</i>	Dallachy's gum	E/C	✓	✓	0.3 – 0.5
<i>Corymbia erythrophloia</i>	red bloodwood	E/C	✓	✓	0.3 – 0.5
<i>Corymbia trachyphloia</i>	brown bloodwood	E/C	✓	✓	0.2 – 0.5
<i>Eucalyptus crebra</i>	narrow leaved ironbark	E/C	✓	✓	1 – 2
<i>Eucalyptus melanophloia</i>	silver leaved ironbark	E/C	✓	✓	0.3 – 1
<i>Eucalyptus orgadophila</i>	mountain coolabah	E/C	✓	✓	0.3 – 0.5
<i>Eucalyptus populnea</i>	poplar box	E/C	✓	✓	0.3 – 0.5
<i>Lysiphyllum carronii</i>	red baubinia	NE/NA	✓	✓	0.3 – 0.5

Species* name	Common name	Life form and functional group code	Clay topsoil	Sand/loam topsoil, ameliorated spoil	Seed rates (kg/ha - uncoated weight)
Framework tree species - total seed weight uncoated					6
Woody understory species					
<i>Acacia conferta</i>	crowded-leaf wattle	SU	-	✓	0.3 – 0.5
<i>Acacia crassa</i>	curracabah	ILA	-	✓	0.3 – 0.5
<i>Acacia excelsa</i>	ironwood wattle	LLA	✓	✓	0.3 – 0.5
<i>Alstonia constricta</i>	bitterbark	SU/NE/NA	✓	✓	0.3 – 0.5
<i>Breynia oblongifolia</i>	coffee bush	SU	✓	✓	0.3 – 0.5
<i>Capparis lasiantha</i> , <i>C. canescens</i> , <i>C. loranthifolia</i> .	wait-a-while	V/C	✓	✓	0.2 – 0.5
<i>Carissa ovata</i>	currant bush	GCS	✓	✓	0.3 – 1
<i>Cassia brewsteri</i> **	Leichhardt bean	SU	✓	✓	0.3 – 0.5
<i>Denhamia cunninghamii</i>			✓	✓	0.3 – 0.5
<i>Dodonaea viscosa</i> **	sticky hop bush	SU	✓	✓	0.3 – 0.5
<i>Eremophila mitchellii</i>	false sandalwood	SU/NE/NA	✓	✓	0.3 – 0.5
<i>Erythroxylon australe</i>	cocaine tree	SU	✓	✓	0.2 – 0.5
<i>Geijera parvifolia</i>	wilga	SU	✓	✓	0.2 – 0.5
<i>Grevillea striata</i>	beefwood	SU/NE/NA	-	✓	0.3 – 0.5
<i>Grewia latifolia</i>	dogs balls	SU	✓	✓	0.3 – 0.5
<i>Jasminum didymum</i>	native jasmine	V/C	✓	✓	0.3 – 0.5
<i>Owenia acidula</i>	emu apple	SU	✓	✓	0.3 – 0.5
<i>Petalostigma pubescens</i>	quinine	SU/NE/NA	✓	✓	0.3 – 0.5
<i>Pittosporum angustifolium</i>	Gumby Gumby	SU/NE/NA	✓	✓	0.3 – 0.5
Woody understory species - total seed weight uncoated					4
Grass species					
<i>Aristida spp</i> (i.e. <i>A. calycina</i> , <i>A. latifolia</i> , <i>A. ramosa</i> , <i>A. caput-</i>	three awned spear grass	NG	-	✓	1 – 2

Species* name	Common name	Life form and functional group code	Clay topsoil	Sand/loam topsoil, ameliorated spoil	Seed rates (kg/ha - uncoated weight)
<i>medusae, A. jerichoensis, A. personata, A. calycina</i>					
<i>Bothriochloa decipiens</i> var. <i>decipiens</i>	pitted blue grass	NG	✓	✓	1 – 2
<i>Bothriochloa ewartiana</i>	desert bluegrass	NG	✓	✓	1 – 2
<i>Chrysopogon fallax</i>	golden beard grass	NG	✓	✓	1 – 2
<i>Cymbopogon refractus</i>	barbwire grass	NG	✓	✓	1 – 2
<i>Cynodon dactylon</i> var. <i>dactylon</i> **	couch	IG	✓	✓	2
<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	Queensland bluegrass	NG	✓	✓	1 – 2
<i>Eulalia aurea</i>	silky brown top	NG	✓	✓	1 – 2
<i>Panicum effusum</i>	hairy panic	NG	✓	✓	1 – 2
<i>Panicum queenslandicum</i>	Yabila grass	NG	✓	-	1 – 2
<i>Themeda triandra</i>	kangaroo grass	NG	✓	✓	1 – 2
Grass species - total seed weight uncoated					10
Cover Crop					
<i>Echinochloa esculenta</i>	Japanese millet	Cover crop	✓	✓	5

*If recommended species are not available, substitute species from RE 11.4.2, RE 11.4.13, RE 11.5.2, RE 11.5.3 or RE 11.10.7

**Species adapted to moderate to high salinity tolerance (DERM, 2011)

6.1.8.8 Watercourse revegetation

Watercourse revegetation activities will be implemented to establish riparian vegetation associated with a watercourse PMLU for the following areas:

- Future surface water diversions
- Existing creek diversions requiring additional revegetation activities
- Natural watercourses or drainage lines which have been disturbed by mining activities

Existing creek diversions that have previously been revegetated are discussed in Section 6.1.7.4 and will be monitored to inform routine maintenance requirements (Section 8.3).

The revegetation zones for natural watercourses (Figure 19) are defined as follows:

- Upper bank: defines the lateral limits of both sides of the watercourse or diversion. It does not include the land adjacent. The upper bank generally extends down the riparian profile and is dominated by taller *Eucalyptus* spp, with a mixed woody and grassy understorey.

- Mid bank: occurs between the upper and lower banks and will vary in size depending on the watercourse geomorphology or diversion design. The mid bank may include benches created from high flow events. The vegetation on the mid bank comprises a mix of species including scattered *Eucalyptus spp.*, as well as species that are more adapted to periodic inundation of water and can withstand some disturbance from floods (i.e. *Melaleuca spp.*).
- Lower bank (including bank toe): commences at the edge of the low flow channel or stream bed and extends up the bank to the area affected by more regular lower flows. The vegetation in the lower bank is dominated by scattered trees adapted to wetter environments (i.e. *Melaleuca spp.*) and a high ground cover of grasses, reeds, sedges and rushes.

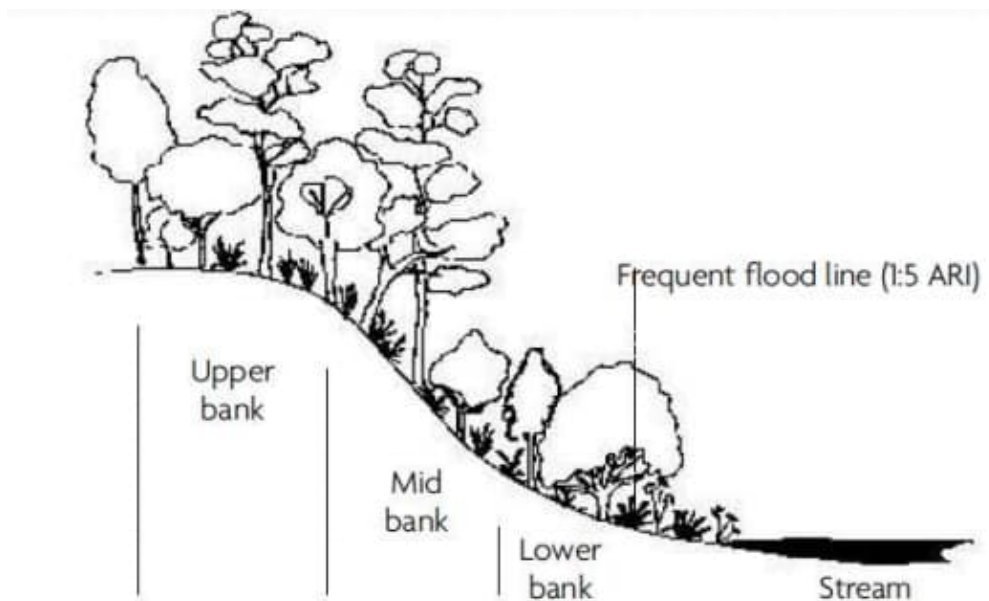


Figure 19: Typical riparian revegetation plantings zone (Vegetation Matters, 2014)

The growth media for watercourse will be pre-stripped topsoil, spread over the bank areas of the rehabilitated landforms at a depth $\geq 150\text{mm}$, and ameliorated if recommended by an AQP (Section 6.1.4).

6.1.8.9 Watercourse revegetation species and seeding rates

The watercourse revegetation species are based on selecting framework trees, woody understorey and groundcover species associated with the predominant natural watercourse RE 11.3.25 occurring on the SSM site (Figure 10).

The recommended watercourse revegetation species and seeding rates are listed in Table 43 and Table 44. The planned seeding rate for upper and mid banks is 20kg/ha comprised of 6kg/ha uncoated framework tree, 4kg/ha uncoated woody understorey species and 10kg/ha uncoated grasses and other groundcover species.

The planned seeding rate for lower banks is 15kg/ha comprised of 5kg/ha uncoated framework tree and 10kg/ha uncoated ground species. The revegetation on the lower banks has been designed to establish a higher percentage of ground cover species, including grasses and rushes. Competitive pasture species have been excluded from the seed mix and only non-aggressive grass species are recommended. Short lived wattle species have also been excluded in the seed mix.

Planting in all revegetation zones will also include the addition of a sterile cover crop (e.g. Japanese millet or similar) seeded at 5kg/ha to provide initial groundcover.

The preferred seeding timing for watercourse revegetation is August to October. There is low chance of frost and less likelihood of significant rainfall in this period allowing the best opportunity for vegetation to establish in a relatively non-erosive period. Seeding may be undertaken at other opportune times, such as for unseasonal climatic conditions.

Table 43: Recommended species list and seeding rates for watercourse revegetation PMLU – upper and mid banks

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
Framework tree species			
<i>Acacia stenophylla</i> *	river myall	LLA	0.5 - 1
<i>Alphitonia excelsa</i>	red ash	NE/NA	0.5 - 1
<i>Angophora floribunda</i>	rough barked apple	E/C	0.5 - 1
<i>Angophora leiocarpa</i>	smooth barked apple	E/C	0.5 - 1
<i>Angophora subvelutina</i>	broadleaf apple	E/C	0.5 - 1
<i>Casuarina cristata</i> *	belah	E/C	0.5 - 1
<i>Casuarina cunninghamiana</i> *	river she oak	NE/NA	0.5 - 1
<i>Corymbia tessellaris</i> *	Moreton Bay ash	NE/NA	0.5 - 1
<i>Eucalyptus camaldulensis subsp. obtusa</i> *	river red gum	E/C	1 - 2
<i>Eucalyptus coolabah subsp. coolabah</i>	Coolabah	E/C	1 - 2
<i>Eucalyptus melanophloia</i>	silver leaved ironbark	E/C	0.5 - 1
<i>Eucalyptus populnea</i>	poplar box	E/C	0.5 - 1
<i>Eucalyptus tereticornis subsp. tereticornis</i> *	Queensland blue gum	E/C	0.5 - 1
<i>Lysiphyllum hookeri</i>	white bauhinia	NE/NA	0.5 - 1
<i>Melaleuca bracteata</i> *	black tea tree	NE/NA	0.5 - 1
<i>Terminalia oblongata</i>	yellowwood	NE/NA	0.5 - 1
Framework tree species - total seed weight uncoated			6
Woody understorey species			
<i>Acacia excelsa</i>	ironwood wattle	ILA	0.5 - 1
<i>Acacia fasciculifera</i>	scaly bark	ILA	0.5 - 1
<i>Cassia brewsteri</i> *	Leichardt bean	SU	0.5 - 1
<i>Carissa ovata</i>	current bush	GCS	0.5 - 1

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
<i>Dodonaea viscosa</i>	sticky hop bush	SU	0.5 - 1
<i>Eremophila mitchellii</i>	false sandalwood	SU	0.5 - 1
<i>Erythroxylum australe</i>	cocaine tree	SU	0.5 - 1
<i>Ficus coronata</i>	creek sandpaper fig	SU	0.5 - 1
<i>Ficus fraseri</i>	white sandpaper fig	SU	0.5 - 1
<i>Ficus opposita</i>	sandpaper fig	SU	0.5 - 1
<i>Grevillea striata</i>	beefwood	SU	0.5 - 1
<i>Grewia latifolia</i>	dogs balls	SU	0.5 - 1
<i>Hakea lorea</i>	bootlace oak	SU	0.5 - 1
<i>Mallotus philippensis</i>	red kamala	SU	0.5 - 1
<i>Petalostigma pubescens</i>	quinine	SU	0.5 - 1
Woody understorey species - total seed weight uncoated			4
Ground species			
<i>Bothriochloa bladhii</i>	forest blue grass	NG	1 - 2
<i>Capillipedium spicigerum</i>	scented top	NG	1 - 2
<i>Cymbopogon refractus</i>	barbwire grass	NG	1 - 2
<i>Cynodon dactylon*</i>	couch	IG	2
<i>Dichanthium sericeum subsp. sericeum</i>	Queensland bluegrass	NG	1 - 2
<i>Digitaria brownii</i>	cotton panic	NG	1 - 2
<i>Eulalia aurea</i>	silky brown top	NG	1 - 2
<i>Eustrephus latifolius</i>	wombat vine	V/C	1 - 2
<i>Heteropogon contortus</i>	bunched speargrass	NG	1 - 2
<i>Jasminum simplicifolium subsp. australiense</i>	stiff jasmine	V/C	0.2 - 0.5
<i>Lomandra longifolia</i>	mat rush	NG	0.2 - 0.5

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
<i>Panicum effusum</i>	hairy panic	NG	1 - 2
<i>Paspalidium distans</i>	shot grass	NG	1 - 2
<i>Rhynchosia minima</i>	Rhynchosia	V/C	1 - 2
<i>Themeda triandra</i>	kangaroo grass	NG	1 - 2
Ground species - total seed uncoated			10
Cover Crop			
<i>Echinochloa esculenta</i>	Japanese millet	Cover crop	5

* Species adapted to moderate to high salinity tolerance (DERM, 2011)

Table 44: Recommended species list and seeding rates for watercourse revegetation PMLU – lower banks

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
Framework tree species			
<i>Casuarina cunninghamiana</i> *	river she oak	NE/NA	0.5 - 1
<i>Lophostemon suaveolens</i>	swamp box	NE/NA	0.5 - 1
<i>Melaleuca bracteata</i> *	black tea tree	NE/NA	0.5 - 1
<i>Melaleuca fluviatilis</i>	weeping tea-tree	NE/NA	0.5 - 1
<i>Melaleuca leucadendra</i> *	broad-leaved tea tree	NE/NA	0.5 - 1
<i>Melaleuca linariifolia</i> *	snow in summer	NE/NA	0.5 - 1
<i>Melaleuca trichostachya</i>	flax-leaf paperbark	NE/NA	0.5 - 1
<i>Melaleuca viminalis</i> *	red bottlebrush	NE/NA	0.5 - 1
Framework tree species - total seed weight uncoated (kg/ha)			5
Ground species			
<i>Bothriochloa bladhii</i> subsp. <i>bladhii</i>	forest blue grass	NG	1 - 2
<i>Cymbopogon refractus</i>	barbwire grass	NG	0.5 - 1
<i>Cynodon dactylon</i> *	couch	IG	2 - 3

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
<i>Cyperus spp. (C. gracilis, C. polystachyos)**</i>	sedge	NG	2 - 3
<i>Dichanthium sericeum subsp. sericeum</i>	Queensland bluegrass	NG	1 - 2
<i>Eustrephus latifolius</i>	wombat vine	V/C	0.5 - 1
<i>Lomandra longifolia</i>	spiny-headed mat rush	NG	2 - 3
<i>Themeda triandra</i>	kangaroo grass	NG	0.5 - 1
Ground species - total seed weight uncoated			10
Cover Crop			
<i>Echinochloa esculenta</i>	Japanese millet	Cover crop	5

* Species adapted to moderate to high salinity tolerance (DERM, 2011); ** Bank toe area only

6.1.8.10 Reference sites

Existing reference sites for cattle grazing, woodland habitat and watercourse PMLUs are detailed in Section 8.4.

Relationship with PRCP Schedule
The revegetation approach for the PMLUs focuses on selection and establishment of suitable species based on the growth media and rehabilitated landforms. Woodland habitat and watercourse rehabilitation considers the inclusion of framework tree species, woody understorey and grass species from REs occurring within or surrounding SSM on similar landforms and substrates. The recommended species will best support achievement of the cattle grazing, woodland habitat and watercourse PMLUs.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule																		
RA1	RA2	RA3	RA4	RA7	RA10	RA12	RA13	RA14	RA15	RA16	RA17	RA18	RA19					
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18	

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM0	0.1 Ground works: - Investigation and development of plan for large scale leucaena management. 0.2 Progressive ground works and sufficient data collection for modelling: - Ongoing leucaena management and earthworks.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM7	7.1 Completed seeding in accordance with recommended pasture mixes and seeding rates as shown in Table 40: Recommended species list and seeding rates for cattle grazing. 7.2 At least four species of 3P pasture species and two legumes, including at least two native pasture species, from Table 40: Recommended species list and seeding rates for cattle grazing are to be applied per application area. 7.3 Minimum seeding rates of 16kg/ha of coated pasture seed and 4 kg/ha of uncoated legume seed will be used, unless adjusted by an AQP based on results of rehabilitation monitoring.
RM8	8.1 Completed seeding in accordance with recommended woodland habitat species mix and seeding rates in Table 42: Recommended species list and seeding rates for woodland habitat (RA1, RA12), or as recommended by an AQP if vegetation is targeting a regional ecosystem (RA4, RA15). 8.2 Minimum seeding rates of 6kg/ha of tree species, 4kg/ha of woody understory species and 10kg/ha of grasses will be used, unless adjusted by an AQP based on results of rehabilitation monitoring (RA1, RA12). 8.3 Non-native seed must not be used for the revegetation of woodland habitat PLMU (except when sterile cover crops or <i>Cynodon dactylon</i> are used). <i>*If recommended species are not available, substitute with species from RE 11.4.2, RE 11.4.13, RE 11.5.2, RE 11.5.3 or RE 11.10.7.</i>
RM9	9.1 Completed seeding in accordance with recommended watercourse species mix and seeding rates in Table 43: Recommended species list and seeding rates for watercourse revegetation PMLU – upper and mid banks and Table 44: Recommended species list and seeding rates for watercourse revegetation PMLU – lower banks. 9.2 Species chosen should reflect regional ecosystem 11.3.25. 9.3 Minimum seeding rates of: - For the upper and mid banks – 6kg/ha uncoated trees species, 4kg/ha uncoated woody understorey species and 10kg/ha uncoated grasses and other groundcover species - For the lower banks – 5kg/ha of uncoated tree species, 10kg/ha uncoated ground species. 9.4 Non-native seed must not be used for the revegetation of watercourse PLMU (except when sterile cover crops or <i>Cynodon dactylon</i> are used).
RM10	10.1 Vegetation meets the following: >50% established and self-sustaining vegetation groundcover, of which at least 50% of dry matter yield is 3P pasture species as listed in Table 40: Recommended species list and seeding rates for cattle grazing PMLU - Minimum composition of three species of 3P grasses (RA3, RA13, RA14, RA16) and two species of 3P grasses (RA7, RA17) present per hectare (averaged).
RM11	11.1 Groundcover: >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover. 11.2 Woodland habitat vegetation meets the following: - BioCondition score of ≥18/60 based on the averaged benchmarks for the representative regional ecosystems as listed in Table 68: BioCondition benchmarks

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
	and scoring of site-based attributes for representative and as assessed by an AQP using the modified 'BioCondition Assessment Manual' (version 2.2) methodology (RA1, RA4, RA12, RA15), or Species richness of ≥ 2 native trees, ≥ 3 native shrubs and ≥ 4 grasses (exotic and native species) (RA10, RA18).
RM12	12.1 Groundcover: $>15\%$ slopes must achieve $\geq 80\%$ groundcover, consisting of at least 50% vegetation groundcover $\leq 15\%$ slopes must achieve $\geq 50\%$ groundcover, consisting of at least 50% vegetation groundcover 12.2 Watercourse vegetation meets the following: - Species richness: ≥ 2 native trees and ≥ 2 native shrubs representative of RE 11.3.25 ≥ 2 grass species (exotic and native species) - Tree canopy cover $\geq 13\%$.
RM13	13.2 Vegetation meets the following criteria: $>50\%$ established and self-sustaining vegetation groundcover - At least 60% of pasture dry matter yield consists of 3P grasses with a minimum composition of three 3P grasses present per hectare (averaged) - Restricted invasive plants (as defined in the Biosecurity Act 2014) comprise $\leq 5\%$ of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed. 13.3 Land suitability class assessed by an AQP and certified that the land has achieved a post-mining land suitability class of 3 or better for cattle grazing, or not different from pre-mining class if it is class 4; where assessment of rehabilitation is in accordance with Short (2023). Class 4 is only accepted if the limitations are water availability, soil nutrient or sub-soil erosion. 13.4 For any Class 4 land suitability areas, land condition is assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas using the Grazing Land Management ABCD land condition framework.
RM14	14.5 Groundcover: $>15\%$ slopes must achieve $\geq 80\%$ groundcover, consisting of at least 50% vegetation groundcover $\leq 15\%$ slopes must achieve $\geq 50\%$ groundcover, consisting of at least 50% vegetation groundcover 14.6 Woodland habitat vegetation meets the following: - BioCondition score of $\geq 35/60$ based on the averaged benchmarks for the representative regional ecosystems as listed in Table 68: BioCondition benchmarks and scoring of site-based attributes for representative and as assessed by an AQP using the modified 'BioCondition Assessment Manual' (version 2.2) methodology - Restricted invasive plants (as defined in the Biosecurity Act 2014) comprise $\leq 5\%$ of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed.

The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
RM15	15.5 Assessment by an AQP that the watercourse diversion has an Index of Diversion Condition (IDC) score >10. 15.6 Watercourse vegetation meets the following: • Riparian vegetation index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method) • Species richness: - o ≥2 native trees and - o ≥2 native shrubs • Tree canopy cover ≥20% • Median tree canopy height ≥10m • Recruitment of at least two woody perennial species in ecological dominant layer • Restricted invasive plants (as defined in the Biosecurity Act 2014) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed.
RM17	17.2 Vegetation meets the following: • >50% established and self-sustaining vegetation groundcover on slopes ≤15%, comprising at least 50% dry matter yield 3P pasture species • >70% established and self-sustaining vegetation groundcover on slopes >15%, comprising at least 50% dry matter yield 3P pasture species • Consists of at least two species of 3P grasses per hectare (averaged) • Restricted invasive plants (as defined in the Biosecurity Act 2014) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed • <i>Leucaena leucocephala</i> must be actively managed to ensure plants >2m high do not exceed stem density of 250 stems per hectare (1 per 40m²) mean of total area. 17.5 Land condition: assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas, for 5 consecutive years using the Grazing Land Management ABCD land condition framework.
RM18	18.2 Woodland habitat vegetation meets the following: • Species richness: - o ≥2 native trees, - o ≥3 native shrubs, and - o ≥4 grasses (exotic and native species) • Tree canopy cover ≥16% • Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed. 18.3 Groundcover: • >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

- ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover.

6.2 Tailings storage facilities

PRCP Guideline (Section 3.6.2)

The tailings require characterisation to determine the geochemistry, rheology and geotechnical parameters that influence the rehabilitation or management strategies and the capacity of the site to support revegetation.

The design for a TSF must include relevant elements:

- *lining of TSF (i.e. embankments and base of structure)*
- *leak detection systems*
- *cellular design of TSF*
- *seepage collection systems*
- *design storage allowance*
- *spillway location*
- *designing TSF for progressive rehabilitation.*

6.2.1 Tailings context

During operations tailings are generated from washing ROM coal, and typically represents the clay, silt and fine sand fraction of rejects. Tailings were previously disposed into two TSFs at SSM – OTD and Ramp 67. Both tailings facilities are located within the Roper project area (Section 1.4.1.2). SSM coal is currently processed at SRM, and no further tailings are planned to be disposed at SSM for the foreseeable future.

A summary of each TSF is included in Table 45 and locations of the SSM TSFs are shown in Figure 20. As is typical of historical TSFs, engineering documentation is limited. BMA has completed investigation and assessment works to retrospectively describe the blueprint and characterisation for the SSM TSFs where possible.

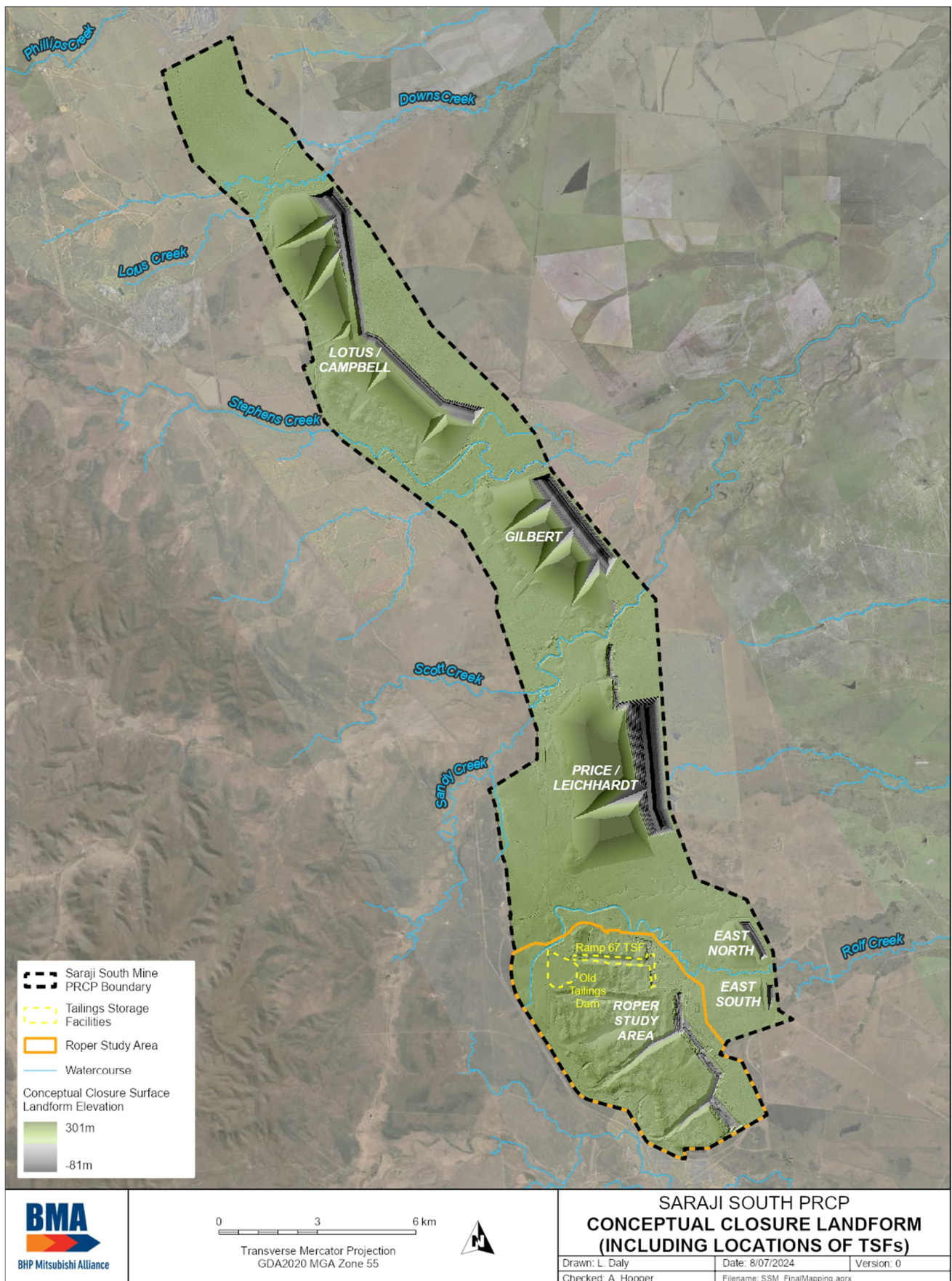


Figure 20: SSM tailings storage facilities

Table 45: Summary of SSM TSFs

TSF	Structure		Current status	Operational period	Spillway location	Decant location	Regulated structure	Rehabilitation strategy
	Type	Description						
OTD	Downslope turkey's nest	A single cell with containment perimeter embankments on the north and west sides and low spoil piles to the east and south. The facility has also been used as an evaporation pond and water storage.	Inactive	1978 – 1998	North-western end of the north wall	North-western corner	No	Detailed closure design to be developed as part of the Roper project
Ramp 67	In-ramp/In-pit	Disused mining pit void and ramp that has been filled with tailings. Bounded by spoil to the west and the high-wall to the east. The facility is also being used as for water storage for the BMA central region operations.	Water storage	1998 – 2012	N/A	East side of the pit, on the high-wall side	No	Detailed closure design to be developed as part of the Roper project

No further tailings are planned to be disposed at SSM for the foreseeable future, however any future tailings disposal strategy at the site will be in accordance with EA condition D6 and will be developed during the remaining life-of-mine, accompanied by a PRCP amendment, if required.

As per condition D6 of the EA, future tailing disposal may include the placement of tailings into voids provided a consequence category assessment in accordance with EA condition G1 has been completed. Additionally, assessments will be undertaken as per the void requirements of the PRCP Guideline to confirm the placement of the tailings in the void does not present an unacceptable risk of environmental harm, prior to future tailings disposal.

The void suitability assessment will include the following:

- Consequence category assessment: in accordance with EA condition G1
- Hydrogeological assessment: including characterisation of the immediately surrounding groundwater aquifer (quality and heights), numerical modelling, groundwater fate and transport modelling and an evaluation of the sink/source relationship with the void
- Void water balance modelling: including an assessment of the sink/source relationship with the groundwater
- Geochemistry and water quality modelling: including an assessment of the impact the placement of the tailings in the void will have on void water quality
- Conceptual site modelling: including an assessment of potentially complete exposure pathways
- Geotechnical stability and safety assessment.

The assessments will provide the following:

- Assessment by an AQP that residual voids continue to meet required stability and safety criteria
- Assessment by an AQP that residual voids continue to not cause environmental harm by:
 - Continuing to act as a long term groundwater sink
 - Permian aquifers and shallower hydrogeological units are not inter-connected
 - No identified, reasonably likely complete exposure pathways, beyond the tenure
- If required, identification of changes to the PRCP schedule

Where the above studies confirm the placement of tailings does not present an unacceptable risk of environmental harm, and there are no changes to the management of the residual void or the PRCP schedule, the residual void will remain a NUMA as outlined within this PRCP. This will typically be where: residual void lakes are maintained on top of the tailings; the residual voids post-mining are collectively modelled to establish as long term groundwater sinks; Permian aquifers and shallower hydrogeological units are not inter-connected; there are no identified reasonably likely complete exposure pathways; and any leachate is not likely to impact environmental values beyond the tenure boundary.

Where the placement of the tailings in the void requires changes to the PRCP schedule, a PRCP amendment will be submitted prior to the future tailings disposal.

6.2.2 Tailings characterisation

Rheological and geotechnical characterisation has been undertaken through a site investigation program and comprehensive laboratory testing suites for OTD. Sampling has generally been carried out across the footprint and vertical profile of OTD. Sampling and testing has not been undertaken at Ramp 67, as safe access to the facility has not been possible.

Additional data will be sourced for both TSFs and further geochemical and geotechnical characterisation work completed as part of the Roper project (Section 1.4.1.2) technical studies.

6.2.2.1 Rheology

Most of the samples from OTD were shear thinning as the shear rate increased, with only a few samples showing an increase in the shear stress with increasing shear rate thereafter (indicative of a change in the structure of the material in response to shear). Viscosity data shows that apparent viscosity decreases by more than two orders of magnitude over the shear rates tested.

Rheological characterisation primarily relates to pumpability and flow behaviour soon after deposition and therefore has limited relevance to the long-term behaviour in TSFs. It can provide an indication of the relative potential for liquefaction in the period from deposition to closure; however, any tendency to flow behaviour reduces over time as the tailings consolidate past a critical state.

6.2.2.2 Geotechnical characterisation

Geotechnical properties for tailings should be considered in the following two groups:

- Those that are inherent to the material regardless of its situation (e.g. particle size distribution, specific gravity, plasticity)
- In situ properties that are affected by the inherent characteristics but also by the stress conditions and moisture distribution within the TSF (e.g. moisture content and dry density, settling density, shear strength, consolidation). Subsequently, stress and moisture are governed by containment, the weight of overlying material, the location of drainage paths, and time since deposition.

While the inherent properties are essentially constant for a particular sample of tailings, in situ properties may vary with location and time. Some in situ properties may be monitored during operation of the TSF to assess the effectiveness of deposition practices, but strength and moisture-density profiles are most useful after deposition has finished and close to when detailed rehabilitation works are being designed and undertaken.

Inherent properties

Results of testing for inherent properties undertaken to date at SSM are summarised in Table 46 and Table 47. Based on this data, tailings at OTD are typically dominated by the silt size fraction (0.075mm to 0.002mm) but are classified as Intermediate Plasticity Silty Clay based on Atterberg Limits (AS1726:2017 Geotechnical Site Investigations). This is typical of coal tailings in the Bowen Basin, including the absence of high plasticity clays (that cause the greatest problems with settlement and strength).

Tailings do not contain gravel, therefore the high proportion of gravel in some samples indicates the samples may have also contained coarse rejects. Additional testing will be required as part of the Roper project to accurately account for tailings and reject materials.

Table 46: Summary of SSM tailings testing of inherent geotechnical properties

Parameter	Unit	SSM (OTD)*
Particle size distribution		
Clay	%	3 - 42
Silt	%	17 - 74
Sand	%	2 - 75
Gravel	%	0 - 24
Specific gravity		
Specific gravity		1.62 - 2.67
Atterberg limits		
Liquid limits	%	24 - 58
Plastic limit	%	13 - 26
Plasticity index	%	6 - 34

* No sampling or testing of Ramp 67 tailings has been completed due to accessibility limitations

In situ properties

Moisture content and dry density have use in computing consolidation stresses but give only an indirect and approximate indication of strength. Moisture content and densities are summarised in Table 47. Four density determinations were made on samples from OTD. Three of the dry density values were typical of normally

consolidated or desiccated tailings. The fourth result was abnormally high and that sample also had a very high specific gravity; the data has been retained in the data set but the sample is flagged as possibly containing some embankment or foundation material.

Table 47: Summary of SSM TSF moisture content and density

Parameter	Unit	SSM (OTD)*
Moisture content	%	11.2 - 82.8
Wet density	t/m ³	1.44 - 2.11
Dry density	t/m ³	1.02 - 1.80

* No sampling or testing of Ramp 67 tailings has been completed due to accessibility limitations

Settling characteristics are relevant to the performance of TSFs in their operational phase - specifically, how the tailings solids beach, how quickly the surface water clears and can be decanted, and the volume of decant water that can be recovered. Settling behaviour is observed during operations and testing would only be undertaken if issues have been identified. By the time a TSF reaches closure, the tailings will have settled and hence this settling is not an important property in the context of SSM rehabilitation and closure planning.

Tailings has minimal shear strength when initially discharged (being fluid) and strength is only gained over time as the deposit dewateres, densifies, and develops a drier surface crust. Shear strength testing is not considered relevant until deposition is completed and the facility is approaching rehabilitation. Therefore, more important in the rehabilitation context, is the strength profiles in the form of vane shear tests and cone penetrometer tests, which measure in situ strength from the resistance to pushing a cone-tipped instrument vertically into the tailings. Vane shear strength testing of the tailings, both peak and remoulded undrained shear strength, measured from OTD are presented in Table 48.

Table 48: Summary of SSM TSF peak and remoulded shear strengths

Parameter	Unit	SSM (OTD)*
Peak shear strength	kPa	15 - 82
Remoulded shear strength	kPa	5 - 56

* No sampling or testing of Ramp 67 tailings has been completed due to accessibility limitations

Consolidation and desiccation parameters, obtained from laboratory oedometer tests and soil water characteristic curve tests respectively, are not in situ measurements but are used with other in situ data to predict settlement (as distinct from settling) and densification over time.

Oedometer consolidation tests were carried out on four samples from OTD and indicate:

- Compression index (Cc): median of 0.10 but with a range of 0.06 to 0.20
- Coefficient of saturated permeability (k): median values for each sample ranged from 0.5 to 2.6 x 10⁻⁹ m/s
- Coefficient of consolidation (Cv): mainly in the range of 10 to 60m²/year

Values for compression index are towards both the high and low ends of the range encountered in Bowen Basin coal tailings and probably reflect the variation in particle size distribution. Coefficients of permeability and consolidation are close to median values for the Bowen Basin. It is noted that laboratory consolidation testing is very sensitive to sample preparation and results should only be used for indicative estimates of actual field performance.

The results of the soil water characteristic curve testing undertaken are summarised in Table 49.

Table 49: Summary of soil water characteristic testing of tailings

Sample location	Volumetric water content (cm ³ /cm ³)				
	0 kPa	10 kPa	33 kPa	100 kPa	1,500 kPa
OTD	39 - 40	31 - 37	25 - 32	16 - 27	7 - 19

In summary, OTD tailings have geotechnical properties that are typical of coal tailings produced and deposited in the Bowen Basin.

6.2.2.3 Geochemical characterisation

Limited geochemical data is available for the tailings at SSM. Geochemical characterisations of both TSFs at SSM will be undertaken as a part of Roper project (Section 1.4.1.2) technical studies.

6.2.3 Rehabilitation strategies

The conceptual cover for tailings will be a non-ponding landform and covered with at least 2m of spoil, however detailed cover designs for each TSF will be developed as part of the technical studies and detailed rehabilitation and management plan for the Roper project (Section 1.4.1.2). This will enable comprehensive characterisation of the tailings to be completed and ensure the cover design addresses the specific risks identified.

Relationship with PRCP schedule

The detailed cover designs for each TSF will be developed as part of the technical studies and detailed rehabilitation and management plan for the Roper project.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3	RA4	RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18							

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1							IA2						
MM1				MM2				MM3					

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM0	0.1 Ground works: - Establish safe access to landforms for data collection and progressive rehabilitation activities. 0.2 Progressive ground works and sufficient data collection for modelling: - Drilling and installation of geochemical boreholes and monitoring - Additional tailings and rejects material testing - Additional waste characterisation - Additional tailings geotechnical characterisation 0.3 Updated modelling and landform:
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The following milestone criteria will contribute to achievement of PMLU to a stable condition:	
	- Hydrogeochemical modelling 0.4 Final landform, designs and updated plans: - Cover design
RM1	1.5 With the exception of 1.2, 1.3 and 1.4 above, the following are complete: All services disconnected, terminated and removed
RM2	2.1 Contaminated Land Investigation Document completed in accordance with the <i>Environmental Protection Act 1994</i>, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2.2 The Contaminated Land Investigation Document confirms the area within the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) does not present an unacceptable risk to the post-mining land use. 2.3 Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future <i>Environmental Protection Act 1994</i> compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.
RM3	3.1 Erosion and sediment control systems are installed as per the construction design and verified by an AQP. <u>Tailings Storage Facilities and rejects (RA16)</u> 3.7 Tailings and rejects to be capped with at least 2m of competent benign spoil. 3.8 Landforms to be non-ponding. 3.9 Landforms are reshaped with slopes not exceeding 12% 3.10 AQP certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5
RM4	4.1 Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. 4.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP and reviewed and endorsed by a third party AQP, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 4.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 4.2. 4.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM7	7.1 Completed seeding in accordance with recommended pasture mixes and seeding rates as shown in Table 40: Recommended species list and seeding rates for cattle grazing PMLU. 7.2 At least 4 species of 3P pasture species and two legumes, including at least 2 native pasture species, from Table 40: Recommended species list and seeding rates for cattle grazing PMLU are to be applied per application area. 7.3 Minimum seeding rates of 16kg/ha of coated pasture seed and 4 kg/ha of uncoated legume seed will be used, unless adjusted by an AQP based on results of rehabilitation monitoring.
RM10	10.1 Vegetation meets the following: >50% established and self-sustaining vegetation groundcover, of which at least 50% of dry matter yield is 3P pasture species as listed in Table 40: Recommended species list and seeding rates for cattle grazing PMLU

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

	- Minimum composition of three species of 3P grasses (RA16) present per hectare (averaged). 10.2 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 10.3 AQP certifies that: - There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and - Mass movement is absent; and - All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 10.4 Despite criteria 10.3, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: - Do not exceed 1m in depth at any point; and - Do not expose environmentally problematic materials; and - The cause of the gully is known and has been resolved; and - Have established and persistent vegetation cover at the head of the gullies; and - Are in a stabilised state, demonstrated by monitoring data over a 2-year period; and - Do not provide a safety hazard within the context of the PMLU; and - Do not impact the stability or performance of engineered drainage features.
RM13	13.1 Hazard assessment completed by an AQP to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 13.2 Vegetation meets the following criteria: >50% established and self-sustaining vegetation groundcover - At least 60% of pasture dry matter yield consists of preferred, palatable and productive (3P) grasses with a minimum composition of three 3P grasses present per hectare (averaged) - Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP as appropriately managed. 13.3 Land suitability class assessed by an AQP and certified that the land has achieved a post-mining land suitability class of 3 or better for cattle grazing, or not different from pre-mining class if it is class 4; where assessment of rehabilitation is in accordance with Short (2023). Class 4 is only accepted if the limitations are water availability, soil nutrient⁵ or sub-soil erosion. 13.4 For any Class 4 land suitability areas, land condition is assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas using the Grazing Land Management ABCD land condition framework. 13.5 AQP certifies that: - There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and - Mass movement is absent; and - All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 13.6 Despite criteria 13.5, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP: - Do not exceed 1m in depth at any point; and - Do not expose environmentally problematic materials; and

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

	- The cause of the gully is known and has been resolved; and - Have established and persistent vegetation cover at the head of the gully; and - Are in a stabilised state, demonstrated by monitoring data over a 5-year period; and - Do not provide a safety hazard within the context of the PMLU; and - Do not impact the stability or performance of engineered drainage features. 13.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with Appendix 2 – Surface water quality limits. 13.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: - Requirements of any Site Management Plan have been met; - Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and - There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
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The following milestone criteria will contribute to achievement of sufficient improvement:

MM1	IA1.10 Residual voids collectively act as groundwater sinks within the relevant mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary post closure as demonstrated by groundwater modelling defined in condition PRCP12.
MM3	IA3.1 Certification from an AQP that: - The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling - The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary.

6.3 Voids

PRCP Guideline (Section 3.6.3)

The information requirements of this domain are dependent on the nature of the proposed PMLU or NUMA for the void. For mine sites with voids, the rehabilitation planning part must include a void closure plan, which includes options for minimising final void area and volume; final void dimensions; pit wall geotechnical and geochemical stability, final slope angles, void hydrology, groundwater modelling, water balance and predicted long-term water quality.

A geotechnical report should focus on how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void.

If floodwaters are likely to move over backfilled material, an assessment of the hydraulic properties must be conducted to assess whether instability may occur.

The rehabilitation and management strategies in the plan must include the supervision, verification and auditing of engineering works carried out to achieve the post-closure void landform, to ensure construction is consistent with the geotechnical design.

The rehabilitation and management strategy must also include confirmation that the post-closure landform demonstrates the level of stability as specified by the design.

A void closure plan has been compiled to support the development of this PRCP. The detailed plan – *Norwich Park Mine Void Closure Plan* (WSP, 2024), is provided in Appendix M.

As per the EA, a residual void is “an open pit resulting from the removal of coal and waste rock that will remain following the cessation of all mining activities and completion of rehabilitation processes”. Therefore, for this PRCP, a residual void is considered to be the remaining mined out pit below ground level after backfill.

For SSM, the residual voids in the final closure landform (Appendix M, Figure 3.1) are associated with:

- Lotus/Campbell Pit
- Gilbert Pit
- Price/Leichhardt Pit
- East Pit 1
- East Pit 2
- Roper Pit 1
- Roper Pit 2
- Roper Pit 3
- Roper Pit 4

These residual voids are pre-approved as NUMAs (Section 4). The NUMA extents upon closure will achieve an area that is safe and structurally stable and include additional set-backs from the void high-wall and end-wall crests and the low-wall crest within the NUMA, if required to achieve wall geotechnical stability (FoS=1.5), and a safety bund (or equivalent) and fence.

6.3.1 Geotechnical stability

The void closure plan includes a geotechnical stability analysis of the proposed final closure landform residual void high-walls, end-walls and low-walls. The analysis determined the FoS of the walls and the set-back distances, for long-term pit wall stability for the high-walls, end-walls and low-walls, to meet the minimum FoS of 1.5.

Additional set-back distance from the void wall crests are included within the NUMA extent to ensure stability and that no assets (BMA, third-party, or of significant environmental value) are within this boundary at closure.

The low-wall stability analysis results are shown in Table 50. The analysis was undertaken on the worst case low-wall conditions for each void. The as-dumped design of the residual void low-walls meets the minimum FoS for all residual voids except the northern end of Price/Leichhardt and Roper 4. For those residual voids that meet the FoS, no additional set-back distance from the low-wall crest is required. A minimum 25m set-back will be designed between the low-wall crest within the NUMA area and the PMLU boundary to ensure erosion within the NUMA does not impact the surrounding PMLUs.

Table 50: Summary of SSM residual void low-wall stability analysis

Pit	Residual Void	Low-wall spoil height (m)*	Low-wall floor dip (°)	Minimum FoS		Additional set-back required at NUMA boundary (m)
				Overall slope (global stability)	Slope outside NUMA (local stability)	
Lotus/Campbell Pit	Lotus (north)	237	4.4	1.9	2.2	0
	Campbell (south)	201	1.9	2.0	2.4	0
Gilbert Pit	Gilbert	265	2.8	2.9	3.1	0
Price/Leichhardt Pit	Price** (north)	72	8.1	1.3	1.9	40
	Leichhardt (south)	338	4.0	1.7	2.4	0
East Pit	East Pit 1	170	4.3	1.8	2.4	0
	East Pit 2	114	3.1	1.8	2.9	0

Pit	Residual Void	Low-wall spoil height (m)*	Low-wall floor dip (°)	Minimum FoS		Additional set-back required at NUMA boundary (m)
				Overall slope (global stability)	Slope outside NUMA (local stability)	
Roper Pit***	Roper 1	63	0.4	1.5	3.2	0
	Roper 4**	84	1.7	1.5	14.9	135

* Spoil height is the full low-wall from toe of low-wall to the spoil dump crest (includes NUMA and RA1 low-wall area).

** Required FoS can be achieved either with a bench or buttress of the low-wall toe.

*** Roper 2 and 3 residual voids were not assessed as the spoil height and floor dip were not considered to present critical low-wall instability conditions; Following completion of the Roper project technical studies and closure design, low-wall specifications may change

The high-wall and end-wall stability analysis results are shown in Table 51. The as-mined design of some of the residual void high-wall and end-walls have a FoS of less than 1.5 and therefore an additional set-back distance from the high-wall crest has been included in the final closure landform design for all pits to ensure the minimum FoS of 1.5 is achieved. A minimum distance of 50m will be designed between the residual void crest and the toe of the safety bund where the residual void is near a tenure boundary.

Table 51: Summary of SSM residual void high-wall stability analysis

Pit	Residual Void	Depth of Tertiary / weathered (m)	Depth of fresh Permian (m)	FoS at wall crest	Distance from toe of wall to achieve FoS=1.5 (m)
Lotus/ Campbell Pit	Lotus (north)	40	80	1.71	139
	Campbell (south)	30	77	1.81	122
Gilbert Pit	Gilbert	19	131	1.43	157
Price/ Leichhardt Pit	Price (north)	30	18	0.94 - 1.39	56 - 82
	Leichhardt (south)	40	155	1.41	263
East Pit	East Pit 1	23	59	2.04	98
	East Pit 2	23	59	2.04	98
Roper Pit*	Roper 1**	13	4	≥4.19	20
	Roper 4**	39	17	≥1.70	200

* Roper 2 and 3 residual voids do not have steep sections of in-situ high-wall and therefore were not assessed

** Following completion of the Roper project technical studies and closure design, high-wall specifications may change

As outlined in Section 1.4.1.2, the geotechnical analysis for Roper Pit will be reassessed as part of the technical studies for the Roper project if changes are made to the closure landform.

6.3.2 Void hydrology

6.3.2.1 Water balance

A dedicated void water balance model, based on the final closure landform design (Section 6.1.5), was completed for the period 2023 to 2399 (377 years) to understand water balance behaviour (including climate change considerations) within the residual voids over time (Appendix M).

Due to insufficient data in the Roper area, there is currently limited understanding of the void interconnectivity within the Roper and East Pit voids resulting in greater variation in the water balance and groundwater modelling outputs, which impact the modelled final residual void lake levels. As discussed in Section 1.4.1.2, further data and technical studies are required to improve the alignment, and to reduce the uncertainty of the models to ensure a safe, stable landform that minimises environmental harm. Appendix M details the relevant void assessments for the Roper area, however due to the uncertainties, the modelling results for the Roper voids are not presented within the void hydrology section of this transitional PRCP.

Key findings for the SSM void water balance are summarised in Table 52. The findings show that after 2370 the water levels start to stabilise for all voids, with a simulated mean inflow being similar to the mean outflow. This indicates that the mean water balance has reached an equilibrium. The equilibrium establishes earlier in the northern voids than the southern voids by approximately a century. As the water levels remain below the groundwater levels for all residual voids (and well below each voids spill point), the voids have a low likelihood of overtopping; and environmental harm beyond the tenure boundary is not expected. Therefore, no management activities are required.

Table 52: Summary of SSM water balance model findings

Residual Void	Spill Level (m AHD)	Mean water flows (years 2380-2399)		Long-term mean void lake level (mAHD)
		Inflows (ML/yr)	Outflows (ML/yr)	
Lotus/Campbell	186	1,048	1,048	92
Gilbert	180	604	605	57
Price/Leichhardt	193	936	936	0
East Pit 1	188	201	200	122
East Pit 2	186	55	55	126

6.3.2.2 Groundwater modelling

The groundwater model detailed in Section 6.1.1.1, indicates within the residual voids in the northern portion of the site (Lotus/Campbell, Gilbert and Price/Leichardt) and in the area immediately surrounding the East Pit residual voids, groundwater will flow to the voids and act as groundwater sinks. The pit lakes that form within these voids, remain below the pre-mining groundwater levels and the base of the unsaturated seams (Section 6.1.1.3), therefore, environmental harm beyond the tenure boundary is not expected.

As outlined in Sections 6.1.1, additional data collection and updated technical studies are required as part of the Roper project to reduce the uncertainty of the groundwater model associated with the Roper area.

6.3.2.3 Water quality

A geochemical assessment has been undertaken in the void closure plan to identify the geochemical characteristics of high-wall and spoil materials and model the resulting effects on the long-term water quality of the residual void lakes.

The analysis of the void water quality (geochemical stability) for the remaining residual voids at SSM identified the following key findings:

- There are no significant sources of acid generation associated with the post-mining surface water hydrology, and acidic conditions are unlikely to develop in the residual voids

- Evapo-concentration processes will drive water quality in the residual voids
- Preliminary, high-level screening based on predicted TDS levels suggest that all SSM residual voids, except Price/Leichhardt may become chemically stratified
- SSM residual voids do not present an unacceptable risk of environmental harm beyond that of the void itself as they stabilise as groundwater sinks over time

As the Lotus/Campbell, Gilbert, Price/Leichhardt and East Pit residual voids stabilise as groundwater sinks over time, they do not present an unacceptable risk of environmental harm beyond the tenure boundary.

Due to the limited geochemical data for the tailings and rejects within the Roper area, the long-term water quality has not been assessed for the Roper residual voids. Additional waste characterisation, groundwater quality and surface water data will be sourced, and further technical studies undertaken as part of the Roper project to determine the long-term predictions for void lake quality.

6.3.3 Options for minimising final void

The pits will be progressively backfilled during the operation to minimise the final void to the final operational mining strip. Over 80% of the mined out pit voids will be progressively backfilled by the end of mining. As detailed in Section 4.3, the final residual voids presented in the PRCP have been further minimised from the original mine plans including:

- Multiple ramp voids will be progressively backfilled, minimising the number of ramps remaining at closure and the void area
- Steepening the residual void high-walls and low-walls while maintaining the required geotechnical stability. Steepening the high-walls and low-walls is also part of the rehabilitation strategy to minimise risk to the environment by reducing the catchment area into the voids.
- Increasing the set-back of the high-wall and end-wall from the lease boundary and watercourses to achieve the required FoS (Section 6.3.1)
- Partial void backfill where required to prevent flood ingress (Section 6.1.2).

Additional backfill will be dependent on the mining sequence of the final strips, which may change during the remaining operational period as new geological data becomes available and market factors change, and to ensure backfill does not result in an unacceptable risk of environmental harm beyond the tenure boundary. As SSM has significant mine life remaining, opportunities for further backfill of the final voids may be refined over the life of the operation and finalised as mining approaches the final strips.

6.3.4 Residual void dimensions and wall angles

Outcomes of the void geotechnical and geochemical stability analyses, void water balance modelling, site-wide hydrogeological and rehabilitation flood modelling have resulted in optimisation of the residual void dimensions towards minimising the extent and location of the NUMAs.

The residual void extents are defined by the high-wall, end-wall and low-wall crests at natural ground level. The void dimensions and wall angles, measured from the wall toe to the wall crest at ground level, are shown in Table 53.

Table 53: Proposed residual void dimensions and overall wall angles

Residual Void	Maximum depth (m)	Maximum length (m)	Maximum width (m)	High-wall overall slope	End-wall overall slope	Low-wall overall slope
Lotus/Campbell	168	9,000	440	45°	37°	21°
Gilbert	164	3,500	645	45°	37°	21°
Price/Leichhardt	273	6,390	980	45°	37°	21°

Residual Void	Maximum depth (m)	Maximum length (m)	Maximum width (m)	High-wall overall slope	End-wall overall slope	Low-wall overall slope
East Pit 1	90	1,260	275	45°	37°	21°
East Pit 2	75	800	255	45°	37°	21°
Roper 1*	18**	1,430	230	50°	20°	33°
Roper 2*	25**	2,330	250	11°	15°	15°
Roper 3*	14**	1,280	290	6°	6°	6°
Roper 4*	67**	4,960	350	22°	26°	26°

* Following completion of the Roper project technical studies and closure design, residual void specifications may change

** Accurate void depths are not available due to water within the voids

The residual void high-wall and end-wall profiles will remain as the final excavated wall profile, with numerous mining benches of varying face angles and heights. Each mining bench is offset with a berm of varying widths, reducing the overall final walls to approximately 45°. These wall angles may vary with the final geotechnical design which will be developed as mining approaches the final pit limits, to ensure it is based on the latest material and geotechnical data.

The final low-wall profile within the NUMA area will remain as the final as-dumped profile, with dragline spoil and each truck dump lifts within the NUMA area remaining at angle of repose (37°). The truck dumps are offset from the dragline spoil by two spoil peaks and each truck dump lift is offset by a bench, reducing the overall low-wall angle to approximately 21°. This wall angle may vary with the final geotechnical design which will be developed as mining approaches the final pit limits, to ensure it is based on the latest material, pit floor and geotechnical data.

The NUMA extents achieve an area that is safe and has structural stability and include the additional set-backs from the void high-wall, end-wall and low-wall crests to achieve a minimum FoS of 1.5 plus a safety bund (Section 6.3.1). The overall high-wall and end-wall angles from void wall toe to the NUMA extents at natural ground level are therefore lower than the angles shown in Table 53.

6.3.5 Improvement and management strategies

The residual voids become available for improvement at SSM once mining of each pit is complete; reshaping of the spoil dump low-wall outside of the NUMA area (within RA1) is complete; any partial backfill for flood mitigation is complete; and they are not being used for water storage. This is for safety reasons, to eliminate the risk of any injury or damage within the NUMA area from the reshaping and rehabilitation activities. Residual voids being used for water storage are available for improvement when they are no longer being used for water storage and are no longer part of the BMA central region water network.

To support attainment of residual voids that are safe and do not present an unacceptable risk of off-tenure environmental harm, the improvement and/or management activities provided in Table 54 will be undertaken.

Table 54: Improvement and/or management strategies for the SSM residual voids

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
Geotechnical stability	✓	✓	-	- For Roper residual voids: reassess geotechnical stability as part of the Roper project if modifications are made to the closure landform - As mining approaches the final limits, an AQP is to reassess the void geotechnical wall

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
				designs and set-backs based on the latest available data - Review and adjust the mine plan and final closure landform, if needed, to account for any revised set-back requirements - Use a minimum FoS of 1.5 as guidance for ongoing void closure planning. (This may be refined over the mine life should industry research provide optimised guidance on observational methods and consequence assessment) - A minimum distance of 50m to be designed between the residual void high-wall crest and the toe of the safety bund where the residual void is near a tenure boundary
Void hydrology	✓	✓	✓	- For Roper residual voids: review drivers and interactions between surface water and groundwater associated with the residual voids as part of the Roper project, including any potential interconnectivity within the Roper voids and East Pit voids - At cessation of mining activities, review and update the void water balance modelling, incorporating identified changes to the closure landform and spill point elevations, rainfall and evaporation, surface water runoff, groundwater inflows, and climate projections - Residual void catchments are minimised as far as practical and predominantly include only the low-wall areas - Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary - Obtain certification from an AQP that the residual voids do not present an unacceptable risk of environmental harm outside the tenure boundary - If necessary, identify and implement mitigation measures for appropriate protection works of landforms where floodwaters from watercourses interact with final closure landforms - Low-walls are free draining into the void lake with a maximum of 37 degree slopes
Void hydrogeology	-	-	✓	For Roper residual voids: review drivers and interactions between surface water and

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
				groundwater associated with the residual voids as part of the Roper project, including any potential interconnectivity within the Roper voids and East Pit voids - At cessation of mining activities, review and update the groundwater modelling, incorporating updated void water balance model outputs and in-field groundwater sampling data, as required - Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary - Obtain certification from an AQP that, upon completion of mining, residual voids do not present an unacceptable risk of environmental harm outside the tenure boundary - Residual voids must not overtop - Residual voids collectively act as a groundwater sinks within the tenure boundary post closure (demonstrated through groundwater modelling)
Void water quality	-	-	✓	- For Roper residual voids: undertake geochemical void lake water quality modelling as part of the Roper project once additional waste characterisation of the area has been undertaken - At cessation of mining activities, review and update the void geochemical assessment, including additional or refined data from in-pit surface water samples, surface- and groundwater samples, and biochemical modelling - Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary - Obtain certification from an AQP that the residual voids will not present an unacceptable risk of environmental harm outside of the relevant tenure boundary
Void access control	✓	-	-	- On cessation of mining activities: - Construct a safety bund at the geotechnical set-back distance - Erect fencing and signage (where required) around the safety bund

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
				- Obtain certification from an AQP that the residual void is safe to humans and livestock - Undertake monitoring and maintenance of exclusion fences and bunds
Erosion	✓	✓	✓	• A minimum distance of 25m to be designed between the residual void low-wall crest within the NUMA and the PMLU • Any erosion sediment to be contained within the residual void • The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the tenure boundary

Relationship with PRCP schedule

The SSM residual voids will be managed as NUMAs. Long-term geotechnical stability of low-walls, end-walls and high-walls is achieved within the NUMA extents. The residual voids have a low likelihood of overtopping and the northern voids (Lotus/Campbell, Gilbert and Price/Leichardt) will stabilise to be ongoing groundwater sinks after equilibrium has been reached post mining, and will not present an unacceptable risk of environmental harm outside of the tenure boundary.

Geotechnical stability and safety requirements, as well as water levels and water quality will be managed in terms of the management milestones specified in the PRCP schedule.

Further technical studies and modelling are required in the Roper area to reduce the uncertainties currently in the model for this area and to allow informed rehabilitation and management activities to be undertaken as part of the Roper project.

The information in this section is relevant to the following highlighted IAs and MMs in the PRCP schedule

IA1		IA2	
MM1	MM1	MM3	

The following milestone criteria will contribute to achievement of sufficient improvement:

RM0	0.3 Updated modelling and landform: • Hydrogeological modelling • Water balance modelling 0.4 Final landform, designs and updated plans: • Void closure plan
MM1	IA1.1 Void backfill will be completed at the end of mining for flood mitigation at: • The northern and southern end-walls of Lotus/Campbell void • The northern and southern end-walls of Gilbert void

The following milestone criteria will contribute to achievement of sufficient improvement:

	- The northern end-wall of Price/ Leichhardt void - The end-walls adjacent to Rolf Creek of East Pit voids. IA1.2 Highwall landforms must: - Prevent surface flow of floodwater into the void - Be geotechnically stable when floodwater is against the creek-side batter - Prevent seepage flow of floodwater into the void - Not be constructed with dispersive material - Have maximum 30% slopes with rock for scour protection. IA1.3 The final design for highwall landform must be completed by an AQP based on the latest flood modelling and materials data prior to construction. IA1.4 Final residual voids are not subject to inundation from floodwaters up to and including the 0.1% AEP. IA1.5 The high-wall, end-wall and low-wall achieve a FoS ≥ 1.5 within the NUMA extents as determined by an AQP. IA1.6 A minimum distance of 50m is to be designed between the residual void crest and the toe of the safety bund, where against an external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary. IA1.7 The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary. IA1.8 Low-walls are free-draining into the void lake with a maximum 37 degree slopes. IA1.9 Residual voids must not overtop. IA1.10 Residual voids collectively act as groundwater sinks within the relevant mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary post closure as demonstrated by groundwater modelling defined in condition PRCP12.
MM2	IA2.1 Competent safety bund or equivalent landform in place to prevent access to the residual void, at the geotechnical set-back distance. IA2.2 Fencing erected, where required to prevent access to the residual void, around the perimeter of the safety bund. IA2.3 Warning signage placed along the fence line (nominally one sign every 100m). IA2.4 A minimum distance of 25m is to be designed between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform in IA2.1.
MM3	IA3.1 Certification from an AQP that: - The residual void is safe to humans and livestock - The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling - Voids retain flood immunity, supported by flood modelling re-run at end of life and calibrated against the final landform - The highwall landform has been constructed in accordance with the final design - Appropriate safety infrastructure at the geotechnical set-back distance has been installed to prevent access to the NUMA - The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary

The following milestone criteria will contribute to achievement of sufficient improvement:

- Erosion of the landform within the NUMA area will not negatively impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU.
- IA3.2** Monitoring and maintenance of exclusion fences and bunds to be carried out to ensure they remain effective.

6.4 Underground mining

PRCP Guideline (Section 3.6.4)

For underground mining operations, the rehabilitation planning part must include:

- a geotechnical study
- an assessment of groundwater interactions and potential lowering of groundwater levels
- the development of a hydrogeological conceptual model
- subsidence analysis and modelling and a subsidence vegetation/habitat impact assessment
- consideration of how potential entries to underground workings will be sealed (i.e. through some form of capping or back filling)
- how surface ponding and cracking will be mitigated
- identification of post-closure stabilisation of underground workings in order to manage the potential for unplanned surface subsidence and unplanned ground collapse such as sinkholes and pot holing.

Not applicable, as there is no underground mining at SSM.

6.5 Built infrastructure

PRCP Guideline (Section 3.6.5)

The administering authority's expectation of rehabilitation relating to built infrastructure is that it will be decommissioned, demolished, salvaged and/or disposed of unless it is being formally retained by the landholder to achieve an appropriate PMLU.

The rehabilitation planning part must include:

- Identification of infrastructure that will be decommissioned and the methods for decommissioning.
- A description of infrastructure that will remain post rehabilitation and the identification of ongoing maintenance requirements.
- Evidence of agreement for any infrastructure that will have ownership transferred.

In accordance with EA condition E10: "All infrastructure, constructed by or for the EA holder during the mining activities including water storage structures, must be removed from the site prior to surrender, except where agreed in writing by the post-mining landowner/landholder." However, the EA further notes that "this is not applicable where the landowner/landholder is also the environmental authority holder", which is the case for the majority of SSM (Section 1.2.12).

Table 55 details the infrastructure associated with the mining activities at SSM. BMA owned surface infrastructure, not beneficial to the PMLU, will be decommissioned and removed in accordance with the EA conditions. Surface infrastructure that may be retained to support the PMLUs will have a demonstrable benefit and may include selected: fencing, access tracks, services related infrastructure, sheds and buildings, hardstand areas/transport logistics areas, and water related infrastructure.

Infrastructure not constructed for the purpose of mining, such as dams used for grazing, gates, cattle grates, stock handling/watering areas, access tracks, fire breaks etc., will not be removed as part of rehabilitation works.

Priority will be to repurpose, salvage or recycle any infrastructure to be removed. Demolition and disposal within the mining voids or spoil dumps will only be undertaken when repurpose, salvage or recycle alternatives are deemed by BMA not to be viable. This approach is in line with the waste and resource management hierarchy outlined in the Queensland Waste Management and Resource Recovery Strategy created under the *Queensland Waste Reduction and Recycling Act 2011*.

Table 55: Infrastructure associated with the approved SSM mining activities

Category		Infrastructure
Built infrastructure	Steel, concrete and brick infrastructure	• Conveyors and transfer stations • Surge bins and hoppers • Tunnels • Train load-out • Various buildings e.g. administration, crib rooms, warehouse, laboratory, storage, sheds • Workshops • Fuel, oil, chemical and water storage • Fuel and wash bays • Sewage treatment plants • Fences
	Supporting services	• Pipes and pumps • Power lines • Switchyard and substations • Communication and lighting towers • Concrete pads and bitumen • Culverts
Water infrastructure		• Mine affected water dams • Raw water dams • Sediment dams • Drains

The timing of the decommissioning and removal of the infrastructure is based on the proposed timing of the SSM operation, final mining and rehabilitation activities.

Any regional infrastructure associated with roads, railways, power, water and communications supply to landowners or townships is not included in this PRCP.

Further detail on the rehabilitation stages after decommissioning of the infrastructure, such as landform reshape, surface preparation, revegetation and monitoring are covered in the relevant sections of this PRCP.

6.5.1 Built infrastructure

Decommissioning of the built infrastructure with no beneficial use to the PMLU will follow the resource management hierarchy and will include:

- Disconnecting services
- Removing surface built and service infrastructure through salvage or recycling activities, or demolishing and burying in the mining voids or spoil dumps
- Removing below-ground built and service infrastructure to a depth of 0.5m below the surface and recycling, or burying in the mine void or spoil dumps, or covering to a minimum depth of 0.5m to enable establishment of the PMLUs
- Removing concrete, bitumen and aggregate to a depth of 0.5m below the surface and recycling, or burying in the mine void or spoil dumps, or covering to a minimum depth of 0.5m to enable establishment of the PMLUs

- Disposing of demolition-related putrescible and hazardous wastes at an appropriately licenced facility.

Below-ground infrastructure, services and waste deeper than 0.5m in relation to the final landform surface can be retained provided it can meet the following:

- Pipelines have been drained
- Below-ground infrastructure (installed after the approval date of this transitional PRCP) is mapped
- The intended PMLU is not compromised
- There is no ongoing risk of environmental harm

6.5.2 Water infrastructure

Decommissioning of the water-related infrastructure constructed for the mining activities with no beneficial use to the PMLU will include:

- Pumping any remaining water to the residual voids, or removing water in accordance with:
 - EA condition F27: *“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 for the purpose of: a) supplying stock water subject to compliance with the quality release limits specified in Table F7 (Stock Water Release Limits); or b) supplying irrigation water subject to compliance with quality release limits in Table F8 (Irrigation Water Release Limits); or c) supplying water for construction and/or road maintenance in accordance with the conditions of this environmental authority”,*
 - EA condition F28: *“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 dams or tanks, for the purpose of supplying water to any operation licensed for either ERA13 (mining black coal) or ERA31 (mineral processing). The volume, pH and electrical conductivity of water transferred must be monitored and recorded”.*
 - EA condition F29: *“If the responsibility for mine affected water is given or transferred to another person in accordance with conditions F27 or F28: a) the responsibility for the mine affected water must only be given or transferred in accordance with a written agreement (the third party agreement); and b) the third party agreement must include a commitment from the person utilising the mine affected water to use it in such a way as to prevent environmental harm or public health incidents and specifically make the persons aware of the General Environmental Duty under section 319 of the Environmental Protection Act 1994, environmental sustainability of the water disposal and protection of environmental values of waters; and c) the third party agreement must be signed by both parties to the agreement”.*
- Disposing of mine dam sediment according to the results of an assessment by an AQP
- Removing any mine dam liners
- Breaching mine dam walls and reshaping of the area to make it free-draining
- Removing culverts and drains constructed for mining activities and operations.

6.5.3 Contaminated land assessment

In accordance with the EA conditions, contaminants must not be released in a manner that constitutes environmental harm, and spillage of any wastes, contaminants or other materials must be cleaned up as quickly as practicable, stored in accordance with relevant standards and handled in a way that prevents environmental harm.

At completion of mining operations and prior to landform reshaping, surface preparation and revegetation, a contaminated land investigation will be undertaken in accordance with the National Environment Protection (Assessment of Site Contamination) Measure (RM2) for the relevant RAs. Where the progressive rehabilitation areas being investigated for contaminated land do not align with legal cadastral property boundaries, the investigations will not fulfil the requirements of an EP Act compliant Contaminated Land Investigation Document. To support the assessment of contaminated land risks of individual progressive rehabilitation areas, the contaminated land investigations will be completed by suitably qualified persons (SQP) to a standard that can

be used as part of a future EP Act compliant Contaminated Land Investigation Document. Prior to the relinquishment of the mining leases, the progressive rehabilitation contaminated land investigations will be collated to produce an EP Act compliant Contaminated Land Investigation Document that will be used to confirm the suitability of the site for the PMLUs and to amend Environmental Management Register listings or to submit Site Management Plans where required.

The contaminated land investigation will assess the site for the presence of contamination with the potential to adversely impact the nominated PMLUs and/or environmental values. Should land contamination be identified, the potential risks will be assessed and, where required, remediation will be undertaken. A Contaminated Land Investigation Document will be completed in accordance with the EP Act, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan to allow the ML area to be safely utilised for the nominated PMLUs (Section 3).

Verification will be undertaken as part of the final rehabilitation milestone of achievement of PMLU to a stable condition to confirm there are no changes to the contaminated land status completed for RM2 and the requirements of any Site Management Plans have been met.

Relationship with PRCP schedule

Surface infrastructure not beneficial to the PMLU will be decommissioned and removed. Below ground infrastructure will be removed if required to a depth of 0.5m or covered to enable establishment of the PMLU provided there is no ongoing risk of environmental harm and the intended PMLU is not compromised.

A contaminated land assessment will be undertaken at the completion of operations and prior to final landform development and shaping. Remediation and/or management of any identified contamination that has the potential to present unacceptable risks to the nominated PMLU or environmental values, will be undertaken.

The information in this section is relevant to the following highlighted RAs and RMs in the PRCP schedule

RA1		RA2		RA3		RA4		RA7		RA10		RA12		RA13		RA14		RA15		RA16		RA17		RA18		RA19	
RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9	RM10	RM11	RM12	RM13	RM14	RM15	RM17	RM18										

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

RM0	0.1 Ground works: - Establish safe access to landforms for data collection and progressive rehabilitation activities. 0.2 Progressive ground works and sufficient data collection for modelling: - Ongoing land contamination investigation.
RM1	1.1 All infrastructure to be retained onsite must be safe, stable and not cause environmental harm. 1.2 All infrastructure and services to be retained onsite must have a signed landholder statement, declaring that they will accept responsibility for the infrastructure (except for those items in 1.4). 1.3 If the underlying landholder is also the EA holder (or a parent corporation or a subsidiary corporation), consent to retain the infrastructure is required from the administering authority (except for those items in 1.4). In seeking consent the holder must justify how the infrastructure will provide a benefit or improvement to the use of the land and/or community once mining has ceased. 1.4 Below-ground infrastructure, services and waste (as per the Environmental Authority (EPML00865013) waste schedule) deeper than 0.5m in relation to the final landform surface can be retained provided it can meet the following: All pipelines have been drained; and

The following milestone criteria will contribute to achievement of PMLU to a stable condition:

	- All below-ground infrastructure (installed after the approval date of this transitional PRCP) to be retained must be mapped; and - The intended PMLU is not compromised; and - There is no ongoing risk of environmental harm. 1.5 With the exception of 1.2, 1.3 and 1.4 above, the following are complete: - All services disconnected, terminated and removed - All buildings and associated infrastructure dismantled and removed - All hardstand, concrete areas and roads (bitumen, blue metal, aggregate) removed - All pipelines drained and removed - All waste, not authorised under the Environmental Authority (EPML00865013) waste schedule, removed - All surface water drainage infrastructure removed - All drillholes, bores, sediment ponds and sumps decommissioned - All machinery and equipment removed from site - Mine water dams are decommissioned - Watercourse crossings and culverts removed. 1.6 Assessment of mine water dams is completed by an AQP and identified sediment and water management actions are completed.
RM2	2.1 Contaminated Land Investigation Document completed in accordance with the <i>Environmental Protection Act 1994</i>, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2.2 The Contaminated Land Investigation Document confirms the area within the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) does not present an unacceptable risk to the post-mining land use. 2.3 Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future <i>Environmental Protection Act 1994</i> compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.
RM13	13.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: - Requirements of any Site Management Plan have been met; - Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and - There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM14	14.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: - Requirements of any Site Management Plan have been met; - Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and - There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.

6.6 Summary of key rehabilitation and management practices

The key rehabilitation activities and associated rehabilitation milestones are shown in Table 56, and the key management/improvement activities and associated management milestones are shown in Table 57.

Table 56: Key rehabilitation activities and rehabilitation milestones for SSM

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
RA1	Spoil dumps	- Reshape the landform with maximum 30% slopes - Cover tertiary spoil slopes >5% with minimum 1m Permian spoil and for slopes >15% at least 0.5m of the upper 1m Permian cover is to be competent rock - Cover Permian spoil with minimum 0.5m competent rock on >15% slopes - Construct landforms so there will be no runoff from landform tops onto batter slopes - Install erosion and sediment control systems, if required - Landform achieves design criteria for geotechnical stability with a FoS ≥ 1.5 - Spread topsoil to a minimum thickness of 100mm or alternative growth media to a minimum thickness of 300mm - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required) - Deep rip along contour of slopes - Seed as per recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	- Progressive rehabilitation has already commenced - Progressive rehabilitation of spoil dump areas as soon as practicable - Rehabilitation of spoil dump low-wall area will commence once mining in each pit is complete	- RM3 - RM5 - RM8 - RM11 - RM14
RA2	- Creek/surface water diversions - Watercourse crossings	- Remove watercourse crossings and culverts - Reshape the disturbed areas within natural watercourse bed and banks to a profile similar to the pre-disturbance condition	Dependent on the location in relation to mining and closure activities, areas are available either at the end of mining or at the end of the major rehabilitation activities, including low-wall reshape	- RM1 - RM3 - RM6 - RM9

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		- For creek diversions requiring realignment and rehabilitation, construct diversions in line with the final functional/ detailed designs - Install erosion and sediment control systems, if required - Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required) - Deep rip along contour of slopes as required - Seed as per recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a watercourse PMLU		- RM12 - RM15
RA3	- MIA - Buildings - Coal stockpiles - Mine dams - Roads - Train load-out and rail infrastructure - Laydown areas - General infrastructure and disturbance	- Disconnect services - Remove surface built and service infrastructure where there is no beneficial use to the PMLU - Remove below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove machinery and equipment where there is no beneficial use to the PMLU - Remove waste not authorised under the EA waste schedule, including demolition waste	Dependent on the use and location in relation to mining and closure activities: coal stockpiles, rail infrastructure and laydown areas are available at the end of mining; with all other infrastructure, such as administration, crib rooms, workshops, available at the end of the major rehabilitation activities, including low-wall reshape	- RM1 - RM2 - RM3 - RM4 - RM7 - RM10 - RM13

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		- Assess mine dam water and sediment and dispose appropriately - Undertake Contaminated Land Investigation Document, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan - Reshape the landform with maximum 12% slopes - Install erosion and sediment control systems, if required - Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Rip along contour of slopes - Seed with recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU		
RA4	- Roads - Laydown areas - Conveyors - Exploration - General infrastructure and disturbance	Where required, dependent on the extent of the disturbance: - Disconnect services - Remove surface built and service infrastructure where there is no beneficial use to the PMLU - Remove below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU	- Exploration rehabilitation is commenced within six months after exploration activities are complete (as per <i>Eligibility criteria and standard conditions for exploration and mineral development projects</i>) - The remaining areas are dependent on the use and location in relation to mining and closure activities: the majority is available at the end of mining; with the remaining available at	- RM1 - RM3 - RM5 - RM8 - RM11 - RM14

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		- Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove waste not authorised under the EA waste schedule, including demolition waste - Decommission drillholes, bores, sediment ponds and sumps - Install erosion and sediment control systems, if required - Reshape the landform with maximum 15% slopes - Spread topsoil to a minimum thickness of 100mm, where topsoil has previously been removed - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Rip along contour of slopes - Seed with recommended seed mix and rate - Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	the end of the major rehabilitation activities, including low-wall reshape	
RA7	Existing rehabilitation	Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	Progressive rehabilitation has already commenced	- RM10 - RM17
RA10	Existing rehabilitation	- Seed as per recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	Progressive rehabilitation has already commenced	- RM8 - RM11 - RM18

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
RA12	Roper project: Spoil dumps	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Reshape the landform with maximum 30% slopes - Cover tertiary spoil slopes >5% with minimum 1m Permian spoil and for slopes >15% at least 0.5m of the upper 1m Permian cover is to be competent rock - Cover Permian spoil with minimum 0.5m competent rock on >15% slopes - Construct landforms so there will be no runoff from landform tops onto batter slopes - Install erosion and sediment control systems, if required - Landform achieves design criteria for geotechnical stability with a FoS ≥ 1.5 - Spread topsoil to a minimum thickness of 100mm or alternative growth media to minimum thickness of 300mm - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Deep rip along contour of slopes - Seed as per recommended seed mix and rates	- Area is available for rehabilitation - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2) - Rehabilitation activities are scheduled to commence in 2035 to align to the detailed rehabilitation and management plan developed for the area	- RM0 - RM3 - RM5 - RM8 - RM11 - RM14

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU		
RA13	Roper project: Spoil dumps	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Reshape the landform with maximum 12% slopes - Install erosion and sediment control systems, if required - Spread topsoil a minimum thickness of 150mm - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Rip along contour of slopes - Seed with recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	- Area is available for rehabilitation - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2) - Rehabilitation activities are scheduled to commence in 2035 to align to the detailed rehabilitation and management plan developed for the area	- RM0 - RM3 - RM4 - RM7 - RM10 - RM13
RA14	Roper project: - Roads - Dams - Laydown areas	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Disconnect services	- Area is available for rehabilitation - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2)	- RM0 - RM1 - RM2 - RM3 - RM4 - RM7

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
	General infrastructure and disturbance	- Remove surface built and service infrastructure where there is no beneficial use to the PMLU - Remove below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove machinery and equipment where there is no beneficial use to the PMLU - Remove waste not authorised under the EA waste schedule, including demolition waste - Assess mine dam water and sediment and dispose appropriately - Undertake Contaminated Land Investigation Document, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan - Reshape the landform with maximum 12% slopes - Install erosion and sediment control systems, if required - Spread topsoil a minimum thickness of 150mm where topsoil has previously been removed - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Rip along contour of slopes - Seed with recommended seed mix and rates	Rehabilitation activities are scheduled to commence in 2035 to align to the detailed rehabilitation and management plan developed for the area	- RM10 - RM13

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU		
RA15	Roper project: - Roads - Laydown areas - General infrastructure and disturbance	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Disconnect services - Remove surface built and service infrastructure where there is no beneficial use to the PMLU - Remove below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU - Remove waste not authorised under the EA waste schedule, including demolition waste - Reshape the landform with maximum 15% slopes - Install erosion and sediment control systems, if required - Spread topsoil a minimum thickness of 100mm where topsoil has previously been removed - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan)	- Area is available for rehabilitation - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2) - Rehabilitation activities are scheduled to commence in 2035 to align to the detailed rehabilitation and management plan developed for the area	- RM0 - RM1 - RM3 - RM5 - RM8 - RM11 - RM14

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		- Rip along contour of slopes - Seed with recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU		
RA16	Roper project: - TSFs - Reject areas	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Remove infrastructure to a depth of 0.5m below the final landform surface - Assessment of contaminated land risks - Tailings and rejects to be covered by a non-ponding landform with at least 2m of spoil cover or as per detailed design - Reshape the landform with maximum 12% slopes - Spread topsoil a minimum thickness of 150mm - Assess growth media characteristics to determine ameliorant and other treatment requirements - Apply ameliorants and other treatments (if required by the plan) - Rip along contour of slopes - Seed with recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	- Area is available for rehabilitation - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2) - Rehabilitation activities are scheduled to commence in 2035 to align to the detailed rehabilitation and management plan developed for the area	- RM0 - RM1 - RM2 - RM3 - RM4 - RM7 - RM10 - RM13

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
RA17	Roper project: Existing rehabilitation	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	- Progressive rehabilitation has already commenced - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2)	- RM0 - RM10 - RM17
RA18	Roper project: Existing rehabilitation	- Undertake ground works to establish safe access for data collection and rehabilitation activities - Data collection - Leucaena management - Technical studies to develop detailed rehabilitation and management plan and designs for Roper project - Seed as per recommended seed mix and rates - Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	- Progressive rehabilitation has already commenced - Ground works and data collection to enable comprehensive technical studies to develop the detailed rehabilitation and management plan for Roper area are scheduled to commence in 2025 (Section 1.4.1.2)	- RM0 - RM8 - RM11 - RM18
RA19	Certified rehabilitation	Continued monitoring	Certified	n/a

Table 57: Key management/improvement activities and management milestones for SSM

IA	Relevant activities	Management/improvement activities	Improvement timing	MMs
IA1	Residual voids	- Design high-walls, end-walls and low-walls to achieve a FoS ≥ 1.5 within the NUMA extents - Design a minimum distance of 50m between the residual void crest and the toe of the safety bund, where against a tenure boundary - Design a minimum distance of 25m between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform - Design residual voids to prevent overtopping - Undertake predictive groundwater modelling - Backfill voids or construct high-wall landforms at the end of mining for flood mitigation as per final flood model - Low-walls to free-drain into the void lake with maximum 37 degree slopes - Construct safety bund or equivalent landform at geotechnical set-back distance to prevent access to the residual voids - Erect fencing and signage around the perimeter of the safety bund, where required - Undertake monitoring to demonstrate achievement of sufficient improvement - Undertake monitoring and maintenance of exclusion fences and bunds	Available for improvement once the PMLU low-wall spoil reshaping is complete for each residual void and any partial backfill for flood mitigation is complete, and the residual void is not being used for water storage	- MM1 - MM2 - MM3
IA2	Roper project: Residual voids	Technical studies to develop detailed rehabilitation and management plan and designs for Roper project as part of RM0	Available for improvement once the residual voids are not being used for water storage	- MM1 - MM2 - MM3

IA	Relevant activities	Management/improvement activities	Improvement timing	MMs
		- Design high-walls, end-walls and low-walls to achieve a FoS ≥ 1.5 within the NUMA extents - Design a minimum distance of 50m between the residual void crest and the toe of the safety bund, where against a tenure boundary - Design a minimum distance of 25m between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform - Design residual voids to prevent overtopping - Undertake predictive groundwater modelling - Backfill voids at the end of mining for flood mitigation as per final flood model - Low-walls to free-drain into the void lake with maximum 37 degree slopes - Construct highwall landforms to design - Construct safety bund or equivalent landform at geotechnical set-back distance to prevent access to the residual voids - Erect fencing and signage around the perimeter of the safety bund, where required - Undertake monitoring to demonstrate achievement of sufficient improvement - Undertake monitoring and maintenance of exclusion fences and bunds		

7 RISK ASSESSMENT

Legislative Requirement

In accordance with section 126C(1)(f) of the EP Act, the rehabilitation planning part of the PRC Plan must identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.

PRCP Guideline (Section 3.7)

As per section 126C(1)(j) of the EP Act, the administering authority considers it necessary for the proposed PRC plan to contain a risk assessment of all proposed NUMAs. The risk assessment must be carried out to identify the risks of the NUMA causing environmental harm and not being safe and structurally stable and detail how the applicant intends to manage and minimise the identified risks.

The AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) describes risk assessment as the overall process of risk identification, risk analysis, risk evaluation and risk treatment. Each of these aspects must be included in the risk assessment in the rehabilitation planning part.

Information requirements in this section apply to all applicants whether or not they are an existing EA holder. Existing holders may have the required information available from previously submitted plans/reports/applications that, if still valid, can be used in the PRC plan.

7.1 Identifying, assessing and treating risks

7.1.1 Risk methodology

A risk-based approach to the SSM PRCP has been undertaken in term of the method described in Figure 21.

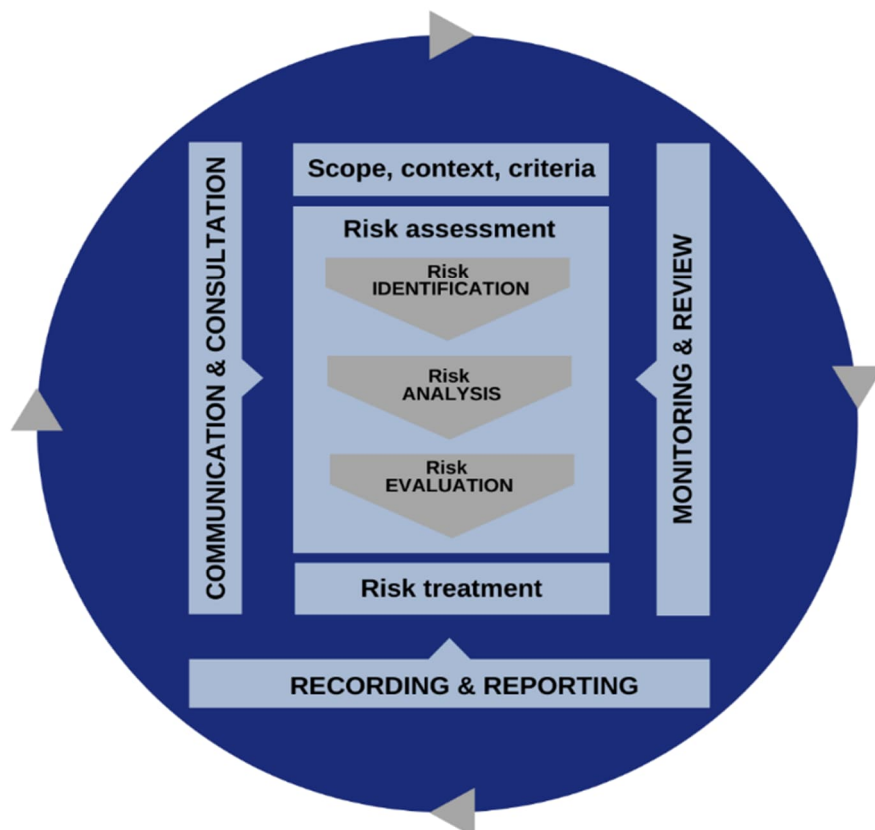


Figure 21: ISO 31000-compliant risk-based approach followed for the SSM PRCP

7.1.2 Risk identification

The risk event - a stable condition for land described as a PMLU not being achieved - was assessed per ISO 31000 methodology described in Figure 21 above, where stable condition is defined as per section 111A of the EP Act:

- The land is safe and structurally stable, and
- There is no environmental harm being caused by anything on or in the land, and
- The land can sustain a PMLU

For SSM, the PMLUs being risk assessed are cattle grazing, woodland habitat and watercourse. Dryland cropping PMLU has not been included in the risk assessment as there is no RA, and therefore no rehabilitation activities planned, for dryland cropping PMLU (Section 3).

In addition, the risk event - NUMAs do not achieve safe, structurally stable condition or causes environmental harm - was also assessed.

7.1.3 Risk analysis, evaluation and relevant treatments

The full risk assessment – *Saraji South Mine PRCP Risk Assessment* is included in Appendix N and provides the risk analysis, risk evaluation and risk treatments for each risk scenario.

Worst case outcomes were assessed for each scenario, preventative and mitigating controls requirement to manage that risk were identified and then a residual risk rating (RRR) was calculated. The BHP likelihood and severity tables, as well as the outcomes of the RRR heat map ratings matrix are provided in Table 58, Table 59 and Table 60 respectively.

Table 58: BHP risk likelihood table

Likelihood table			
Uncertainty	Frequency	Likelihood factor	Guidance
Highly Likely	Likely to occur within a 1-year period	3	Event is expected to occur >80% of the time during a 5-year planning cycle
Likely	Likely to occur within a 1 – 5-year period	1	Event is expected to occur 60% to 80% of the time during a 5-year planning cycle
Probable	Likely to occur within a 5 – 20-year period	0.3	Event is expected to occur 30% to 60% of the time during a 5-year planning cycle
Unlikely	Likely to occur within a 20 – 50-year period	0.1	Event is expected to occur 10% to 30% of the time during a 5-year planning cycle
Highly Unlikely	Not likely to occur within a 50-year period	0.03	Event is expected to occur <10% of the time during a 5-year planning cycle

Table 59: BHP risk severity table

Severity table		
Severity level	Descriptor	Severity factor
5	Severe impact to the environment and where recovery of ecosystem function takes 10 years or more	1000

Severity table		
Severity level	Descriptor	Severity factor
4	Serious impact to the environment, where recovery of ecosystem function takes between 3 and up to 10 years	300
3	Substantial impact to the environment, where recovery of ecosystem function takes between 1 and up to 3 years	100
2	Measurable but limited impact to the environment, where recovery of ecosystem function takes less than 1 year	30
1	Minor, temporary impact to the environment, where the ecosystem recovers with little intervention	10

Table 60: BHP RRR heat map

			Severity level	S1	S2	S3	S4	S5
			Severity factor	10	30	100	300	1000
	Likelihood	Likelihood factor	Timeframe	Residual risk calculation (with controls in place and effective)				
Likelihood	Highly Likely	3	Within 1 year	30	90	300	900	3000
	Likely	1	Within 1 – 5 years	10	30	100	300	1000
	Probable	0.3	Within 5 – 20 years	3	10	30	90	300
	Unlikely	0.1	Within 20 – 50 years	1	3	10	30	100
	Highly Unlikely	0.03	Not within 50 years	0.3	1	3	10	30

With controls in place and implemented effectively, the RRR for the identified risk scenarios of the risk event – a stable condition for land described as a PMLU not being achieved, is deemed to be low (RRR of 30).

The risk treatments for each scenario that are necessary for achieving a stable condition for the land described as the PMLUs are shown below in Table 61.

Table 61: Necessary risk treatments identified to achieve a stable condition for the PMLUs

Aspect	Risk treatment
Risk event: Stable condition for land described as a post-mining land (reference SSM EA Table E1 - cattle grazing, woodland habitat and watercourse) is not achieved	
PMLU scenario 1: Landform failure	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: Approval	- Technical Services - Site operations

Aspect	Risk treatment
Implementation	
Proposed actions	- Materials characterisation - Growth media assessment to determine ameliorant and physical treatment requirements - Landform designed for materials available onsite and what can be achieved based on their properties - PMLU selected based on what is most appropriate for landform and materials - Groundcover of vegetation and rock (where appropriate on slopes) to provide erosion resistance - Rehabilitation monitoring and maintenance
Resource requirements	- Available material inventory - Erosion modelling - Equipment capabilities - Survey - Rehabilitation monitoring - Growth media assessment - Stockpile materials if required
Performance measures and constraints	- Comparison against design - Tracking against milestone criteria
Reporting and monitoring	Rehabilitation monitoring
Risk timing and scheduling	From commencement of rehabilitation activities to final achievement of PMLU
PMLU scenario 2: Alteration of hydrogeological conditions	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Site operations - Environment team
Proposed actions	- Contaminated land investigation at time of closure - Appropriate management, placement, and monitoring of waste (spoil, tailings, rejects) during operations - Landforms designed and constructed to minimise contaminant generation and transport, and minimise catchments and the potential for flooding of the residual voids - Revisiting and updating the groundwater models every 5 years to provide confirmation that voids and landforms are not presenting an unacceptable risk to the environment

Aspect	Risk treatment
Resource requirements	- Groundwater monitoring infrastructure - Sample collection/gauging and laboratory analysis as per PRCP
Performance measures and constraints	Compliance with milestone criteria
Reporting and monitoring	Reporting of identified releases of contaminants to waters under existing EA requirements
Risk timing and scheduling	From establishment of landforms with sampling as per PRCP monitoring program
PMLU scenario 3: Alteration of surface water systems	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Site operations - Environment team
Proposed actions	- All imported hazardous materials to be stored and used in accordance with relevant standards and removed from site on completion of operations - Mine affected water dams to be decommissioned and areas rehabilitated - Surface water monitoring to be undertaken in accordance with EA conditions - A contaminated land investigation will be undertaken at the completion of operations and remediation works undertaken as appropriate - Rehabilitation of disturbed areas will be undertaken as soon as practical after land becomes available - Rehabilitation and monitoring of disturbed reaches of creeks undertaken - Appropriate management, placement, and monitoring of waste (spoil, tailings, rejects) during operations - Landforms constructed to minimise the potential for flooding of the residual voids - Tailings and other waste disposal facilities appropriately capped
Resource requirements	- Undertake surface water sampling - Sampling equipment and infrastructure to allow collection of samples during runoff events - Flood modelling
Performance measures and constraints	Surface water milestone criteria and water quality objectives
Reporting and monitoring	Monitoring when sufficient runoff or surface water flow events occur

Aspect	Risk treatment
	Reporting under existing EA requirements
Risk timing and scheduling	During runoff or surface water flow events suitable for the collection of surface water samples
PMLU Scenario 4. Creek diversions to meet closure objectives	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Site operations - Environment Team
Proposed actions	- Creek diversion concept designs to be progressed to functional designs when rehabilitation of surrounding areas commences - Construction of any diversion channels in line with the final functional designs - Removal and rehabilitation of any mine infrastructure that presents an unacceptable risk to the diversion attaining a relinquishable state (i.e. culverts and dams) - Rehabilitation of surrounding landforms - Surface water monitoring to be undertaken - Creek diversion monitoring to relevant IDC standard and maintenance to be undertaken
Resource requirements	- Progress concept designs to functional designs, including flood modelling - Creek diversion monitoring and maintenance - Collection and analysis of water samples
Performance measures and constraints	- Watercourse geomorphic index and riparian vegetation index milestone criteria - Surface water milestone criteria and water quality objectives
Reporting and monitoring	- Creek diversion IDC method monitoring - Surface water quality data
Risk timing and scheduling	As scheduled frequencies from commencement of rehabilitation activities to final achievement of PMLU
PMLU scenario 5: Contaminated land impacting on environmental receptors, rehabilitation, and attainment of PMLUs	
Reasons for selecting treatment option	Studies and analysis performed show that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: Approval	- Technical Services - Environment team

Aspect	Risk treatment
Implementation	
Proposed actions	- Environmental monitoring and reporting as per the EP Act 1994 and existing EA requirements - All stored hazardous materials and infrastructure within the MIA and CHPP, that have the potential to release contaminants to groundwater, will be appropriately recycled or disposed - Contaminated land investigation to be undertaken at the completion of operations to identify contamination that has the potential to cause adversely impact PMLUs - Implementation of remediation and/or site management plans as required to reduce potential contaminate land risks
Resource requirements	- SQP to undertake contaminated land investigations and oversee on-going monitoring requirements - Sample collection, laboratory analyses and engineering controls
Performance measures and constraints	Attainment of surface water and groundwater milestone criteria and a site suitability statement
Reporting and monitoring	Contaminated land investigation document and reporting of water quality as per EA
Risk timing and scheduling	Contaminated land Investigation at closure and water sampling as per PRCP monitoring program
PMLU scenario 6: Flooding influences on rehabilitation and final landforms	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site operations
Proposed actions	- Removal of infrastructure from watercourses (e.g. culverts) that could adversely impact flow - Decommissioning of dams - Design of landforms within flood extents that are safe and stable - Establishment of vegetation suitable for the environment and reduces erosion risks - Undertake monitoring for potential landform risks and undertake maintenance
Resource requirements	- Flood modelling - Rehabilitation monitoring post flood events
Performance measures and constraints	No flooding damage to landforms up to a 0.1% AEP event

Aspect	Risk treatment
Reporting and monitoring	Rehabilitation monitoring
Risk timing and scheduling	As per PRCP monitoring program
PMLU scenario 7: Rehabilitated landforms result in alteration of flood hydrology upstream and downstream	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site Operations
Proposed actions	- Removal of infrastructure within watercourse alignments (e.g. culverts) that could adversely impact flows - Decommissioning of dams - Establishment of landforms that are stable - Provide appropriate level of flood protection for residual voids - Undertake monitoring and maintenance works where required to maintain landforms
Resource requirements	- Flood modelling - Monitoring post flood events
Performance measures and constraints	No unacceptable damage to infrastructure or ecosystems as a result of changes to flood regime or change to flood extent
Reporting and monitoring	Rehabilitation monitoring
Risk timing and scheduling	As per PRCP monitoring program
PMLU scenario 8: Insufficient or inappropriate growth media and rock resources required for rehabilitation activities	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Environment team - Site operations
Proposed actions	- Management of topsoil and rock stockpiling - Management of rehabilitation material application - Review of the growth media and rock resource quantities periodically during operations - Growth media assessment to determine ameliorant and fertiliser requirements

Aspect	Risk treatment
	- Application of ameliorants surface treatments as per assessment - Rehabilitation monitoring and maintenance
Resource requirements	- Topsoil and rock inventory - Burden model - Survey - Equipment capabilities - Rehabilitation monitoring and maintenance - Growth media assessment
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	Rehabilitation monitoring
Risk timing and scheduling	From planning of soil stripping to final achievement of PMLU
PLMU scenario 9: Insufficient management of mineral waste	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Engineering team - Environment team - Site operations
Proposed actions	- Waste characterisation during operations - Ongoing material sampling during operations - Tailings and reject material appropriately disposed on-site - In-situ geochemical monitoring of landforms - Surface and groundwater monitoring during operations - Rehabilitation monitoring and maintenance
Resource requirements	- Data from waste characterisation - Mineral waste sampling data - In-situ geochemical monitoring - Rehabilitation monitoring - Surface and groundwater monitoring
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	- Rehabilitation monitoring - Waste characterisation sampling and analysis - Surface and groundwater monitoring

Aspect	Risk treatment
Risk timing and scheduling	Throughout operations to final achievement of PMLU
PLMU scenario 10: Failure of, or inappropriate engineered cover design	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Environment team - Site operations
Proposed actions	- Waste characterisation during operations including physical properties of cover materials - Ongoing material sampling during operations - Tailings and reject material appropriately disposed on-site - In-situ geochemical and geotechnical monitoring of landforms - Detailed cover design completed prior to installation - Surface and groundwater monitoring during operation - Rehabilitation monitoring and maintenance
Resource requirements	- Final detailed cover design - Data from waste characterisation - Mineral waste sampling data - In-situ geochemical and geotechnical monitoring - Rehabilitation monitoring - Surface and groundwater monitoring
Performance measures and constraints	- Completion against design - Tracking against milestone criteria
Reporting and monitoring	- Rehabilitation monitoring - Waste characterisation sampling and analysis - Surface and groundwater monitoring
Risk timing and scheduling	From cover design to final achievement of PMLU
PMLU scenario 11: Inadequate and/or inappropriate revegetation	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Environment team - Site operations

Aspect	Risk treatment
Proposed actions	- Growth media assessment to determine ameliorant and physical treatment requirements for the PMLU - Management of seed selection, provenance and quality - Rehabilitation and reference site monitoring - Maintenance as identified
Resource requirements	- Rehabilitation and reference site monitoring data - Growth media assessment - Seed
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	Rehabilitation and reference site monitoring
Risk timing and scheduling	From growth media planning to final achievement of PMLU
PMLU scenario 12: Deterioration of built infrastructure conditions	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Environment team - Site operations
Proposed actions	- Undertake a preliminary contaminated land assessment prior to the completion of the approved activities, conduct a detailed site investigation and develop remediation plan if required - Rehabilitation monitoring and maintenance
Resource requirements	- SQP to undertake contaminated land investigations and oversee on-going monitoring requirements - Rehabilitation monitoring
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	Rehabilitation monitoring
Risk timing and scheduling	Throughout operations to final achievement of PMLU

The risk treatments for each scenario that are necessary for achieving a safe and structurally stable NUMA that does not cause environmental harm are shown below in Table 62.

Table 62: Necessary risk treatments identified to achieve a safe and structurally stable NUMA that does not cause environmental harm

Aspect	Risk treatment
Risk event: NUMAs do not achieve safe, structurally stable condition or causes environmental harm off tenure	

Aspect	Risk treatment
NUMA scenario 1: Void walls do not achieve geotechnical stability	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site operations
Proposed actions	- Geotechnical assessment and final void wall design - Pit floor treatments as required to improve low-wall stability - Geotechnical monitoring during operations - Updated geotechnical assessment to be completed as mining approaches final limits and wall design and NUMA extent adjusted if required - NUMA extents designed to include the required FoS limit - Bunding, fencing and signage placed at FoS limit
Resource requirements	Geotechnical assessment and design
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	Geotechnical monitoring
Risk timing and scheduling	From detailed closure design of each void to relinquishment
NUMA scenario 2: Uncontrolled access to NUMA	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site operations
Proposed actions	- Safety bunding or equivalent landform, fencing and signage placed at FoS limit where required to restrict access - Geotechnical modelling completed to determine FoS limit
Resource requirements	- Monitoring and maintenance - Geotechnical modelling
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	- Document visual inspection - Monitoring

Aspect	Risk treatment
Risk timing and scheduling	From detailed closure design of each void to relinquishment
NUMA scenario 3: Uncontrolled flooding into residual voids	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site operations
Proposed actions	- Flood modelling - Flood mitigation (partial backfill and/or landform) designed to correct flood event - Flood mitigation installed - Monitoring
Resource requirements	- Flood modelling - Landform design - Monitoring and maintenance
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	- Document visual inspection - Monitoring
Risk timing and scheduling	From detailed closure design of each void to relinquishment
NUMA scenario 4: Water in the void causes environmental harm outside of the mining tenure	
Reasons for selecting treatment option	Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: - Approval - Implementation	- Technical Services - Site operations
Proposed actions	- Modelling - Flood mitigation designed to correct flood event - Flood mitigation installed - Groundwater quality and level monitoring - Landform design to enable establishment of collective groundwater sink within tenure boundary
Resource requirements	Groundwater and void lake water balance modelling

Aspect	Risk treatment
	- Landform design - Monitoring
Performance measures and constraints	Tracking against milestone criteria
Reporting and monitoring	- Groundwater level and quality monitoring - Water quality monitoring
Risk timing and scheduling	From detailed closure design of each void to relinquishment

Relationship with PRCP schedule
A risk-based approach has been adopted to develop the milestones in the PRCP schedule. This is primarily driven by a residual risk rating. Should a risk event materialise, the additional proposed actions identified in this risk section will be implemented and, where necessary, adjusted accordingly (in line with the risk treatment identified in this section).

7.2 Rehabilitation trials

PRCP Guideline (Section 3.7.1)

In accordance with section 126C(1)(j) of the EP Act, if rehabilitation trials are planned, the rehabilitation planning part must state:

- the objective of the trial(s)*
- the trial design including, but not limited to, the location, underlying land characteristics and potential issues*
- the details of how the trial(s) will be carried out*
- when the trial(s) will commence*
- the duration of the trial(s)*
- how the trial(s) will be assessed for success*
- how the results of the trial(s) will be incorporated into rehabilitation strategies and the development of milestones, and*
- where the trials have previously been carried out by the applicant.*

The information requirements in this section will apply to all applicants, whether or not they are an existing EA holder, who have planned or commenced rehabilitation trials. Existing EA holders can provide details of any rehabilitation trials that have occurred prior to the submission of the proposed PRC plan.

No rehabilitation trials are proposed at SSM. Current rehabilitation practices will be executed in line with the PRCP rehabilitation milestone criteria for each PMLU.

8 MONITORING AND MAINTENANCE

PRCP Guideline (Section 3.8)

Under section 126C(1)(j) of the EP Act, the administering authority considers monitoring and maintenance necessary to decide if the PRC plan is consistent with the requirements of the legislation. The rehabilitation planning part must contain a monitoring and maintenance program that identifies and describes the monitoring systems that will be carried out in order to demonstrate a milestone and milestone criteria have been achieved. The program must include, where relevant to the milestone and milestone criteria (but is not limited to):

- schedule of monitoring, reporting and review for each milestone
- description of methodologies and standards, which could include field-based assessments and the application of new remote sensing, GIS and other relevant emerging technologies
- monitoring that enables the repeatable collection of relevant statistically valid data
- monitoring using appropriate quality assurance and data management processes and systems
- regular analysis of site data including multi-year comparison trends and bench-marking against analogue/reference sites
- contingency strategies if monitoring data indicates milestone criteria are not being met
- post-closure monitoring to ensure milestone criteria has been demonstrated
- intent of monitoring reports, such as provision of results and key findings

The information requirements in this section will apply to all applicants whether or not they are an existing EA holder. However, existing holders may already have the required information available from previously submitted plans/reports/applications that, if still valid, could be used in the PRC plan. If there has/is any monitoring or maintenance of areas already rehabilitated, details must be included in the PRC plan.

8.1 Rehabilitation monitoring

Rehabilitation milestone monitoring will be undertaken at SSM by an AQP (as per condition A5 of the EA) to demonstrate achievement of the PMLUs of cattle grazing, woodland habitat or watercourse.

The RMs and associated milestone criteria for SSM are detailed in Section 1.4.2 and Section 10.3. A combination of monitoring, reporting and data analysis approaches will be used to demonstrate the achievement of the RMs as detailed in Table 63.

Table 63: Rehabilitation milestones with relevant reporting requirements

Milestone reference	Rehabilitation milestone	Reporting requirements
RM0.1	Ground works	• Investigation and development of plan for large scale leucaena management • Establish safe access to landforms for data collection and progressive rehabilitation activities.
RM0.2	Progressive ground works and sufficient data collection for modelling	• Ongoing leucaena management and earthworks • Drilling and installation of additional groundwater bores and water monitoring • Drilling and installation of geochemical boreholes and monitoring • Additional tailings and rejects material testing • Additional waste characterisation • Additional tailings geotechnical characterisation • On-going land contamination investigation.

Milestone reference	Rehabilitation milestone	Reporting requirements
RM0.3	Updated modelling and landform	- Flood modelling - Hydrogeological modelling - Water balance modelling - Hydrogeochemical modelling - Landform design iterations.
RM0.4	Final landform, design and updated plans	- Final landform design - Cover design - Water management plan - Void closure plan - Risk assessment.
RM1	Infrastructure decommissioning and removal	- Document visual inspections - Map of retained below-ground infrastructure (installed after the approval date of this transitional PRCP) - Document regulated waste removal - Assessment report for mine water dams
RM2	Remediation and/or management of contaminated land	- Contaminated Land Investigation Document, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan - Site assessment reports for individual areas of progressive rehabilitation that will be suitable to form part of a future Contaminated Land Investigation Document
RM3	Landform development and reshaping	- Survey/LiDAR of landform - Analysis of final landform against design - Certification that the landform is geotechnically stable with FoS ≥ 1.5 (RA1, RA12, RA16)
RM4	Surface preparation (cattle grazing)	- Document growth media depth - Growth media assessment and amelioration and physical treatment plan - Document ameliorants and physical treatments applied
RM5	Surface preparation (woodland habitat)	- Document growth media depth - Growth media assessment and amelioration and physical treatment plan - Document ameliorants and physical treatments applied

Milestone reference	Rehabilitation milestone	Reporting requirements
RM6	Surface preparation (watercourse)	- Document growth media depth - Growth media assessment and amelioration and physical treatment plan - Document ameliorants and physical treatments applied
RM7	Revegetation (cattle grazing)	Document seed mix, purity information, planting timing, seed application rates and areas
RM8	Revegetation (woodland habitat)	Document seed mix, purity information, planting timing, seed application rates and areas
RM9	Revegetation (watercourse)	Document seed mix, purity information, planting timing, seed application rates and areas
RM10	Achievement of surface requirements (cattle grazing)	Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5
RM11	Achievement of surface requirements (woodland habitat)	Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5
RM12	Achievement of surface requirements (watercourse)	Rehabilitation monitoring as per Sections 8.1, 8.3 and 8.5
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA13, RA14, RA16)	- Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5 - Hazard assessment - Contaminated land verification report
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA12, RA15)	- Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5 - Hazard assessment - Landform geotechnical FoS certification
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2)	- Rehabilitation monitoring as per Sections 8.1, 8.3 and 8.5 - Hazard assessment
RM17	Achievement of post-mining land use to a stable condition (cattle grazing, existing rehabilitation – RA7, RA17)	- Rehabilitation monitoring as per Section 8.1 and 8.2 - Hazard assessment
RM18	Achievement of post-mining land use to a stable condition (woodland habitat, existing rehabilitation – RA10, RA18)	- Rehabilitation monitoring as per Section 8.1 and 8.2 - Hazard assessment

8.1.1 Remote sensing and technology

The current rehabilitation monitoring program utilises the capture and analysis of field data. Future advances in monitoring could include developments in remote sensing, technology and/or digital data capture which may be incorporated into the program, wherever practical.

8.1.2 Erosion monitoring

Erosion monitoring will be conducted for all PMLUs at the frequencies in Table 65 and Table 69, and will support achievement of surface requirements (RM10 – RM12) and the PMLU to a stable condition (RM13 – RM15, RM17, RM18).

There is no consensus in Australia on a quantitative or precise definition of what constitutes minor, moderate and/or severe erosion (CSIRO, 2009). For this reason, the best approach to assess the state and severity of erosion is by an AQP during monitoring.

Sheet, rill or gully erosion classified as severe according to the Australian soil and land survey field handbook (CSIRO, 2009) will be remediated (Table 64). All minor or moderate erosion, plus other erosion types, such as tunnel erosion, will be assessed by an AQP and will be remediated if assessed as requiring intervention to ensure the PMLU is achieved. This ensures the erosion is assessed holistically, such as to ensure remediation will not cause more damage, instead of a purely quantitative assessment. Additional criteria has been proposed for gully erosion as this is considered the major erosion risk to achievement of a PMLU to a stable condition:

- Gullies do not exceed 1m in depth at any point
- Gullies do not expose geochemically problematic materials
- The cause of the gully is known and has been resolved
- Gullies have established and persistent vegetation cover at the head of the gullies
- Gullies are stabilised

The rehabilitation milestones for the achievement of PMLU to a stable condition also require a safety hazard assessment to be completed, which also ensures any erosion that is a safety hazard is remediated. SSM plan to develop site-based criteria to assess erosion within five years of the commencement of this PRCP.

Table 64: Erosion classifications

Erosion*	Minor	Moderate	Severe
Sheet erosion	Indicators may include shallow soil deposits in downslope sediment traps (fencelines, farm dams). Often very difficult to assess as evidence may be lost with cultivation, pedoturbation or revegetation.	Indicators may include partial exposure of roots, moderate soil deposits in downslope sediment traps (fencelines, farm dams)	Indicators may include loss of surface horizons, exposure of subsoil horizons, pedestalling, root exposure, substantial soil deposits in downslope sediment traps (fencelines, farm dams)
Rill erosion	Occasional rills	Common rills	Numerous rills forming corrugated ground surface
Gully erosion	Gullies are isolated, linear, discontinuous and restricted to primary or minor drainage lines	Gullies are linear, continuous and restricted to primary and minor drainage lines	Gullies are continuous or discontinuous and either tend to branch away from primary

**Erosion classification definitions (CSIRO, 2009)*

8.2 Cattle grazing and woodland habitat monitoring

8.2.1 Monitoring schedule

The rehabilitation monitoring program follows a phased approach as detailed in Table 65. Initial monitoring is undertaken on an annual basis for the first three years to primarily assess vegetation establishment and achieving initial surface requirements (RM10 and RM11). This approach allows a timely assessment of the performance of rehabilitation post initial seeding and provides critical information to determine if rehabilitation is on track towards achieving surface requirements, or if maintenance is required.

Additional rehabilitation parameters are included into the monitoring program in years three, five, 10 and five-yearly thereafter, to assess and track achievement of surface requirements (RM10 and RM11) and achievement of PMLU to a stable condition (RM13, RM14, RM17 and RM18). The phased approach of the monitoring program enables regular analysis of rehabilitation monitoring data, including multi-year comparison of trends.

Monitoring of cattle grazing and woodland habitat reference sites will be undertaken for the parameters listed in Table 65 and will be implemented as per the monitoring schedule from Year 3.

Table 65: Cattle grazing and woodland habitat PMLU monitoring schedule and measured rehabilitation parameters

Rehabilitation parameter	Monitoring schedule				
	Year 1	Year 2	Year 3	Year 5	Year 10+ (5-yearly thereafter)
Cattle grazing and woodland habitat PMLUs					
Landform and erosion	✓	✓	✓	✓	✓
Soil and spoil	✓	-	✓	✓	✓
Cattle grazing PMLU					
Groundcover	✓	✓	✓	✓	✓
Invasive plants	✓	✓	✓	✓	✓
Grazing land suitability assessment	✓	-	✓	✓	✓
Land condition	-	-	✓	✓	✓
Pasture condition	-	-	✓	✓	✓
Woodland habitat PMLU					
Groundcover (including native perennial grass cover, little cover, non-native plant cover)	✓	✓	✓	✓	✓
Species richness (trees, shrubs, grass, forbs/other)	✓	✓	✓	✓	✓
Tree height	-	-	✓	✓	✓
Tree canopy and shrub layer cover	-	-	✓	✓	✓

Rehabilitation parameter	Monitoring schedule				
	Year 1	Year 2	Year 3	Year 5	Year 10+ (5-yearly thereafter)
Recruitment	-	-	✓	✓	✓
Invasive species	✓	✓	✓	✓	✓
Tree stem count/basal area	-	-	✓	✓	✓

8.2.2 Rehabilitation monitoring sites

Permanent rehabilitation monitoring sites will be established as part of the initial rehabilitation monitoring (Year 1) and will be assessed during all phases of rehabilitation monitoring. The permanent field monitoring sites should be selected using the following criteria:

- Representative of rehabilitation slope
- Accessible (vehicle access preferred)

Selection of suitable reference sites for cattle grazing, woodland habitat and watercourse PMLUs are discussed in Section 8.4.

8.2.3 General rehabilitation monitoring parameters

8.2.3.1 Landform and erosion

Landform and erosion will be assessed as part of all monitoring phases (Table 65). Prior to commencing the field monitoring work, a desktop assessment using LiDAR data and aerial imagery will be completed to assess the rehabilitated slope against the landform design (Year 1), and the ongoing monitoring of the landform and slopes.

The desktop analysis will identify potential areas of major ponding due to dump settlement, areas of deposition (where the ground level has increased over time), as well as the progression of erosion features such as developing gullies.

Field-based erosion monitoring will be conducted at the permanent monitoring sites, as well as any new areas identified in the desktop assessment. If erosion is present, an erosion monitoring transect will be established by running a 50m tape perpendicular to the slope and across the erosional activity identified by the LiDAR analysis. Erosion will be assessed based on the classifications in Section 8.1.2.

8.2.3.2 Soil and spoil

The parameters detailed in Table 66 will be analysed during all monitoring events for soils and spoils. Soil profile pits or cores will be located within close proximity to the permanent rehabilitation monitoring sites. Surface sampling depth refers to top 0 – 10cm; and sub-surface sampling depth refers to layers at 10 – 30cm, 30 – 60cm and 90 – 100cm.

Table 66: Soil and spoil analysis parameters for rehabilitation monitoring

Category	Analyte	Purpose of analyte	Depth	
			Surface	Sub-surface
Acidity / alkalinity	pH	Identify anomalies that may affect plant growth and sustainability	✓	✓

Category	Analyte	Purpose of analyte	Depth	
			Surface	Sub-surface
Salinity	EC	Identify leaching profile. High salinity can lead to poor vegetation germination and establishment, reduced plant growth and vigour	✓	✓
Exchangeable cations	CEC	Major factor in soil fertility. Controls soil stability, nutrient availability and buffers soil's chemical properties	✓	✓
	Exchangeable Sodium Percentage (ESP)	ESP is a measure of the dominance of sodium ions on the soil's cation exchange complex. Sodicity in soils can lead to slaking and dispersion which impact soil structure and stability	✓	✓
Organic matter	Organic carbon	An indicator of soil nutrient stores and a contributor to improvements in soil structure. Increases in organic carbon is a key indicator of rehabilitation success	✓	-
Major elements	Total Nitrogen	Indicator of soil nutrient store and is also a major plant nutrient	✓	-
	Extractable Phosphorous (Colwell method)	Indicator of phosphorous readily available to plants	✓	-
	Total Phosphorous	Indicator of total store of phosphorous, some of which is readily available. Key indicator of potential for long-term success or failure of rehabilitation	✓	-

8.2.4 Cattle grazing specific rehabilitation parameters

8.2.4.1 Groundcover

Groundcover will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring events. Groundcover type is recorded as either live cover (with species recorded), standing dry cover, organic litter (including leaves, hay and woody debris (i.e., logs or dead timber)), rocks, or bare ground. The percentage of total groundcover (anything in contact with the soil surface) is calculated.

8.2.4.2 Invasive plants

An invasive plant is a prohibited or restricted matter under the Queensland *Biosecurity Act 2014*, and is defined as a species that has, or is likely to have an adverse impact on a biosecurity consideration because of the introduction, spread or increase in population size of the species in an area. Prohibited invasive plants are currently not present or known to be present in Queensland and have therefore been excluded from any proposed criteria. A complete list of invasive plant species is listed in Schedule 2, Part 2 (Restricted matter – invasive biosecurity matter) of the *Biosecurity Act 2014*.

'Restricted' invasive plants will be assessed at the permanent rehabilitation monitoring sites and reference sites as part of all monitoring phases. The presence and percent cover of invasive plants, calculated as a percentage of the total vegetation cover, will be recorded at each site.

Leucaena is an acceptable species within a grazing PMLU with existing transitional EA milestone criteria applied for planned cattle grazing.

8.2.4.3 Grazing land suitability assessment

Land suitability class (Section 3.1.1) is assessed at Year 1 to determine the effectiveness of ameliorants or if further treatments are required. Ongoing land suitability assessments will be undertaken at the permanent rehabilitation monitoring sites as part of all monitoring events from Year 3. The land suitability will be rated class 1 to 5 as per the limitations in *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin: Technical Paper 1* (Short, 2023) (Table 26).

8.2.4.4 Land condition

Grazing Land Management ABCD land condition will be assessed at the permanent cattle grazing rehabilitation monitoring sites from Year 3. This allows at least two seasons after seeding for pasture species to establish. Land condition will be assessed and rated Good (A), Fair (B), Poor (C) or Degraded (D) as described in the *Queensland Reef Protection Regulations Farming in Reef Catchments Grazing Guide* (DES, 2022a) (Table 27).

8.2.4.5 Pasture condition

Pasture condition will be assessed at the permanent rehabilitation monitoring sites from Year 3. The density and coverage of 3P grasses is a key indicator of pasture condition (DES, 2022a). Pasture condition monitoring will be undertaken in accordance with the Stocktake GLM method (Department of Agriculture and Fisheries, 2021). The assessment includes an estimate of the percentage dry matter yield in kg/ha comprised of 3P pasture species versus the percentage dry matter yield in kg/ha of annual and undesirable grasses. Based on the monitoring data, pasture condition will be rated as per the condition indicators in Table 67.

Table 67: Pasture condition assessment table

Condition rating	Condition indicators			
	Preferred pasture species		Annual grass dry matter yield (%)	Undesirable grasses and other weeds dry matter yield (%)
	Dry matter yield (%)	Crown cover		
Excellent (A) - 1	>80	Dense and plants healthy	<20	<20
Good (B) - 2	60 – 80	High to moderate density and some plants unhealthy	20 – 39	20 – 29
Poor (C) - 3	10 – 59	Moderate to low density and some plants dead	40 – 70	30 – 80
Very poor (D) - 4	<10	Sparse and many plants dead	>70	>80

8.2.5 Woodland habitat specific rehabilitation parameters

The rehabilitation monitoring parameters for monitoring all woodland habitat areas are consistent with the Queensland Biodiversity and Ecology Information System tertiary level assessment, as recommended for monitoring hybrid native ecosystems in the OQMRC *Evaluating methods for assessing native ecosystem mine rehabilitation success – Technical Paper* (Spain, Nuske, & Gagen, 2023). The monitoring method for future woodland habitat rehabilitation (RA1, RA4, RA12 and RA15) will be a modified *BioCondition – A condition assessment framework for terrestrial biodiversity in Queensland assessment manual, version 2.2* (BioCondition Assessment Manual) (Eyre, et al., 2015). The applicable site-based attributes will be assessed and recorded. The BioCondition Assessment Manual scoring tables will be used to determine the site-based attribute scores, whereby the 'benchmarks' in the scoring refers to the combined representative REs averaged benchmarks detailed in Table 68 (noting the representative REs are as per Section 1.2.8 and the revegetation objectives in Section 6.1.8.1). The applicable site-based attributes have a maximum possible site score of 60.

The modified BioCondition Assessment Manual method will involve reducing the length of the transect when assessing some parameters (e.g. tree canopy and shrub layer cover).

Table 68: BioCondition benchmarks and scoring of site-based attributes for representative regional ecosystems

Representative REs	Maximum Score for Attributes	Benchmark*				Combined REs
		RE 11.4.2	RE 11.5.2	RE 11.5.3	RE 11.10.7	Averaged Benchmark
Recruitment of dominate canopy species (%)	5	100	100	100	100	100
Native plant species richness - trees (#)	5	4	5	6	6	5
Native plant species richness - shrubs (#)	5	5	10	6	6	7
Native plant species richness - grasses (#)	5	8	9	6	7	8
Native plant species richness - forbs/other (#)	5	7	16	10	9	11
Tree canopy height (m)	5	20	20	16	18	19
Tree canopy cover (%)	5	25	24	20	40	27
Shrub layer cover (%)	5	13	7	3	8	8
Native perennial grass cover (%)	5	16	38	19	20	23
Litter cover (%)	5	30	25	20	53	32
Non-native plant cover (%)	10	0	0	0	0	0
Maximum Site Score	60					

* Benchmarks for each applicable site-based attribute for each RE (State of Queensland, 2024)

8.2.5.1 Groundcover

Groundcover will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring events. The percentage of total groundcover (anything in contact with the soil surface) is calculated.

For groundcover, the following BioCondition site-based attributes will be assessed and recorded (noting the total sum of cover will equal 100%):

- Native groundcover (shrubs, grasses and forbs)
- Non-native plant groundcover
- Organic litter (fine and coarse organic material, such as fallen leaves, twigs and branches)
- Rock
- Bare ground

8.2.5.2 Species richness

All woody species are recorded for each survey plot. Species richness will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring phases. Species richness includes a full floristic

assessment and count of trees, shrubs, grasses (native and exotic), and forbs and other ground species at each site.

8.2.5.3 Tree height

Tree height and height range will be assessed at the permanent rehabilitation monitoring sites from Year 3. Tree height (measured to the top of the highest leaves) refers to the median canopy height for trees in the canopy layer (Eyre, et al., 2015).

8.2.5.4 Tree canopy and shrub layer cover

Tree canopy cover and shrub layer cover will be assessed at the permanent rehabilitation monitoring sites from Year 3 using the line intercept method. The crown of each tree (single-stemmed woody plant greater than 2m tall) and the crown of each shrub (woody plant that is multi-stemmed from the base (or within 200mm from ground level) or if single stemmed, less than 2m tall) (Eyre, et al., 2015) is recorded and summed as a total tree canopy or shrub distance and converted to a percent cover at each monitoring site.

8.2.5.5 Recruitment

Recruitment will be assessed at the permanent rehabilitation monitoring sites from Year 3. Recruitment of canopy species is assessed by observing the proportion of the species in the ecological dominant layer regenerating (<5cm diameter at breast height) at each monitoring site.

8.2.5.6 Invasive plants

'Restricted' invasive plants will be assessed at the permanent rehabilitation monitoring sites and reference sites as part of all monitoring phases. The presence and percent cover of invasive plants, calculated as a percentage of the total vegetation cover, will be recorded at each site.

8.2.5.7 Tree stem count/basal area

Tree stem count provides another measure of species' abundance which helps describe the vegetation community. The tree stem count records the number of individual trees in a 50m x 10m plot by species. A tree that branches into two or more stems 30cm above the ground is counted as one individual (Neldner, 2022).

Basal area is recorded by species using a single sweep of a Bitterlich stick or similar with basal area factor of 1 from the centre of the plot (Neldner, 2022).

8.3 Watercourse monitoring

Watercourse monitoring will be conducted at SSM to assess the performance of diversions and rehabilitated watercourses disturbed by mining activities. The purpose of the monitoring is to assess the performance of the rehabilitated watercourses in achieving watercourse surface requirements (RM12) and achievement of post-mining land use to a stable condition (RM15).

Watercourse monitoring will be undertaken in accordance with the IDC methodology which is outlined in the *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A, 2001). The IDC is a quantitative monitoring method used to measure the geomorphic and riparian vegetation condition of creek diversions; however, it can be utilised for both diverted and rehabilitated reaches of watercourses. For rehabilitated watercourse reaches which are not diversions (such as where culverts are removed), a modified IDC method, with a reduced number of monitoring points within each reach, is required due to the reduced impact area.

The SSM watercourse monitoring schedule is detailed in Table 69. The monitoring schedule indicates the IDC parameters measured over time from Year 1, Year 2, Year 5 and then 5 yearly thereafter.

The IDC methodology encompasses:

- Visual inspection of the diversion/rehabilitated watercourse and upstream and downstream reaches (i.e. reference sites)
- Assessment of geomorphic index and riparian vegetation index at nominated monitoring points within the diversion/rehabilitated watercourse, upstream and downstream reaches

- Determination of reach-averaged geomorphic index and riparian vegetation index and overall IDC scores for the diversion/rehabilitated watercourse, upstream and downstream reaches
- Comparison of the geomorphic index and riparian vegetation index and overall IDC scores for the diversion/rehabilitated watercourse reaches to the relative upstream and downstream reaches

In addition to the IDC index parameters, several other parameters will also be monitored as listed in Table 69.

Table 69: Watercourse PMLU monitoring schedule and measured rehabilitation parameters

Monitoring parameters		Monitoring schedule			
Parameter	Monitoring detail	Year 1	Year 2	Year 5	Year 10+ (5-yearly thereafter)
Geomorphic index parameters					
Stream width	Width of high flow channel (m) Width of active channel (m) Width of low flow channel (m)	✓	✓	✓	✓
Bank condition	Presence of erosion	✓	✓	✓	✓
Piping of banks	Presence of piping on the banks	✓	✓	✓	✓
Bed condition	Presence of aggradation or degradation within the channel bed	✓	✓	✓	✓
Spoil piles	Proximity of spoil dumps in relation to the monitoring point	✓	✓	✓	✓
Recovery	Presence or absence of benches with/ without vegetation	✓	✓	✓	✓
Instream structures	Stability of each identified instream structure	✓	✓	✓	✓
Riparian index parameters					
Riparian zone	Width of riparian zone (m)	✓	✓	✓	✓
Structural intactness	Over-storey, understorey and ground cover (% density)	✓	✓	✓	✓
Regeneration	Presence or absence of regeneration on banks	-	✓	✓	✓
Longitudinal continuity	Assess the gaps in the riparian vegetation corridor along the banks	✓	✓	✓	✓
Additional parameters					
Erosion	Assessment of sheet, rill, gully, tunnel and mass movement	✓	✓	✓	✓
Groundcover	Groundcover (%)	✓	✓	✓	✓
Species richness - trees and shrubs	Native plant species richness for life-forms trees and shrubs	✓	✓	✓	✓

Monitoring parameters		Monitoring schedule			
Parameter	Monitoring detail	Year 1	Year 2	Year 5	Year 10+ (5-yearly thereafter)
Tree canopy cover	Native tree canopy cover (%)	-	-	✓	✓
Tree canopy height	Tree median canopy height (m) for ecologically dominant layer or canopy layer	-	-	✓	✓
Recruitment of woody perennial species	Recruitment of woody perennial species in ecological dominant layer	-	-	✓	✓

8.4 Reference Sites

8.4.1 Cattle grazing reference sites

Cattle grazing reference sites have been established at the locations shown in Figure 22. The reference sites were monitored in 2024 and will continue to be monitored in accordance with the cattle grazing monitoring requirements outlined in Section 8.2. Existing cattle grazing reference site results have been summarised in Table 70. Additional or alternative cattle grazing reference sites may be established in the future. Land suitability classes for the cattle grazing reference sites were assessed against the land suitability framework (Short, 2023).

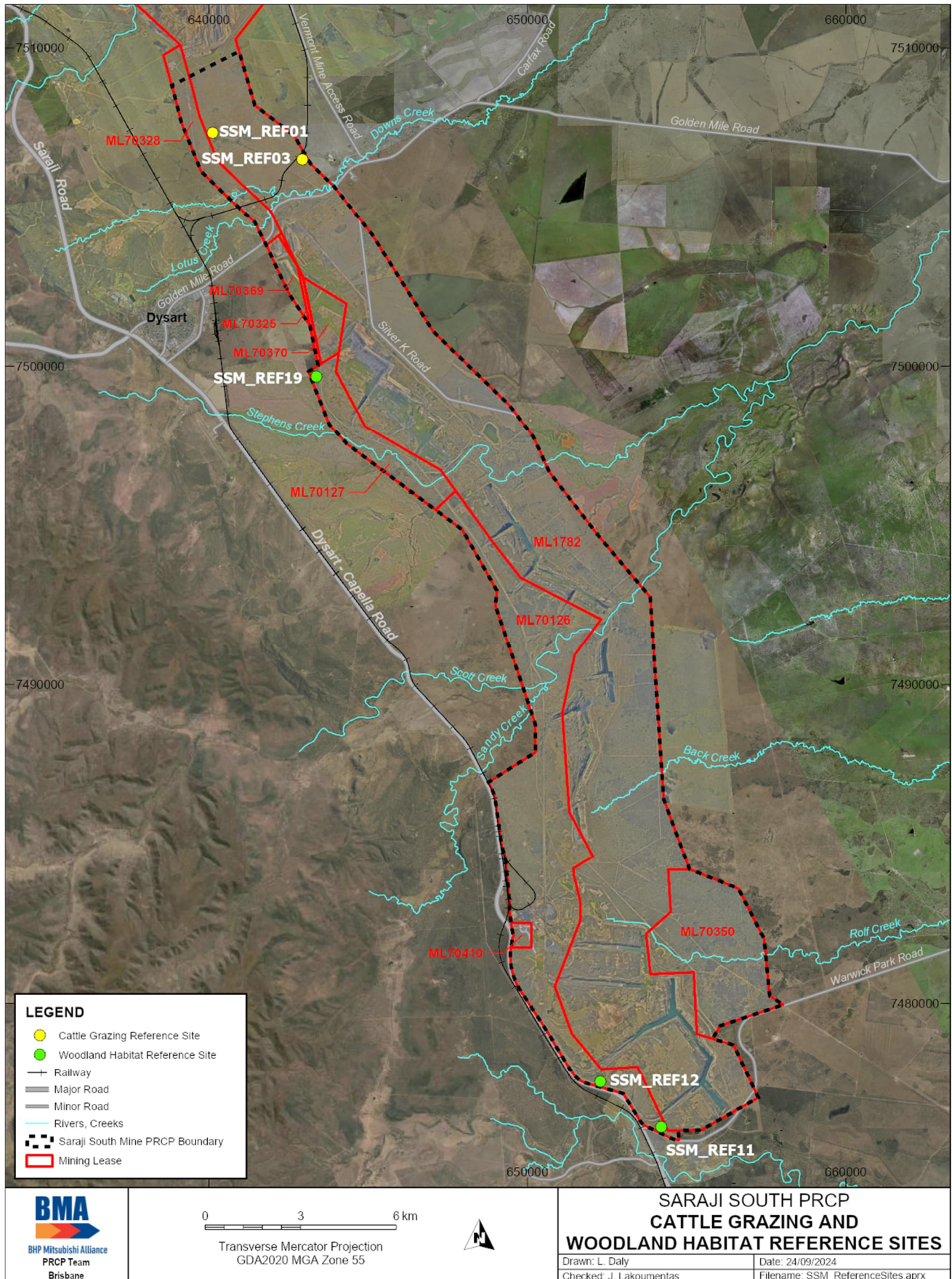


Figure 22: SSM cattle grazing and woodland habitat reference sites

Table 70: SSM cattle grazing reference sites

Site ID	SSM_REF01	SSM_REF03
Image		
Coordinates (MGA2020 Zone 55)	640116 E, 7507340 N	642924 E, 7506500 N
Mean slope (%)	<2	<2
Total groundcover (%)	94	100
Native grass Species	<i>Heteropogon contortus</i> (black spear grass) (3P), <i>Bothriochloa bladhii</i> (forest bluegrass) (3P)	<i>Heteropogon contortus</i> (black spear grass) (3P)
Exotic grass Species	<i>Setaria incrassata</i> (purple pigeon grass*) (3P)	<i>Bothriochloa pertusa</i> (Indian couch*) (2P)
Tree species	<i>Casuarina cristata</i> (belah), <i>Terminalia oblongata</i> (yellowwood)	<i>Atalaya hemiglauca</i> (whitewood)
Shrub species	<i>Capparis lasiantha</i> , <i>Carissa ovata</i> (currant bush)	<i>Acacia farnesiana</i> (prickly mimosa bush*)
Invasive plants	Not present	<i>Parthenium hysterophorus</i> (parthenium*)
Dry matter yield (kg/ha)	3,500	2,000
Land Condition	Good (A)	Poor (C)

*Exotic species

8.4.2 Woodland habitat reference sites

Woodland habitat reference sites have been established in areas of remnant vegetation undisturbed by mining as shown in Figure 22. The reference sites were monitored in 2023, and will continue to be monitored, in accordance with the woodland habitat monitoring requirements outlined in Section 8.2. A summary of existing woodland habitat reference site results on SSM have been provided in Table 71. Additional or alternative woodland habitat reference sites may be established in the future.

Table 71: SSM woodland habitat reference sites

Site ID	SSM_REF11	SSM_REF12	SSM_REF19
Image			
Coordinates (MGA2020 Zone 55)	654200 E, 7476115 N	652300 E, 7477532 N	643371 E, 7499674 N
Mean slope (%)	< 2	< 3	< 3
Regional ecosystem	11.4.2	11.5.3	11.4.2
Total groundcover (%)	100	91	89
Tree canopy cover (%)	34.6	66.6	17
Tree species	<i>Eucalyptus melanophloia</i> (silver leaved ironbark), <i>Corymbia erythrophloia</i> (red bloodwood), <i>Corymbia tessellaris</i> (Moreton Bay ash), <i>Corymbia dallachiana</i> (Dallachys gum)	<i>Eucalyptus populnea</i> (poplar box), <i>Atalaya hemiglauc</i> a (whitewood), <i>Bursaria incana</i> (prickly pine), <i>Acacia harpophylla</i> (brigalow), <i>Alphitonia excelsa</i> (soap ash), <i>Acacia excelsa</i> (ironwood), <i>Casuarina cristata</i> (belah)	<i>Eucalyptus orgadophila</i> (mountain coolibah), <i>Terminalia oblongata</i> (yellowwood)
Evidence of recruitment	Yes	Yes	Yes

Site ID	SSM_REF11	SSM_REF12	SSM_REF19
Shrub species	<i>antulum lanceolatum</i> (sandalwood), <i>Carissa ovata</i> (currant bush), <i>Atalaya hemiglauc</i> (whitewood), <i>Psydrax oleifolia</i> (psydrax), <i>Citrus glauca</i> (native lime bush), <i>Acacia farnesiana</i> (prickly mimosa bush*), <i>Capparis arborea</i> (brush caper berry), <i>Capparis lasiantha</i> , <i>Eremophila mitchellii</i> (false sandalwood)	<i>Psydrax oleifolia</i> (psydrax), <i>Owenia acidula</i> (emu apple), <i>Carissa ovata</i> (currant bush), <i>Dodonaea viscosa</i> (hopbush), <i>Alectryon diversifolius</i> (holly bush), <i>Eremophila mitchellii</i> (false sandalwood), <i>Flindersia dissosperma</i> (scrub leopardwood), <i>Capparis canescens</i> , <i>Breynia oblongifolia</i> , <i>Acacia salicina</i> (sally wattle), <i>Denhamia cunninghamii</i>	<i>Alectryon oleifolius</i> (boonaree), <i>Carissa ovata</i> (currant bush), <i>Alectryon diversifolius</i> (holly bush), <i>Owenia acidula</i> (emu apple)
Grass species	Native Grasses: <i>Heteropogon contortus</i> (black spear grass), <i>Themeda triandra</i> (kangaroo grass) Exotic Grasses: <i>Bothriochloa pertusa</i> (Indian couch*), <i>Cenchrus ciliaris</i> (buffel grass*)	Native Grasses: <i>Heteropogon contortus</i> (black spear grass), <i>Themeda triandra</i> (kangaroo grass), <i>Enneapogon pallidus</i> (nine awn pale bottle washer), <i>Bothriochloa decipiens</i> (pitted bluegrass) Exotic Grasses: <i>Cenchrus ciliaris</i> (buffel grass*), <i>Megathyrsus maximus</i> var. <i>pubiglumis</i> (green panic*)	Native Grasses: <i>Aristida ramosa</i> (purple wiregrass), <i>Bothriochloa bladhii</i> (forest bluegrass) Exotic Grasses: <i>Cenchrus ciliaris</i> (buffel grass*), <i>Bothriochloa pertusa</i> (Indian couch*)
Invasive plants	<i>Leucaena leucocephala</i> (Leucaena*), <i>Opuntia</i> sp. (tree pear*)	<i>Leucaena leucocephala</i> (Leucaena*), <i>Harrisia martinii</i> (harrisia cactus*)	<i>Opuntia</i> sp. (tree pear*)

*Exotic species

8.4.3 Watercourse reference sites

Watercourse reference sites have been established in the existing diversions associated with Lotus Creek, Downs Creek, Stephens Creek and Rolf Creek diversions as listed in Table 72 and shown in Figure 23. New reference sites will be established following construction and rehabilitation of future surface water diversions. Reference sites will be monitored in accordance with the watercourse monitoring requirements outlined in Section 8.3. Where revegetation is required in a natural watercourse (such as where culverts have been removed), a proportional number of reference sites utilising a modified IDC method (ID&A, 2001) will be established due to the reduced impact areas.

Table 72: SSM watercourse reference site locations

Stream	Reference Type	Location	Easting*	Northing*
Downs Creek	Downstream	DC - D1	643087	7505508
Downs Creek	Downstream	DC - D2	643175	7505460
Downs Creek	Downstream	DC - D3	643255	7505447
Downs Creek	Downstream	DC - D4	643613	7505605
Downs Creek	Upstream	DC - U1	641785	7505474
Downs Creek	Upstream	DC - U2	642043	7505554
Downs Creek	Upstream	DC - U3	641995	7505468
Downs Creek	Upstream	DC - U4	642146	7505342
Lotus Creek	Upstream	LC - U1	641180	7504389
Lotus Creek	Upstream	LC - U2	641540	7504331
Lotus Creek	Upstream	LC - U3	641732	7504431
Lotus Creek	Upstream	LC - U4	641747	7504461
Stephens Creek	Upstream	STC - U1	648771	7497402
Stephens Creek	Upstream	STC - U2	648624	7497248
Stephens Creek	Upstream	STC - U3	648544	7497129
Stephens Creek	Upstream	STC - U4	648598	7496998
Stephens Creek	Downstream	STC - D1	645437	7497149
Stephens Creek	Downstream	STC - D2	645587	7497370
Stephens Creek	Downstream	STC - D3	645829	7497282
Stephens Creek	Downstream	STC - D4	645965	7497089
Scott Creek	Downstream	SCC – HR - D1	650522	7490041
Scott Creek	Downstream	SCC – HR - D2	650595	7490052

Stream	Reference Type	Location	Easting*	Northing*
Scott Creek	Downstream	SCC – HR - D3	650649	7490058
Scott Creek	Upstream	SCC – HR - U1	650222	7489905
Scott Creek	Upstream	SCC – HR - U2	650271	7489930
Scott Creek	Upstream	SCC – HR - U3	650324	7489970
Scott Creek	Upstream	SCC – HR - U4	650367	7490007
Scott Creek	Crossing	SCC - HRCross2	650432	7490027
Sandy Creek	Downstream	SDC – HR - D1	650586	7489822
Sandy Creek	Downstream	SDC – HR - D2	650567	7489915
Sandy Creek	Upstream	SDC – HR - U1	650366	7489676
Sandy Creek	Upstream	SDC – HR - U2	650379	7489715
Sandy Creek	Upstream	SDC – HR - U3	650392	7489760
Sandy Creek	Upstream	SDC – HR - U4	650405	7489799
Sandy Creek	Crossing	SDC - HRCross1	650455	7489860
Rolf Creek	Downstream	RC - D1	654987	7481312
Rolf Creek	Downstream	RC - D2	655178	7481530
Rolf Creek	Downstream	RC - D3	655417	7481559
Rolf Creek	Downstream	RC - D4	655616	7481415

*MGA2020 Zone 55

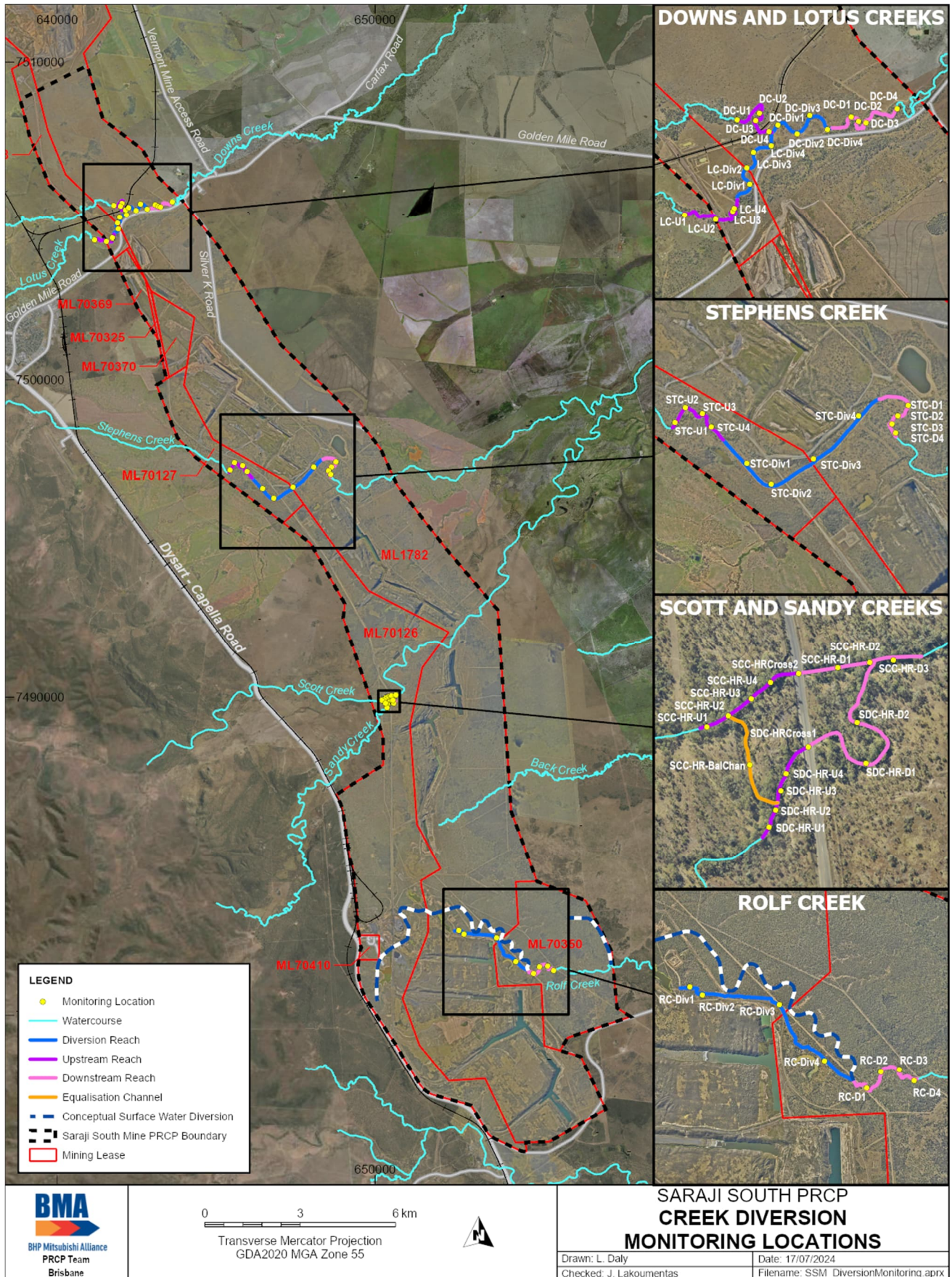


Figure 23: SSM creek diversion monitoring locations

8.5 Surface water monitoring

Surface water runoff monitoring will be undertaken for:

- Representative areas of rehabilitation as part of surface requirements (RM10 – RM12) and to demonstrate achievement of PMLU to a stable condition (RM13 – RM15) within areas of rehabilitation commenced post approval of this transitional PRCP; and
- Watercourse locations included in Table 73, commencing prior to the completion of surface preparation (RM4 – RM6) works for the entire site.

The surface water monitoring data currently held for the site has been collected for a variety of purposes, for which different sampling methodologies and data quality objectives were applied, and therefore, this data is not suitable for the development of site-specific criteria. Also, as per ANZG (2018), the default guideline values are for generic applications and may not be representative of local conditions, and therefore are not suitable for use as water quality limits for a specific mine site. The execution of scopes for the collection of appropriate data sets to support the development of site-specific criteria, could not be completed within the transitional PRCP notice timeframes.

Water quality limits should be site-specific and developed through appropriate sampling analytical and quality plans that include data quality objective processes aligned with the intended use of the data. BMA have requested the transitional PRCPs be conditioned to allow the appropriate development of site-specific water quality limits. As the watercourses at SSM are highly ephemeral and do not support baseflows, the establishment of the site-specific water quality limits will be based on the ANZECC guidance for temporary waters (Smith, 2020).

Due to the variability and availability of the stream flows in the target ephemeral watercourses, there is some uncertainty around the timing for completing the establishment of site-specific water quality limits. Depending on the availability of flows with the required watercourses up-stream of the site, it is anticipated the program to develop and implement the site-specific criteria, could take up to 10 years.

Water quality monitoring will be undertaken in accordance with the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy 2009* (DES, 2018).

8.5.1 Rehabilitation area surface water monitoring

Representative areas of rehabilitation will be selected by BMA to conduct surface water monitoring. Representative is defined in the EA as “a sample set that covers the variance in monitoring or other data due to either natural changes or operational phases of the mining activities”. A range of factors including: timing of rehabilitation; PMLU; slope; underlying material type; and surface treatment. The objective of the rehabilitation area surface water sampling is to demonstrate that rehabilitation areas are progressing towards or have achieved a stable condition. The selected rehabilitation areas will be designed and constructed to allow the capture of surface water flows for sampling from the rehabilitated area’s surface, without significant influence from surrounding operational areas. Depending on the nature of the rehabilitation area, the method of surface water collection may vary from area to area. Samples from the selected rehabilitation areas will be collected and analysed for parameters developed for the site-specific surface water quality limits, when suitable runoff occurs and when safe to do so.

Surface water runoff will be collected across representative areas of rehabilitation as part of surface requirements (RM10 – RM12) and achievement of PMLU (RM13 – RM15) for rehabilitation commenced post approval of this transitional PRCP.

8.5.2 Receiving environment surface water monitoring

The collection and analysis of surface water samples from watercourses (Table 73 and Figure 24) will commence, with at least one year of monitoring undertaken, prior to the completion of surface preparation (RM4 – RM6) for the entire site. The objective of the watercourse samples is to facilitate relinquishment of the site through confirming the rehabilitated site is not causing environmental harm through surface water discharges and has generated a stable landform suitable to support the PMLUs.

Surface water quality will be monitored at least once per month when flows at the downstream gauging station record $>1\text{m}^3/\text{s}$ (when safe to collect samples). Due to the ephemeral nature of the watercourses that cross SSM, there are no baseflows to allow for collection of samples on a predetermined schedule, and therefore sampling will be undertaken following rainfall events that generate flows at the downstream gauging station record $>1\text{m}^3/\text{s}$.

The water quality within the watercourses, within the five-year period immediately prior to surrender, will be assessed via the following process:

1. Downstream monitoring results will be compared to the site-specific surface water quality limits (once developed). Where downstream monitoring results are below the surface quality limits, no further actions will be required.
2. Where exceedances of the surface water quality limits are identified at the downstream sample locations, the downstream results will be compared to the upstream results for that monitoring round. Where downstream results are equal to or less than the upstream results, no further actions will be required.
3. Where downstream results are above both the specified water quality limits and the upstream results, an AQP will be engaged to assess the risk to achieving a stable condition. Where risks are determined to be low, no further action will be taken.
4. Where a risk greater than low is identified by the AQP, an assessment of potential environmental harm and any changes or rectification actions to rehabilitation activities will be assessed and implemented.
5. Where environmental harm is identified and/or rectification actions to rehabilitation activities are required, at least five years of further surface water monitoring will be undertaken.

The surface water monitoring locations may be amended as required to account for changes to upstream land uses/stream dynamics or to improve the effectiveness of the monitoring program.

Table 73: Surface water monitoring locations (approximate)

Sample location ID	Easting (MGA2020 Zone 55)	Northing (MGA2020 Zone 55)	Description
Upstream monitoring locations			
SSM PRCP SW01	640805	7505239	Downs Creek – Upstream of the haul road culvert within ML70328.
SSM PRCP SW02	641514	7504376	Lotus Creek – Upstream of haul road adjacent to ML70328 boundary
SSM PRCP SW04	645897	7497234	Stephens Creek – Upstream, adjacent to haul road on ML70127
SSM PRCP SW06	649918	7489892	Scott Creek – Upstream, existing monitoring point UMP1 on ML70126
Downstream monitoring locations			
SSM PRCP SW03	644049	7505860	Downs Creek – Adjacent to Golden Mile Road and down-stream of ML1782
SSM PRCP SW05	650364	7496878	Stephens Creek – Downstream, existing monitoring point DMP2 on ML1782
SSM PRCP SW07	653579	7493065	Scott Creek – Down-stream ML1782 boundary adjacent to overhead power easement.
SSM PRCP SW08	657479	7481525	Rolf Creek – Downstream ML70350 boundary

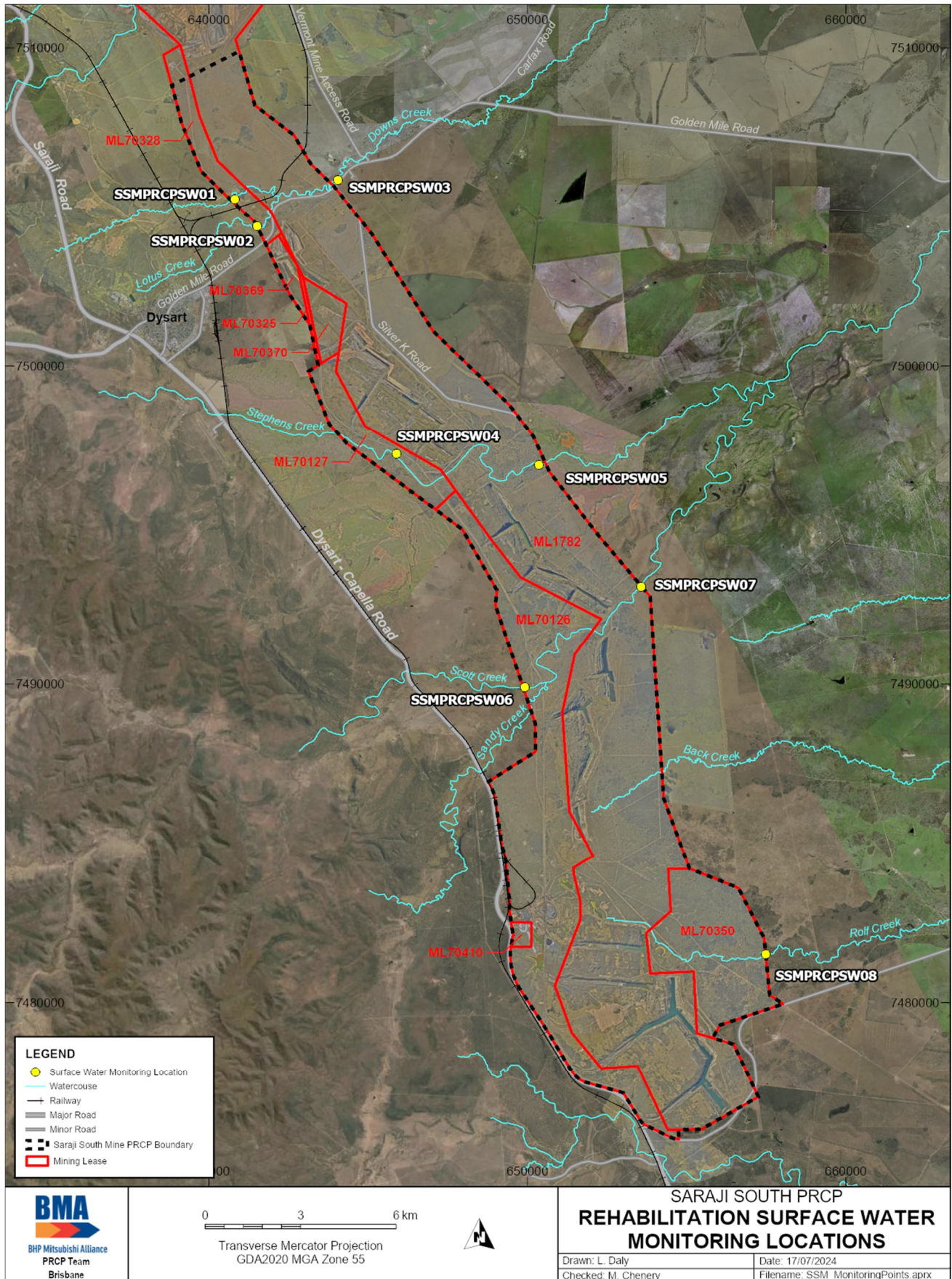


Figure 24: SSM rehabilitation surface water monitoring locations

8.6 Groundwater monitoring

In line with the *Guideline for Progressive certification for resource activities* (DES, 2022b), deep drainage water quality will be “addressed holistically for a site at surrender”. The objective and acceptance criteria for groundwater is not considered relevant to progressive rehabilitation of discrete packages of rehabilitated land due to the scale and nature of groundwater aquifers. Therefore, groundwater monitoring will commence following installation of groundwater bores by 2050.

8.6.1 Groundwater quality

The groundwater monitoring data currently held for the site has been collected for a variety of purposes, for which different sampling methodologies and data quality objectives were applied, and therefore, this data is not suitable for the development of site-specific criteria. Also, as per ANZG (2018), the default guideline values are for generic applications and may not be representative of local conditions, and therefore are not suitable for use as water quality limits. The execution of scopes for the installation of monitoring infrastructure and collection of appropriate data sets to support the development of site-specific criteria, could not be completed within the transitional PRCP notice timeframes.

Water quality limits should be site-specific and developed through appropriate sampling analytical and quality plans that include data quality objective processes aligned with the intended use of the data. BMA have requested the transitional PRCPs are conditioned to allow the appropriate development of site-specific water quality limits.

To allow sufficient time to install required monitoring infrastructure, and collect a reasonable data set of the required quality to support the development of the required site-specific criteria, the development of the criteria is expected to take in the order of 10 years.

Water quality monitoring will be undertaken in accordance with the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy 2009* (DES, 2018).

8.6.2 Groundwater levels

Monitoring of groundwater levels will focus on the relationship between the Permian groundwater level recovery and the residual void lake levels. Groundwater level/gradient trends over time will be assessed against the more dynamic pit lake levels with the data incorporated into the predictive numerical groundwater models. The numerical groundwater models will be used to confirm the residual voids are progressing to a stabilised state, where collectively they will act as a site wide on-going sink for the Permian hosted groundwater and thus minimising the potential for an unacceptable risk of environmental harm off-tenure.

Due to the timeframes involved for the stabilisation of the void lakes and groundwater levels surrounding the mining voids, the intention of the groundwater level monitoring is to show progress towards development of long-term sinks and not to confirm the attainment of long-term sinks. Demonstrating the progress towards development of long-term sinks is to be done through assessment of trends and comparison to groundwater and void lake water balance model predictions by an AQP. The groundwater model and water balance model will be recalibrated and predictions rerun at least every five years commencing from 2050. These updates will incorporate up to date information and confirm the predictions for the residual voids.

8.6.3 Groundwater monitoring schedule

During operations, groundwater monitoring will continue as per the applicable EA conditions.

Following installation of rehabilitation groundwater monitoring bores by 2050, groundwater will be monitored six monthly and compared against the site-specific groundwater quality limits.

8.6.4 Groundwater monitoring locations

Groundwater monitoring to support the assessment of closure conditions will be undertaken on bores that provide a geographical distribution across SSM and coverage of the key hydrogeological units. The groundwater monitoring bore network to assess closure conditions will include selected bores existing at closure and bores installed specifically to close data gaps and to replace bores that may have been lost due to mining disturbances or otherwise are not operational. The groundwater monitoring network to be utilised for assessment of rehabilitation are provided in Table 74 and shown in Figure 25.

The rehabilitation groundwater monitoring bore network may require maintenance or adjustment throughout the monitoring period. Where bores become inoperable or are not producing the required data due to damage to bores, changes in water levels, changes to the catchment or other site-specific circumstances, replacement bores or additional bores may be installed as required.

Table 74: Groundwater monitoring locations (approximate)

Hydro-geologic unit	Sample location ID	Easting (MGA2020 Zone 55)	Northing (MGA2020 Zone 55)	Description	Ground-water quality	Ground-water level
Tertiary – Basalt	NPMMB02_02	649871	7489948	Located adjacent to Scott Creek in the proximity of the western EA boundary	✓	✓
Tertiary/ Alluvial	MB20NPM05A	653474	7493065	Located adjacent to Scott Creek in the proximity of the eastern EA boundary	✓	✓
Permian	MB20NPM06P_R01	653471	7493065	Located adjacent to Scott Creek in the proximity of the eastern EA boundary	✓	✓
Permian – Moranbah Coal Measures D Seam	MBR02A	656146	7478205	To the east of the Roper residual voids and west of the EA boundary	✓	✓
Tertiary	MBR02B	656147	7478199	To the east of the Roper residual voids and west of the EA boundary	✓	✓
Tertiary	NPMMB08_01	650989	7483200	Located to the north of the Roper voids in the proximity of the MIA	✓	✓
Permian – Interburden	NPMMB03_01	650331	7496840	Adjacent to Stephens Creek in the proximity of the eastern EA boundary	✓	✓
Permian – Interburden	NPMMB02_01	649882	7489942	Adjacent to Scott Creek in the proximity of the western EA boundary	✓	✓
Permian – Interburden	MB20NPM07A	656941	7479627	To the east of the Roper residual voids and to the south of East Pit residual voids	✓	✓
Permian – Moranbah Coal Measures H Seam	MB20NPM02P	643393	7505500	Adjacent to Downs Creek and to the north of Lotus/Campbell residual voids.	✓	✓

Hydro-geologic unit	Sample location ID	Easting (MGA2020 Zone 55)	Northing (MGA2020 Zone 55)	Description	Ground-water quality	Ground-water level
Permian – Moranbah Coal Measures H Seam	MB20NPM04P	650340	7496840	Adjacent to Stephens Creek to the north of Gilbert Pit	✓	✓
Permian – Moranbah Coal Measures P Seam	MB20NPM08P	656954	7479627	To the east of the Roper residual voids and to the south of East Pit residual voids	✓	✓
Tertiary	SSM PRCP New Bore 01	650427	7480896	To the west of the Roper spoil Dumps in the proximity of the Murphy Dams to the south of the MIA	✓	✓
Permian – Back Creek Group	SSM PRCP New Bore 02	650437	7480917	To the west of the Roper spoil Dumps in the proximity of the Murphy Dams to the south of the MIA	✓	✓
Permian – Moranbah Coal Measures H/D Seam	SSM PRCP New Bore 03	654090	7482190	Located between the Roper 1 residual void and East Pit residual void	✓	✓
Permian – Moranbah Coal Measures H/D Seam	SSM PRCP New Bore 04	656780	7477042	To the east of Roper 4 in the south-eastern corner of the EA area	✓	✓
Permian – Moranbah Coal Measures H/D Seam	SSM PRCP New Bore 05	645214	7501099	To the east of the Lotus Campbell residual void	✓	✓
Permian – Moranbah Coal Measures H/D Seam	SSM PRCP New Bore 06	653344	7490180	To the east of Price Pit and to the north of Leichardt residual void	✓	✓

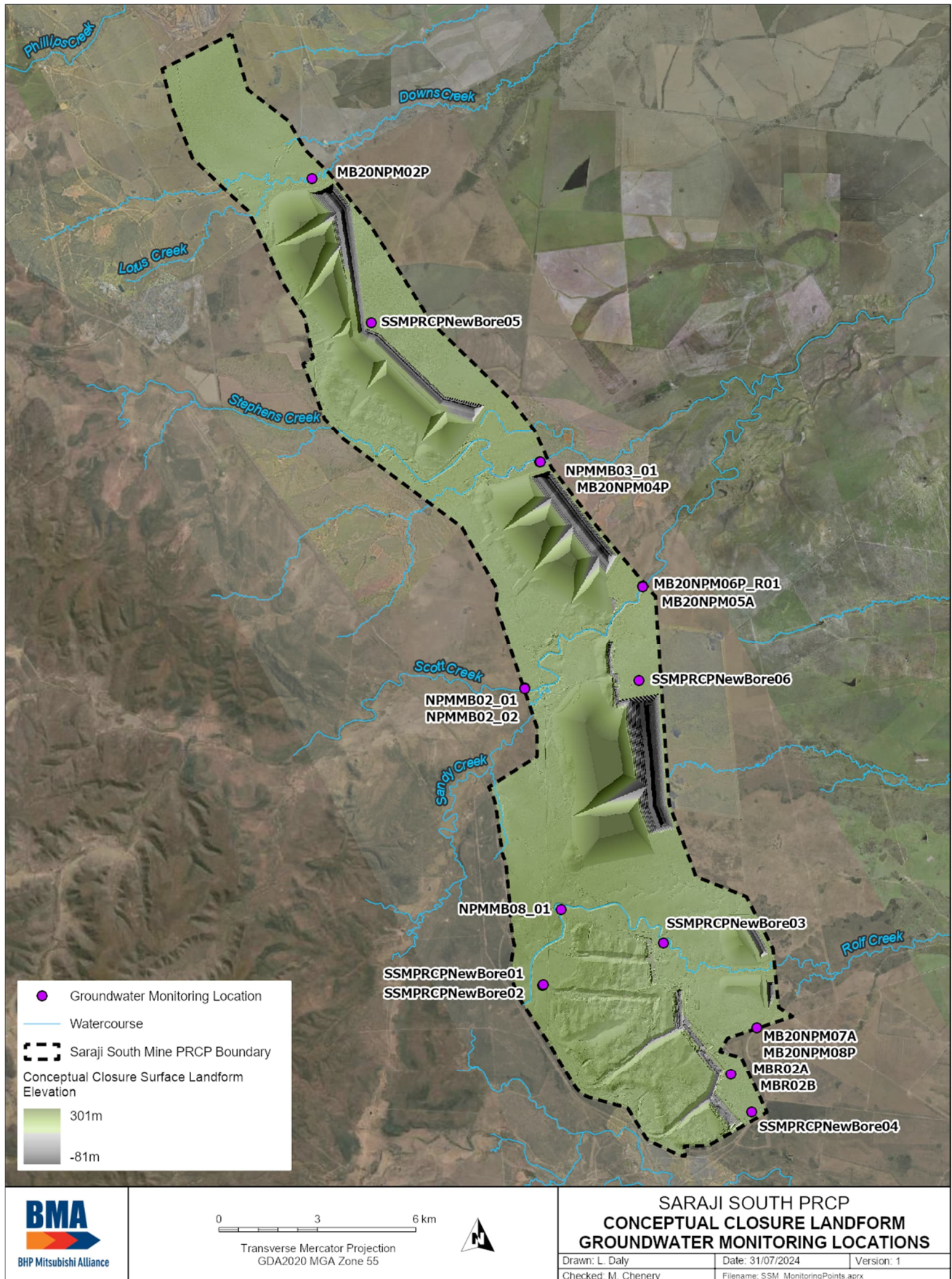


Figure 25: SSM rehabilitation groundwater monitoring bores

8.7 NUMA milestone monitoring

Management milestone (MM) monitoring will be undertaken at SSM by an AQP (as per condition A5 of the EA) to demonstrate achievement of the MMs, as they relate to achieving sufficient improvement of the NUMA extents. The MMs and associated milestone criteria for SSM are detailed in Section 10.5. A combination of monitoring, reporting and data analysis approaches will be used to demonstrate the achievement of the MMs prior to site relinquishment as detailed in Table 75.

Table 75: Management milestones with relevant reporting requirements

MM	Management milestone	Reporting requirements
MM1	Achievement of structural stability	- Final groundwater model and assessment - Final flood model and assessment - Final geotechnical assessment - Final void design - Survey/LiDAR of landform - Analysis of final landform against design
MM2	Achievement of surface requirements	Document visual inspections of safety bund, fencing and signage
MM3	Achievement of sufficient improvement	- Groundwater monitoring (Section 8.6) - Residual voids water quality and level (Section 6.3.5) - AQP certification that residual voids: - Are safe to humans and livestock - Are immune from flooding - Highwall landforms are constructed to final design - Safety infrastructure is installed as per design - Will not present an unacceptable risk of environmental harm outside of the tenure - Will not impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU - Document visual inspections of safety bund, fencing and signage

8.8 Achievement schedule

8.8.1 PMLUs

The timing of the rehabilitation milestones specific to achievement of surface requirements and achievement of cattle grazing, woodland habitat and watercourse PMLUs are listed in Table 76. These timeframes have regard to the risks presented in Section 7.

Achievement of surface requirements for cattle grazing (RM10) is proposed within a 10-year timeframe from revegetation and a further five years for achievement of PMLU to a stable condition for cattle grazing (RM13 and RM17). There are a number of factors which can influence the successful establishment of pastures on post-mined land including landform, soil management and amelioration, species selection, seeding rates and seeding timing, plus rainfall. This will allow for sufficient time to demonstrate the ongoing sustainability of the PMLU for cattle grazing through rehabilitation monitoring data associated with land condition and pastures.

Achievement of surface requirements for woodland habitat (RM11) and watercourse (RM12) are proposed within a 10-year timeframe from revegetation. A further 10 years is allowed for establishment and successional processes and natural recruitment to occur, prior to achievement of the PMLUs to a stable condition (RM14, RM15 and RM18).

Table 76: Time for achievement of surface requirements and PMLUs rehabilitation milestones

RM	Rehabilitation milestone	Milestone achievement time after revegetation (in PRCP schedule)*
RM10	Achievement of surface requirements (cattle grazing)	10-years
RM11	Achievement of surface requirements (woodland habitat)	10-years
RM12	Achievement of surface requirements (watercourse)	10-years
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA13, RA14, RA16)	Up to 15-years
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA12, RA15)	Up to 20-years
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2)	Up to 20-years
RM17	Achievement of post-mining land use to a stable condition (cattle grazing - existing rehabilitation – RA7, RA17)	Up to 15-years
RM18	Achievement of post-mining land use to a stable condition (woodland habitat – existing rehabilitation – RA10, RA18)	Up to 20-years

**Within the Roper area, the existing rehabilitation has an additional 10-year period for the Roper project.*

8.8.2 NUMAs

The timing of the management milestones specific to achievement of sufficient improvement (MM3) is listed in Table 77.

Table 77: Timeline for achievement of sufficient improvement for NUMA management milestones

MM	Management milestone	Milestone achievement timeline (in PRCP schedule)
MM3	Achievement of sufficient improvement	Aligned with achievement of neighbouring PMLUs (RM13, RM14, or RM15) for maximum monitoring period to demonstrate minimising environmental harm

8.9 Data analysis and reporting

Rehabilitation monitoring data will be collected and analysed by an AQP and assessed against the milestone criteria. The data will be analysed to identify changes and trends, as well as map the trajectory of rehabilitation to identify whether it is on track to achieve the milestone criteria or requires corrective actions or maintenance.

The rehabilitation data will be stored and processed within internal geospatial and document management systems.

8.10 Maintenance

Maintenance will be implemented when monitoring identifies issues with the rehabilitation, or when milestone criteria are not being met. In order to select the most appropriate corrective actions, rehabilitation monitoring data will be analysed to identify the likely cause(s). Required maintenance/corrective actions will be entered into the BMA work management system for actioning and record management.

To support ongoing operations, exploration and minor ancillary activities may be required in areas not within a RA in some circumstances (Section 1.4.2). Rehabilitation of these activities will be managed as part of maintenance works and executed as soon as practicable and within at least six months of the completion of the exploration or minor disturbance. Maintenance works may include removing infrastructure, reshaping the area, re-spreading stripped topsoil, applying seed mix aligned to the PMLU, weed control or managing erosion. These rehabilitated areas will be monitored as per Section 8.

8.11 Quality assurance and quality control

The QA/QC process to be followed as part of SSM ongoing rehabilitation monitoring is illustrated in Figure 26. The process provides for initial execution of the rehabilitation in accordance with the rehabilitation plan developed for each area prior to execution, followed by verification of the execution against the rehabilitation plan. Based on the verification outcomes, allowance is made for implementation of corrective actions, as needed. All rehabilitated areas then undergo rehabilitation monitoring; and subsequent execution of maintenance actions identified through the monitoring (Section 8) and improvements to the rehabilitation methodology. This process allows for a repetitive execution-verification-corrective action-monitoring QA/QC approach, to ensure rehabilitation areas progress on a trajectory towards achievement of milestone criteria and eventual certification.



Figure 26: Rehabilitation monitoring QA/QC process

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B: PRCP SCHEDULE

10PRCP SCHEDULE

Legislative Requirement

In accordance with section 126D(1) of the EP Act, the PRCP Schedule in the PRC Plan must:

- a) describe the area of each resource tenure either a post-mining land use or non-use management area, and
- b) for each post-mining land use state:
 - i. each rehabilitation milestone required to achieve a stable condition, and
 - ii. when each rehabilitation milestone is to be achieved, and
- c) for each non-use management area state:
 - i. each management milestone, and
 - ii. when each management milestone is to be achieved, and
- d) include maps showing the land mentioned in (a), (b) and (c).

PRCP Guideline (Section 3.8)

Under section 126C(1)(j) of the EP Act, the administering authority considers monitoring and maintenance necessary to decide if the PRC plan is consistent with the requirements of the legislation. The rehabilitation planning part must contain a monitoring and maintenance program that identifies and describes the monitoring systems that will be carried out in order to demonstrate a milestone and milestone criteria have been achieved. The program must include, where relevant to the milestone and milestone criteria (but is not limited to):

- schedule of monitoring, reporting and review for each milestone
- description of methodologies and standards, which could include field-based assessments and the application of new remote sensing, GIS and other relevant emerging technologies
- monitoring that enables the repeatable collection of relevant statistically valid data
- monitoring using appropriate quality assurance and data management processes and systems
- regular analysis of site data including multi-year comparison trends and bench-marking against analogue/reference sites
- contingency strategies if monitoring data indicates milestone criteria are not being met
- post-closure monitoring to ensure milestone criteria has been demonstrated
- intent of monitoring reports, such as provision of results and key findings

The information requirements in this section will apply to all applicants whether or not they are an existing EA holder. However, existing holders may already have the required information available from previously submitted plans/reports/applications that, if still valid, could be used in the PRC plan. If there has/is any monitoring or maintenance of areas already rehabilitated, details must be included in the PRC plan.

10.1 Final site design

The SSM final site design is provided in Figure 27.

10.2 Reference map

The SSM reference map is provided in Figure 28.

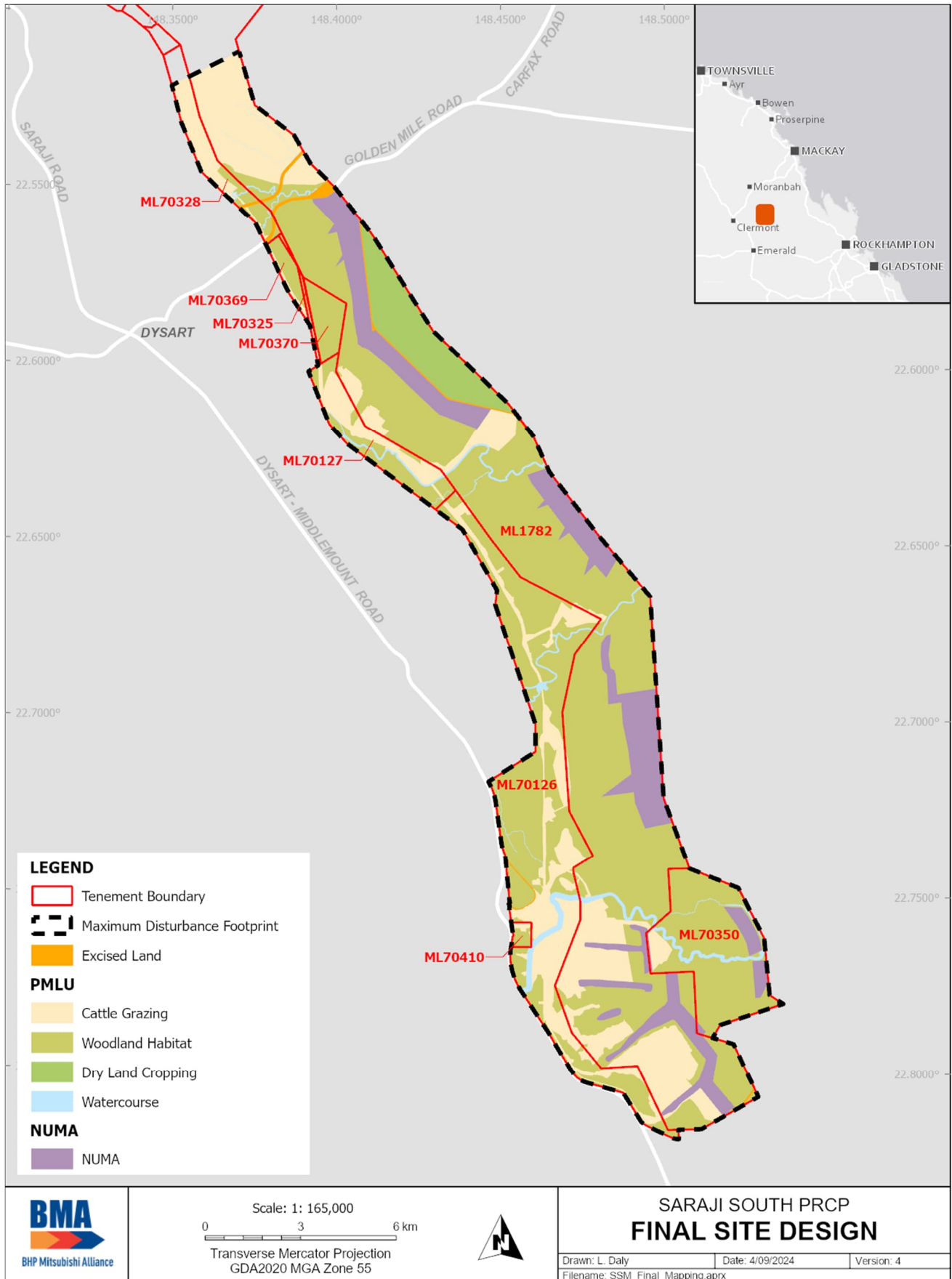


Figure 27: SSM final site design

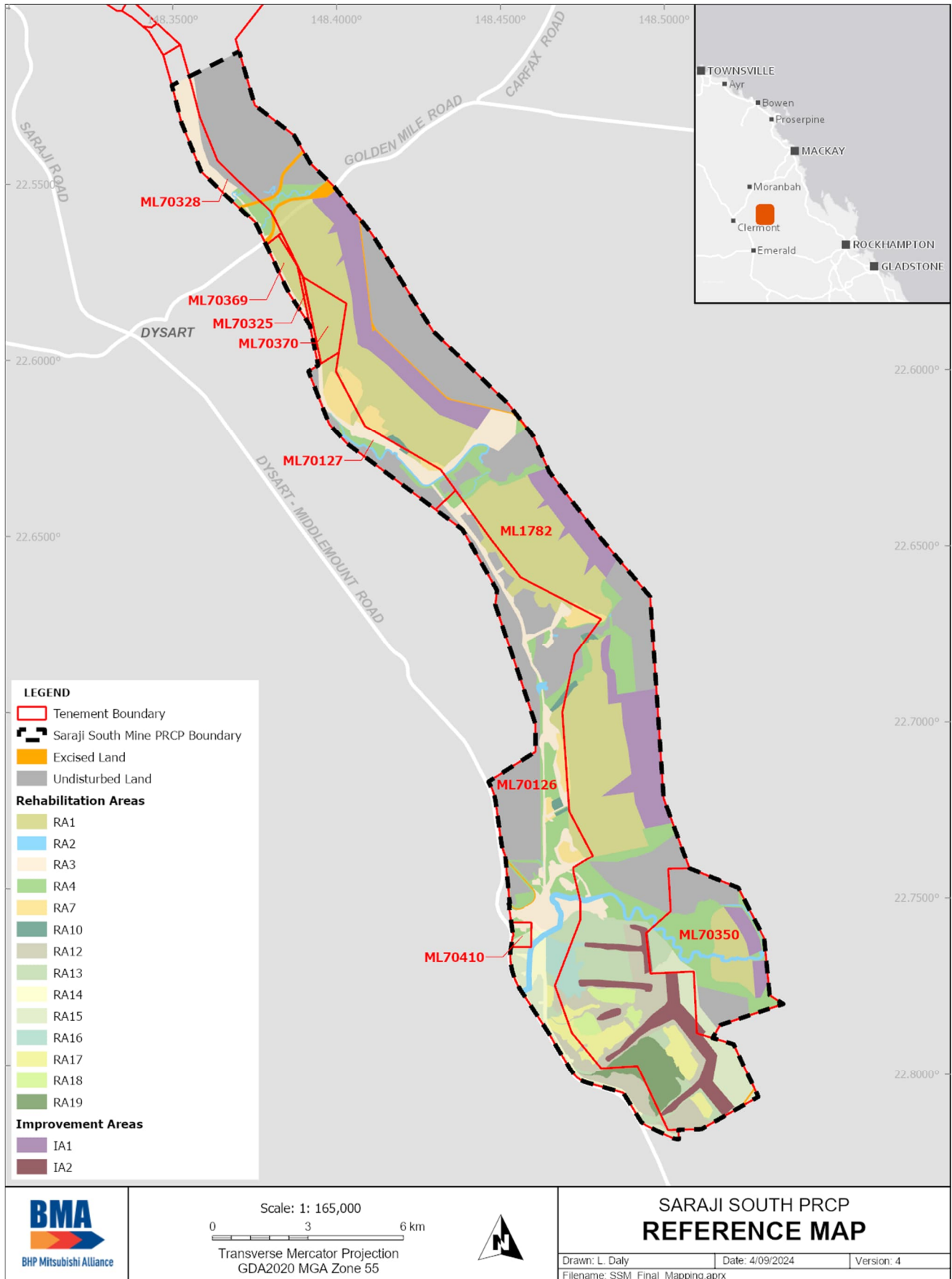


Figure 28: SSM reference map

10.3 Schedule Conditions

The groundwater and surface water conditions for the SSM PRCP are shown in Table 78.

Table 78: SSM PRCP conditions for groundwater and surface water

Condition #	PRCP Condition
PRCP11	With respect to groundwater: a) The monitoring bores listed in Table 74: Groundwater monitoring locations must be installed by 2050; and b) Following monitoring bore installation, groundwater quality must be monitored six monthly at, but not limited to, bores specified in Table 74: Groundwater monitoring locations; and c) The holder must develop site-specific groundwater quality limits for the bores listed in Table 74: Groundwater monitoring locations; and d) The groundwater model and water balance model must be recalibrated and predictions rerun at least every 5 years commencing from 2050.
PRCP12	With respect to groundwater the following must be demonstrated prior to surrender: a) Groundwater quality results for compliance bores have not exceeded the site-specific groundwater quality limits, for 3 consecutive results within the 5-year period immediately prior to surrender; and b) There is no environmental harm beyond the boundaries of the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), and c) Predictive groundwater modelling as per the Australian Groundwater Modelling Guidelines (current version), undertaken at the completion of all mining, confirms the network of residual voids will collectively develop into groundwater sinks and prevent environmental harm through the release of contaminants from the void lakes beyond the tenure boundaries post-closure.
PRCP13	With respect to surface water: a) The holder must install monitoring equipment at the relevant surface water monitoring locations specified in Table 73: Surface water monitoring locations and undertake at least 1 year of surface water quality monitoring prior to the completion of surface preparations for the entire site; and b) Surface water quality must be monitored at the locations specified in Table 73: Surface water monitoring locations at least once per month when flows at the downstream gauging station record 1m³/second, when safe to collect samples; and c) The holder must develop site-specific surface water quality limits for the watercourses listed in Table 73: Surface water monitoring locations.
PRCP14	With respect to surface water the following must be demonstrated prior to surrender: a) Surface water quality must not exceed the site-specific surface water quality limits within the 5-year period immediately prior to surrender; b) If the surface water quality exceeds criteria a), the applicable upstream/reference site must be compared to the downstream site result; and quality result measured at a downstream site must be equal to or less than the quality result measured at the applicable upstream/reference site.
PRCP15	Where the surface water quality at the downstream site exceeds the upstream site result as per PRCP14b), an AQP¹ must complete an assessment of the cause of the exceedance and

Condition #	PRCP Condition
	risk of rehabilitation not achieving a stable condition (PRCP 14) within the schedule timeframe and: a) Where there is a low risk to achieving a stable condition from the mining tenure (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), then no further action is to be taken; or b) Where there is a risk greater than low to achieve a stable condition, then an assessment of potential environment harm and any changes or rectification actions to rehabilitation activities must be determined and implemented.
PRCP16	The assessment/s under PRCP15 must be completed and provided to the administering authority within 3 months of receiving the relevant sampling results.
PRCP17	Despite PRCP14, PRCP15a) can be triggered 3 times over 5 consecutive years prior to surrender.
PRCP18	If PRCP15b) is triggered the 5-year timeframe under PRCP14a) is reset.

10.4 Rehabilitation milestones

The rehabilitation milestones and milestone criteria for SSM are shown in Table 79.

Table 79: SSM rehabilitation milestones and milestone criteria

Milestone reference	Rehabilitation milestone	Milestone criteria
RM0.1	Project ground works	Ground works: a) Investigation and development of plan for large scale leucaena management b) Establish safe access to landforms for data collection and progressive rehabilitation activities.
RM0.2	Project data collection	Progressive ground works and sufficient data collection for modelling: a) Ongoing leucaena management and earthworks b) Drilling and installation of additional groundwater bores and water monitoring c) Drilling and installation of geochemical boreholes and monitoring d) Additional tailings and rejects material testing e) Additional waste characterisation f) Additional tailings geotechnical characterisation g) On-going land contamination investigation.
RM0.3	Project modelling	Updated modelling and landform: a) Flood modelling b) Hydrogeological modelling c) Water balance modelling d) Hydrogeochemical modelling

Milestone reference	Rehabilitation milestone	Milestone criteria
		e) Landform design iterations.
RM0.4	Project designs and plans	Final landform, designs and updated plans: a) Final landform design b) Cover design c) Water management plan d) Void closure plan e) Risk assessment.
RM1	Infrastructure decommissioning and removal	1.1 All infrastructure to be retained onsite must be safe, stable and not cause environmental harm. 1.2 All infrastructure and services to be retained onsite must have a signed landholder statement, declaring that they will accept responsibility for the infrastructure (except for those items in 1.4). 1.3 If the underlying landholder is also the EA holder (or a parent corporation or a subsidiary corporation), consent to retain the infrastructure is required from the administering authority (except for those items in 1.4). In seeking consent the holder must justify how the infrastructure will provide a benefit or improvement to the use of the land and/or community once mining has ceased. 1.4 Below-ground infrastructure, services and waste (as per the Environmental Authority (EPML00865013) waste schedule) deeper than 0.5m in relation to the final landform surface can be retained provided it can meet the following: a) All pipelines have been drained; and b) All below-ground infrastructure (installed after the approval date of this transitional PRCP) to be retained must be mapped; and c) The intended PMLU is not compromised; and d) There is no ongoing risk of environmental harm. 1.5 With the exception of 1.2, 1.3 and 1.4 above, the following are complete: a) All services disconnected, terminated and removed b) All buildings and associated infrastructure dismantled and removed c) All hardstand, concrete areas and roads (bitumen, blue metal, aggregate) removed d) All pipelines drained and removed e) All waste, not authorised under the Environmental Authority (EPML00865013) waste schedule, removed f) All surface water drainage infrastructure removed g) All drillholes, bores, sediment ponds and sumps decommissioned h) All machinery and equipment removed from site i) Mine water dams are decommissioned j) Watercourse crossings and culverts removed.

Milestone reference	Rehabilitation milestone	Milestone criteria
		1.6 Assessment of mine water dams is completed by an AQP¹ and identified sediment and water management actions are completed. ¹Appropriately qualified person (AQP) 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 relating to the subject matter using the relevant protocols, standards, methods or literature
RM2	Remediation and/or management of contaminated land	2.1 Contaminated Land Investigation Document completed in accordance with the <i>Environmental Protection Act 1994</i>, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2.2 The Contaminated Land Investigation Document confirms the area within the mining leases (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) does not present an unacceptable risk to the post-mining land use. 2.3 Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future <i>Environmental Protection Act 1994</i> compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.
RM3	Landform development and reshaping	3.1 Erosion and sediment control systems are installed as per the construction design and verified by an AQP¹. <u>Spoil Dumps (RA1, RA12)</u> 3.3 Landforms are constructed such that there will be no runoff from landform tops onto batter slopes. 3.4 Landforms reshaped with maximum 30% slopes. 3.5 Tertiary spoil to be covered with minimum 1m Permian spoil for slopes >5% and for slopes >15% at least 0.5m of the upper 1m Permian cover is to be competent rock. 3.6 Permian spoil to be covered with minimum 0.5m competent rock on >15% slopes. 3.7 AQP¹ certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5 <u>Tailings Storage Facilities and rejects (RA16)</u> 3.7 Tailings and rejects to be capped with at least 2m of competent benign spoil. 3.8 Landforms to be non-ponding. 3.9 Landforms are reshaped with slopes not exceeding 12%. 3.10 AQP¹ certifies that as constructed landform achieves design criteria for geotechnical stability with a Factor of Safety (FoS) ≥ 1.5. <u>Watercourses (RA2)</u> 3.11 Disturbed natural watercourse bed and banks returned to a profile similar to the pre-disturbance condition. <u>Other areas</u> 3.12 Landforms are reshaped with slopes not exceeding 12% (RA3, RA13, RA14).

Milestone reference	Rehabilitation milestone	Milestone criteria
		3.13 Landforms are reshaped with slopes not exceeding 15% (RA4, RA15).
RM4	Surface preparation (cattle grazing)	4.1 Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. 4.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP¹ and reviewed and endorsed by a third party AQP¹, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 4.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 4.2. 4.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM5	Surface preparation (woodland habitat)	5.1 Topsoil placed at minimum depth of 100mm or alternative growth media at minimum depth of 300mm, in areas where topsoil has previously been removed. 5.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP¹ and reviewed and endorsed by a third party AQP¹, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 5.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 5.2. 5.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM6	Surface preparation (watercourse)	6.1 Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. 6.2 Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP¹ and reviewed and endorsed by a third party AQP¹, to ensure growth media is suitable for target vegetation establishment, the PMLU and stability of the landform. 6.3 Ameliorant and physical treatments such as fertiliser, gypsum and/or organic matter are applied as identified in criteria 6.2. 6.4 Deep rip at least 300mm into soil/subsoil profile along contour of slopes.
RM7	Revegetation (cattle grazing)	7.1 Completed seeding in accordance with recommended pasture mixes and seeding rates as shown in Table 40: Recommended species list and seeding rates for cattle grazing PMLU. 7.2 At least four species of 3P pasture species and two legumes, including at least two native pasture species, from Table 40: Recommended species list and seeding rates for cattle grazing PMLU are to be applied per application area. 7.3 Minimum seeding rates of 16kg/ha of coated pasture seed and 4 kg/ha of uncoated legume seed will be used, unless adjusted by an AQP¹ based on results of rehabilitation monitoring.

Milestone reference	Rehabilitation milestone	Milestone criteria
RM8	Revegetation (woodland habitat)	8.1 Completed seeding in accordance with recommended woodland habitat species mix and seeding rates in Table 42: Recommended species list and seeding rates for woodland habitat PMLU (RA1, RA12), or as recommended by an AQP¹ if vegetation is targeting a regional ecosystem (RA4, RA15)². 8.2 Minimum seeding rates of 6kg/ha of tree species, 4kg/ha of woody understory species and 10kg/ha of grasses will be used, unless adjusted by an AQP¹ based on results of rehabilitation monitoring (RA1, RA12). 8.3 Non-native seed must not be used for the revegetation of woodland habitat PLMU (except when sterile cover crops or <i>Cynodon dactylon</i> are used). ²Seed application may not be required in all RA4 areas. <i>*If recommended species are not available, substitute with species from RE 11.4.2, RE 11.4.13, RE 11.5.2, RE 11.5.3 and RE 11.10.7.</i>
RM9	Revegetation (watercourse)	9.1 Completed seeding in accordance with recommended watercourse species mix and seeding rates in Table 43: Recommended species list and seeding rates for watercourse revegetation PMLU – upper and mid banks and Table 44: Recommended species list and seeding rates for watercourse revegetation PMLU – lower banks. 9.2 Species chosen should reflect regional ecosystem 11.3.25. 9.3 Minimum seeding rates of: a) For the upper and mid banks – 6kg/ha uncoated trees species, 4kg/ha uncoated woody understorey species and 10kg/ha uncoated grasses and other groundcover species b) For the lower banks – 5kg/ha of uncoated tree species, 10kg/ha uncoated ground species. 9.4 Non-native seed must not be used for the revegetation of watercourse PLMU (except when sterile cover crops or <i>Cynodon dactylon</i> are used).
RM10	Achievement of surface requirements (cattle grazing)	10.1 Vegetation meets the following: a) >50% established and self-sustaining vegetation groundcover, of which at least 50% of dry matter yield is 3P pasture species as listed in Table 40: Recommended species list and seeding rates for cattle grazing PMLU b) Minimum composition of three species of 3P grasses (RA3, RA13, RA14, RA16) and two species of 3P grasses (RA7, RA17) present per hectare (averaged). 10.2 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits (RA3, RA13, RA14, RA16). 10.3 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU.

Milestone reference	Rehabilitation milestone	Milestone criteria
		10.4 Despite criteria 10.3, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not expose environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and d) Have established and persistent vegetation cover at the head of the gullies; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 2-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. ³Stabilised erosion: one or both of the following conditions apply: no evidence of sediment movement; sides and/or floors of erosion form are revegetated.
RM11	Achievement of surface requirements (woodland habitat)	11.1 Groundcover: a) >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover⁴ b) ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover⁴. 11.2 Woodland habitat vegetation meets the following: a) BioCondition score of ≥18/60 based on the averaged benchmarks for the representative regional ecosystems as listed in Table 68: BioCondition benchmarks and scoring of site-based attributes for representative and as assessed by an AQP¹ using the modified 'BioCondition Assessment Manual' (version 2.2) methodology (RA1, RA4, RA12, RA15), or b) Species richness of ≥2 native trees, ≥3 native shrubs and ≥4 grasses (exotic and native species) (RA10, RA18). 11.3 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits (RA1, RA4, RA12, RA15). 11.4 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 11.5 Despite criteria 11.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not expose environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and d) Have established and persistent vegetation cover at the head of the gullies; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 2-year period; and

Milestone reference	Rehabilitation milestone	Milestone criteria
		f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. ⁴Vegetation groundcover: Means plants, plant litter, tree leaf litter, twigs and woody debris that protect the soil surface from erosion.
RM12	Achievement of surface requirements (watercourse)	12.1 Groundcover: a) >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover⁴ b) ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover⁴. 12.2 Watercourse vegetation meets the following: a) Species richness: ≥2 native trees and ≥2 native shrubs representative of RE 11.3.25 ≥2 grass species (exotic and native species) b) Tree canopy cover ≥13%. 12.3 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 12.4 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 12.5 Despite criteria 12.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not expose environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and d) Have established and persistent vegetation cover at the head of the gullies; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 2-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features.
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA13, RA14, RA16)	13.1 Hazard assessment completed by an AQP¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 13.2 Vegetation meets the following criteria: a) >50% established and self-sustaining vegetation groundcover

Milestone reference	Rehabilitation milestone	Milestone criteria
		b) At least 60% of pasture dry matter yield consists of 3P grasses with a minimum composition of three 3P grasses present per hectare (averaged) c) Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise $\leq 5\%$ of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP¹ as appropriately managed. 13.3 Land suitability class assessed by an AQP¹ and certified that the land has achieved a post-mining land suitability class of 3 or better for cattle grazing, or not different from pre-mining class if it is class 4; where assessment of rehabilitation is in accordance with Short (2023). Class 4 is only accepted if the limitations are water availability, soil nutrient⁵ or sub-soil erosion. 13.4 For any Class 4 land suitability areas, land condition is assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas using the Grazing Land Management ABCD land condition framework. 13.5 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 13.6 Despite criteria 13.5, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not expose environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and d) Have established and persistent vegetation cover at the head of the gully; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 5-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. 13.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with Appendix 2 – Surface water quality limits. 13.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: a) Requirements of any Site Management Plan have been met; b) Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and c) There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.

Milestone reference	Rehabilitation milestone	Milestone criteria
		⁵ Only applies when soil nutrient status cannot reasonably be ameliorated, as determined by an AQP.
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA12, RA15)	14.1 Hazard assessment completed by an AQP¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 14.2 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 14.3 Despite criteria 14.2, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not exposed environmentally problematic materials; and c) The cause of the gully is known and has been resolved; d) Have established and persistent vegetation cover at the head of the gully; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 5-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. 14.4 Rehabilitation is assessed as geotechnically stable by an AQP¹ with FoS²≥1.5 (RA1, RA12). 14.5 Groundcover: a) >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover⁴ b) ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover⁴. 14.6 Woodland habitat vegetation meets the following: a) BioCondition score of ≥35/60 based on the averaged benchmarks for the representative regional ecosystems as listed in Table 68: BioCondition benchmarks and scoring of site-based attributes for representative and as assessed by an AQP¹ using the modified 'BioCondition Assessment Manual' (version 2.2) methodology b) Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP¹ as appropriately managed. 14.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 14.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm:

Milestone reference	Rehabilitation milestone	Milestone criteria
		a) Requirements of any Site Management Plan have been met; b) Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and c) There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2)	15.1 Hazard assessment completed by an AQP¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 15.2 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 15.3 Despite criteria 15.2, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not exposed environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and d) Have established and persistent vegetation cover at the head of the gully; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 5-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. 15.4 Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method⁶). 15.5 Watercourse vegetation meets the following: a) Riparian vegetation index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method⁶) b) Species richness: • ≥2 native trees and • ≥2 native shrubs c) Tree canopy cover ≥20% d) Median tree canopy height ≥10m e) Recruitment of at least two woody perennial species in ecological dominant layer f) Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP¹ as appropriately managed.

Milestone reference	Rehabilitation milestone	Milestone criteria
		15.6 Assessment by an AQP¹ that the watercourse diversion has an Index of Diversion Condition (IDC) score >10. 15.7 Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. The representative samples comply with site-specific surface water quality limits. 15.8 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: a) Requirements of any Site Management Plan have been met; b) Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and c) There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2. ⁶For watercourse rehabilitation not within a diversion (i.e. crossings/culverts), a modified IDC method with a reduced number of monitoring points within each reach will be used.
RM17	Achievement of post-mining land use to a stable condition (cattle grazing - existing rehabilitation – RA7, RA17)	17.1 Hazard assessment completed by an AQP¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 17.2 Vegetation meets the following: a) >50% established and self-sustaining vegetation groundcover on slopes ≤15%, comprising at least 50% dry matter yield 3P pasture species b) >70% established and self-sustaining vegetation groundcover on slopes >15%, comprising at least 50% dry matter yield 3P pasture species c) Consists of at least two species of 3P grasses per hectare (averaged) d) Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP¹ as appropriately managed e) <i>Leucaena leucocephala</i> must be actively managed to ensure plants >2m high do not exceed stem density of 250 stems per hectare (1 per 40m²) mean of total area. 17.3 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 17.4 Despite criteria 17.3, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹: a) Do not exceed 1m in depth at any point; and b) Do not exposed environmentally problematic materials; and c) The cause of the gully is known and has been resolved; and

Milestone reference	Rehabilitation milestone	Milestone criteria
		d) Have established and persistent vegetation cover at the head of the gully; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 5-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. 17.5 Land condition: assessed as Good (A) condition for non-grazed areas, or Good (A) or Fair (B) condition for grazed areas, for 5 consecutive years using the Grazing Land Management ABCD land condition framework. 17.6 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: a) Requirements of any Site Management Plan have been met; b) Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and c) There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.
RM18	Achievement of post-mining land use to a stable condition (woodland habitat - existing rehabilitation – RA10, RA18)	18.1 Hazard assessment completed by an AQP¹ to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. 18.2 Woodland habitat vegetation meets the following: a) Species richness: • ≥2 native trees, • ≥3 native shrubs, and • ≥4 grasses (exotic and native species) b) Tree canopy cover ≥16% c) Restricted invasive plants (as defined in the <i>Biosecurity Act 2014</i>) comprise ≤5% of vegetation groundcover, with the exception of <i>Parthenium hysterophorus</i> which must not exceed 10% vegetation groundcover and assessed by an AQP¹ as appropriately managed. 18.3 Groundcover: a) >15% slopes must achieve ≥80% groundcover, consisting of at least 50% vegetation groundcover⁴ b) ≤15% slopes must achieve ≥50% groundcover, consisting of at least 50% vegetation groundcover⁴. 18.4 AQP¹ certifies that: a) There is no severe sheet, rill or gully erosion present (as defined in Table 64: Erosion classifications); and b) Mass movement is absent; and c) All other erosion, including tunnel erosion, requiring intervention has been remediated and does not impact achieving the PMLU. 18.5 Despite criteria 18.4, gullies are acceptable on the final landform provided they meet the following criteria, as certified by an AQP¹:

Milestone reference	Rehabilitation milestone	Milestone criteria
		a) Do not exceed 1m in depth at any point; and b) Do not exposed geochemically and highly saline problematic materials; and c) The cause of the gully is known and has been resolved; d) Have established and persistent vegetation cover at the head of the gully; and e) Are in a stabilised³ state, demonstrated by monitoring data over a 5-year period; and f) Do not provide a safety hazard within the context of the PMLU; and g) Do not impact the stability or performance of engineered drainage features. 18.6 Verification by a suitably qualified person through a site inspection, records review and aerial imagery to confirm: a) Requirements of any Site Management Plan have been met; b) Notifiable activities have not been undertaken post completion of RM2 that would impact the use of the land for the intended PMLU; and c) There is no evidence indicating an adverse change to the contaminated land status has occurred post the completion of RM2.

10.5 Management milestones

The management milestones and milestone criteria for SSM are shown in Table 80.

Table 80: SSM management milestones and milestone criteria

Milestone Reference	Management milestone	Milestone criteria
MM1	Achievement of structural stability	IA1.1 Void backfill will be completed at the end of mining for flood mitigation at: a) The northern and southern end-walls of Lotus/Campbell void b) The northern and southern end-walls of Gilbert void c) The northern end-wall of Price/ Leichhardt void d) The end-walls adjacent to Rolf Creek of East Pit voids. IA1.2 Highwall landforms must: a) Prevent surface flow of floodwater into the void b) Be geotechnically stable when floodwater is against the creek-side batter c) Prevent seepage flow of floodwater into the void d) Not be constructed with dispersive material e) Have maximum 30% slopes with rock for scour protection. IA1.3 The final design for highwall landform must be completed by an AQP¹ based on the latest flood modelling and materials data prior to construction.

Milestone Reference	Management milestone	Milestone criteria
		IA1.4 Final residual voids are not subject to inundation from floodwaters up to and including the 0.1% AEP. IA1.5 The high-wall, end-wall and low-wall achieve a FoS ≥ 1.5 within the NUMA extents as determined by an AQP¹. IA1.6 A minimum distance of 50m is to be designed between the residual void crest and the toe of the safety bund, where against an external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary. IA1.7 The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary. IA1.8 Low-walls are free-draining into the void lake with a maximum 37 degree slopes. IA1.9 Residual voids must not overtop. IA1.10 Residual voids collectively act as groundwater sinks within the relevant mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410) boundary post-closure as demonstrated by groundwater modelling defined in condition PRCP12.
MM2	Achievement of surface requirements	IA2.1 Competent safety bund or equivalent landform in place to prevent access to the residual void, at the geotechnical set-back distance. IA2.2 Fencing erected, where required to prevent access to the residual void, around the perimeter of the safety bund. IA2.3 Warning signage placed along the fence line (nominally one sign every 100m). IA2.4 A minimum distance of 25m is to be designed between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform in IA2.1.
MM3	Achievement of sufficient improvement	IA3.1 Certification from an AQP¹ that: a) The residual void is safe to humans and livestock b) The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by groundwater level, quality monitoring and modelling c) Voids retain flood immunity, supported by flood modelling re-run at end of life and calibrated against the final landform d) The highwall landform has been constructed in accordance with the final design e) Appropriate safety infrastructure at the geotechnical set-back distance has been installed to prevent access to the NUMA f) The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1782, ML70126, ML70127, ML70325, ML70328, ML70350, ML70369, ML70370, ML70410), boundary

Milestone Reference	Management milestone	Milestone criteria
		g) Erosion of the landform within the NUMA area will not negatively impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU. IA3.2 Monitoring and maintenance of exclusion fences and bunds to be carried out to ensure they remain effective.

10.6 Schedule

The SSM PRCP schedule is provided below.

Post-mining land uses (PMLU)										
Rehabilitation area				RA1						
Relevant activities				Spoil Dumps						
Total rehabilitation area size (ha)				3824						
Commencement of first milestone: RM3				10/12/2024						
PMLU				Woodland Habitat						
Date area is available	10/12/2024	10/12/2029	10/12/2034	10/12/2039	10/12/2044	10/12/2049	10/12/2054	10/12/2059	10/12/2064	10/12/2069
Cumulative area available (ha)	172	365	557	636	737	855	979	1085	1205	1340
Milestone completed by	10/12/2029	10/12/2034	10/12/2039	10/12/2044	10/12/2049	10/12/2054	10/12/2059	10/12/2064	10/12/2069	10/12/2074
Milestone Reference	Cumulative area achieved (ha)									
RM3	172	365	557	636	737	855	979	1085	1205	1340
RM5	172	365	557	636	737	855	979	1085	1205	1340
RM8	172	365	557	636	737	855	979	1085	1205	1340
RM11			172	365	557	636	737	855	979	1085
RM14					172	365	557	636	737	855

Date area is available	10/12/2074	10/12/2079	10/12/2084	10/12/2089	10/12/2094	10/12/2099				
Cumulative area available (ha)	1518	1755	1875	2095	2958	3824				
Milestone completed by	10/12/2079	10/12/2084	10/12/2089	10/12/2094	10/12/2099	10/12/2104	10/12/2109	10/12/2114	10/12/2119	10/12/2124
Milestone Reference	Cumulative area achieved (ha)									
RM3	1518	1755	1875	2095	2958	3824				
RM5	1518	1755	1875	2095	2958	3824				
RM8	1518	1755	1875	2095	2958	3824				
RM11	1205	1340	1518	1755	1875	2095	2958	3824		
RM14	979	1085	1205	1340	1518	1755	1875	2095	2958	3824



Post-mining land uses (PMLU)												
Rehabilitation area				RA2								
Relevant activities				Creek Diversions and Crossings								
Total rehabilitation area size (ha)				261								
Commencement of first milestone: RM1				10/12/2034								
PMLU				Watercourse								
Date area is available	10/12/2034	10/12/2037	10/12/2047	10/12/2060	10/12/2063	10/12/2073	10/12/2099	10/12/2102				
Cumulative area available (ha)	180			197			250	261				
Milestone completed by	10/12/2037	10/12/2047	10/12/2057	10/12/2063	10/12/2073	10/12/2083	10/12/2102	10/12/2104	10/12/2112	10/12/2114	10/12/2122	10/12/2124
Milestone Reference	Cumulative area achieved (ha)											
RM1	180			197			250	261				
RM3	180			197			250	261				
RM6	180			197			250	261				
RM9	180			197			250	261				
RM12		180			197				250	261		
RM15			180			197					250	261



Post-mining land uses (PMLU)												
Rehabilitation area	RA3											
Relevant activities	Infrastructure Areas - MIA, workshop, dams, roads and general infrastructure											
Total rehabilitation area size (ha)	1070											
Commencement of first milestone: RM1	10/12/2098											
PMLU	Cattle Grazing											
Date area is available	10/12/2098	10/12/2101										
Cumulative area available (ha)	717	1070										
Milestone completed by	10/12/2101	10/12/2103	10/12/2111	10/12/2113	10/12/2115	10/12/2121	10/12/2123	10/12/2125	10/12/2128	10/12/2130	10/12/2133	10/12/2138
Milestone Reference	Cumulative area achieved (ha)											
RM1	717	1070										
RM2			598	951		1070						
RM3				598	951		1070					
RM4				598	951		1070					
RM7				598	951		1070					
RM10							598	951			1070	
RM13									598	951		1070

Post-mining land uses (PMLU)												
Rehabilitation area				RA4								
Relevant activities				Roads, creek corridor areas, exploration and general infrastructure								
Total rehabilitation area size (ha)				1549								
Commencement of first milestone: RM1				10/12/2034								
PMLU				Woodland Habitat								
Date area is available	10/12/2034	10/12/2036	10/12/2039	10/12/2049	10/12/2059	10/12/2076	10/12/2079	10/12/2089	10/12/2099			
Cumulative area available (ha)	356				543				1549			
Milestone completed by	10/12/2036	10/12/2039	10/12/2049	10/12/2059	10/12/2076	10/12/2079	10/12/2089	10/12/2099	10/12/2100	10/12/2103	10/12/2113	10/12/2123
Milestone Reference	Cumulative area achieved (ha)											
RM1	356				543				1549			
RM3		356				543				1549		
RM5		356				543				1549		
RM8		356				543				1549		
RM11			356				543				1549	
RM14				356				543				1549

Post-mining land uses (PMLU)										
Rehabilitation area				RA7						
Relevant activities				Existing Rehabilitation						
Total rehabilitation area size (ha)				361						
Commencement of first milestone: RM10				10/12/2024						
PMLU				Cattle Grazing						
Date area is available	10/12/2024									
Cumulative area available (ha)	361									
Milestone completed by	10/12/2034	10/12/2039								
Milestone Reference	Cumulative area achieved (ha)									
RM10	361									
RM17		361								

Post-mining land uses (PMLU)										
Rehabilitation area	RA10									
Relevant activities	Existing Rehabilitation									
Total rehabilitation area size (ha)	63									
Commencement of first milestone: RM8	10/12/2024									
PMLU	Woodland Habitat									
Date area is available	10/12/2024	10/12/2024								
Cumulative area available (ha)	46	63								
Milestone completed by	10/12/2024	10/12/2026	10/12/2034	10/12/2036	10/12/2044	10/12/2046				
Milestone Reference	Cumulative area achieved (ha)									
RM8	46	63								
RM11			46	63						
RM18					46	63				



Post-mining land uses (PMLU)										
Rehabilitation area				RA12						
Relevant activities				Roper Project - Spoil Dumps						
Total rehabilitation area size (ha)				658						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Woodland Habitat						
Date area is available	10/12/2024									
Cumulative area available (ha)	658									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2038	10/12/2041	10/12/2048	10/12/2051	10/12/2058	10/12/2061
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	658									
RM0.2		658								
RM0.3			658							
RM0.4				658						
RM3					263	658				
RM5					263	658				
RM8					263	658				
RM11							263	658		
RM14									263	658



Post-mining land uses (PMLU)										
Rehabilitation area				RA13						
Relevant activities				Roper Project - Spoil Dumps						
Total rehabilitation area size (ha)				519						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Cattle Grazing						
Date area is available	10/12/2024									
Cumulative area available (ha)	519									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2038	10/12/2041	10/12/2048	10/12/2051	10/12/2053	10/12/2056
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	519									
RM0.2		519								
RM0.3			519							
RM0.4				519						
RM3					246	519				
RM4					246	519				
RM7					246	519				
RM10							246	519		
RM13									246	519



Post-mining land uses (PMLU)										
Rehabilitation area				RA14						
Relevant activities				Roper Project - Infrastructure Areas - Murphy's dam, haulroad and general infrastructure						
Total rehabilitation area size (ha)				99						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Cattle Grazing						
Date area is available	10/12/2024									
Cumulative area available (ha)	99									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2037	10/12/2057	10/12/2060	10/12/2070	10/12/2075	
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	99									
RM0.2		99								
RM0.3			99							
RM0.4				99						
RM1					99					
RM2						99				
RM3							99			
RM4							99			
RM7							99			
RM10								99		
RM13									99	



Post-mining land uses (PMLU)										
Rehabilitation area				RA15						
Relevant activities				Roper Project - Roads, creek corridor areas, exploration and general infrastructure						
Total rehabilitation area size (ha)				506						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Woodland Habitat						
Date area is available	10/12/2024									
Cumulative area available (ha)	506									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2036	10/12/2039	10/12/2049	10/12/2059		
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	506									
RM0.2		506								
RM0.3			506							
RM0.4				506						
RM1					506					
RM3						506				
RM5						506				
RM8						506				
RM11							506			
RM14								506		



Post-mining land uses (PMLU)										
Rehabilitation area				RA16						
Relevant activities				Roper Project - Tailings Storage Facility and Coal Rejects Dump						
Total rehabilitation area size (ha)				158						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Cattle Grazing						
Date area is available	10/12/2024									
Cumulative area available (ha)	158									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2037	10/12/2057	10/12/2062	10/12/2072	10/12/2077	
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	158									
RM0.2		158								
RM0.3			158							
RM0.4				158						
RM1					158					
RM2						158				
RM3							158			
RM4							158			
RM7							158			
RM10								158		
RM13									158	



Post-mining land uses (PMLU)										
Rehabilitation area				RA17						
Relevant activities				Roper Project - Existing Rehabilitation						
Total rehabilitation area size (ha)				324						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Cattle Grazing						
Date area is available	10/12/2024									
Cumulative area available (ha)	324									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2044	10/12/2049				
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	324									
RM0.2		324								
RM0.3			324							
RM0.4				324						
RM10					324					
RM17						324				

Post-mining land uses (PMLU)										
Rehabilitation area				RA18						
Relevant activities				Roper Project - Existing Rehabilitation						
Total rehabilitation area size (ha)				124						
Commencement of first milestone: RM0.1				10/12/2024						
PMLU				Woodland Habitat						
Date area is available	10/12/2024									
Cumulative area available (ha)	124									
Milestone completed by	10/12/2026	10/12/2032	10/12/2033	10/12/2034	10/12/2036	10/12/2046	10/12/2056			
Milestone Reference	Cumulative area achieved (ha)									
RM0.1	124									
RM0.2		124								
RM0.3			124							
RM0.4				124						
RM8					124					
RM11						124				
RM18							124			

Post-mining land uses (PMLU)										
Rehabilitation area				RA19						
Relevant activities				Progressively Certified Rehabilitation						
Total rehabilitation area size (ha)				294						
Commencement of first milestone:				Rehabilitation has been progressively certified by DESI						
PMLU				Cattle Grazing						
Date area is available										
Cumulative area available (ha)										
Milestone completed by										
Milestone Reference	Cumulative area achieved (ha)									

Non-use management area (NUMA)										
Rehabilitation area					IA1					
Relevant activities					Residual voids					
Total rehabilitation area size (ha)					1481					
Commencement of first milestone: MM1					10/12/2094					
PMLU					NUMA					
Date area is available	10/12/2094	10/12/2096	10/12/2098	10/12/2100						
Cumulative area available (ha)	265	538	655	1481						
Milestone completed by	10/12/2096	10/12/2098	10/12/2100	10/12/2102	10/12/2138					
Milestone Reference	Cumulative area achieved (ha)									
MM1	265	538	655	1481						
MM2	265	538	655	1481						
MM3					1481					

Non-use management area (NUMA)										
Rehabilitation area					IA2					
Relevant activities					Residual voids					
Total rehabilitation area size (ha)					454					
Commencement of first milestone: MM1					10/12/2098					
PMLU					NUMA					
Date area is available	10/12/2098									
Cumulative area available (ha)	454									
Milestone completed by	10/12/2100	10/12/2138								
Milestone Reference	Cumulative area achieved (ha)									
MM1	454									
MM2	454									
MM3		454								

C: APPENDICES

Appendix A: Saraji South Mine Environmental Authority (EPML00865013) (29 June 2023)

Appendix B: DES (27 May 2021) - Progressive Rehabilitation and Closure Plan Transition Notice. Ref. EPML00865013

Appendix C: BHP (20 May 2021) - Progressive Rehabilitation and Closure Plan BMA NPM - DES Pre-Notification Memo

Appendix D: SLR (2024a) – Saraji South Mine Transitional PRC Plan Hydrogeology

Appendix E: SLR (2024c) – Saraji South Mine Groundwater Modelling Technical Report

Appendix F: Landloch (2023a) – Saraji South Mine Material Characterisation Study

Appendix G: BHP (2024a) – Saraji South Mine Community Consultation Register

Appendix H: SLR (2024b) – Saraji South Mine Transitional PRCP Voids in Floodplain Assessment

Appendix I: WMS (2024) – Saraji South Mine PRCP Rehabilitation Flood Modelling

Appendix J: BHP (2024b) – Saraji South Mine PRCP Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste

Appendix K: Landloch (2024) - Erosion and Landform Evolution Simulations to Support Waste Landform Design: Saraji South Mine

Appendix L: Engeny (2024) – Concept Design Report Rolf Creek East

Appendix M: WSP (2024) – Norwich Park Mine Void Closure Plan

Appendix N: BHP (2024c) – Saraji South Mine PRCP Risk Assessment Matrix



Saraji South Mine

Groundwater Modelling Technical Report

BMA

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Brisbane QLD 4000 Australia

Prepared by:

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SLR Project No.: 620.31444.00000

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v2.0	22 August 2024	Louis Bouchet Maryam Kahe	Derwin Lyons	Derwin Lyons

Basis of Report

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with BMA (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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1.0 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) has been engaged by BM Alliance Coal Operations Pty Ltd (BMA) to undertake a hydrogeological assessment supporting the Norwich Park Mine (NPM) (operationally known as Saraji South Mine, SSM) transitional Progressive Rehabilitation and Closure Plan (PRC Plan). SSM is located immediately to the south of BMA's Saraji Mine and the western SSM Environmental Authority (EA) boundary is approximately 5 kilometres (km) to the east of Dysart and 86 km to the north-east of Emerald. The hydrogeological assessment is being developed in accordance with the relevant requirements of the Queensland Government Department of Environment and Science (DES) Guideline: Progressive Rehabilitation and Closure Plans (DES Reference: ESR/2019/4964, version 3.00, effective 4 April 2023) - "the Guideline" and will be integrated into the design of the rehabilitation strategies and selection of post mining land uses (PMLUs) and Non-use Management Areas (NUMAs) within the SSM PRC Plan. As part of the hydrogeological assessment for the PRCP Plan, a numerical groundwater model for the SSM site has been developed.

1.2 This Report

This report documents the technical details of the SSM numerical groundwater model development to support the SSM PRCP Plan hydrogeological assessment.

Conceptualisation of the groundwater regime and the calibration of the model against observed data are key to achieving a reliable numerical model. Conceptualisation is a simplified overview of the groundwater regime (i.e. the distribution and flow of groundwater) based on available data and experience. Consistency between numerical model results and the conceptual understanding of the groundwater regime increases the credibility of the numerical model predictions. The conceptualisation of the groundwater regime is presented in the SSM Transitional PRC Plan Hydrogeology Assessment report (SLR, 2024).

Confidence in the numerical model is increased by calibration of numerical model results against observed data. A well calibrated model has demonstrated the ability to simulate groundwater levels that approximate observed levels at specific locations.

1.3 Model Objectives

Numerical modelling was undertaken in support of the hydrogeological assessment for the PRC Plan to evaluate the potential impacts of proposed SSM PRC Plan's Final Landform on the groundwater regime. The objectives of the predictive modelling were to:

- Assess the nature (timing and elevation) of void water level recovery (i.e. time to reach post mining equilibrium and definition of that equilibrium level), and associated groundwater fluxes to/from voids.
- Assess the groundwater levels at post mining equilibrium in all relevant hydrogeologic units, and associated impacts on current and potential future receptors (drawdown, water quality and groundwater flow direction).
- Assess impacts to alluvial and Tertiary hosted groundwater and any identified potential receptors.
- Assess the influence on potential groundwater receptors associated with surface drainage lines.



2.0 Model Construction and Development

2.1 Model Code

MODFLOW-USG Transport was used as the model code (Panday et al. 2013). MODFLOW-USG is a recent version of industry standard MODFLOW code and was determined to be the most suitable modelling code for accomplishing the model objectives. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. These cells take any polygonal shape, with variable size constraints allowing for refinement in areas of interest.

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop, or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post mining rewetting to be represented by the model. For the SSM model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method.

Fortran code and a MODFLOW-USG edition of the Groundwater Data Utilities (Watermark Numerical Computing) were used to construct the MODFLOW-USG input files.

2.2 Model Extent and Mesh Design

The groundwater model extent is shown in **Figure 2-1**. The model is a regional scale model with the domain extent designed to meet environmental approvals application requirements for cumulative impact assessment, (i.e., the domain is large enough to appropriately consider all potential overlapping groundwater impacts from resource operations in the Bowen Basin). The northern extent of the groundwater model domain overlaps with the southern extent of the Saraji East version of BMA's central Bowen Basin regional groundwater model (SLR, 2022).

The model domain is intended to place boundary conditions sufficiently distant from the SSM site to allow the extent of potential impacts from mining activities on the groundwater system to be assessed. At its widest extents, the model is approximately 25 km west-east by 43 km north-south. The model domain was selected based on the following considerations:

- The western boundary is represented by the outcrop boundary of the Back Creek Group, which is considered the regional low permeability basement for the purpose of this modelling.
- The northern boundary contains the primary geological unit being targeted by the SSM site and is approximately 4 km away from the proposed open cut mine areas. This boundary overlaps with BMA's central Bowen Basin regional groundwater model as shown on **Figure 2-1**. Applied linkages with the central Bowen Basin regional groundwater model are discussed in **Section 2.3** and **Section 2.5.1**.
- The southern boundary is set approximately 8 km south of the SSM site and is expected to be far outside the range of predicted SSM related drawdown.
- The eastern boundary is set along the SSM fault approximately 11 km east of the SSM area and is expected to be far outside the range of predicted SSM related drawdown.

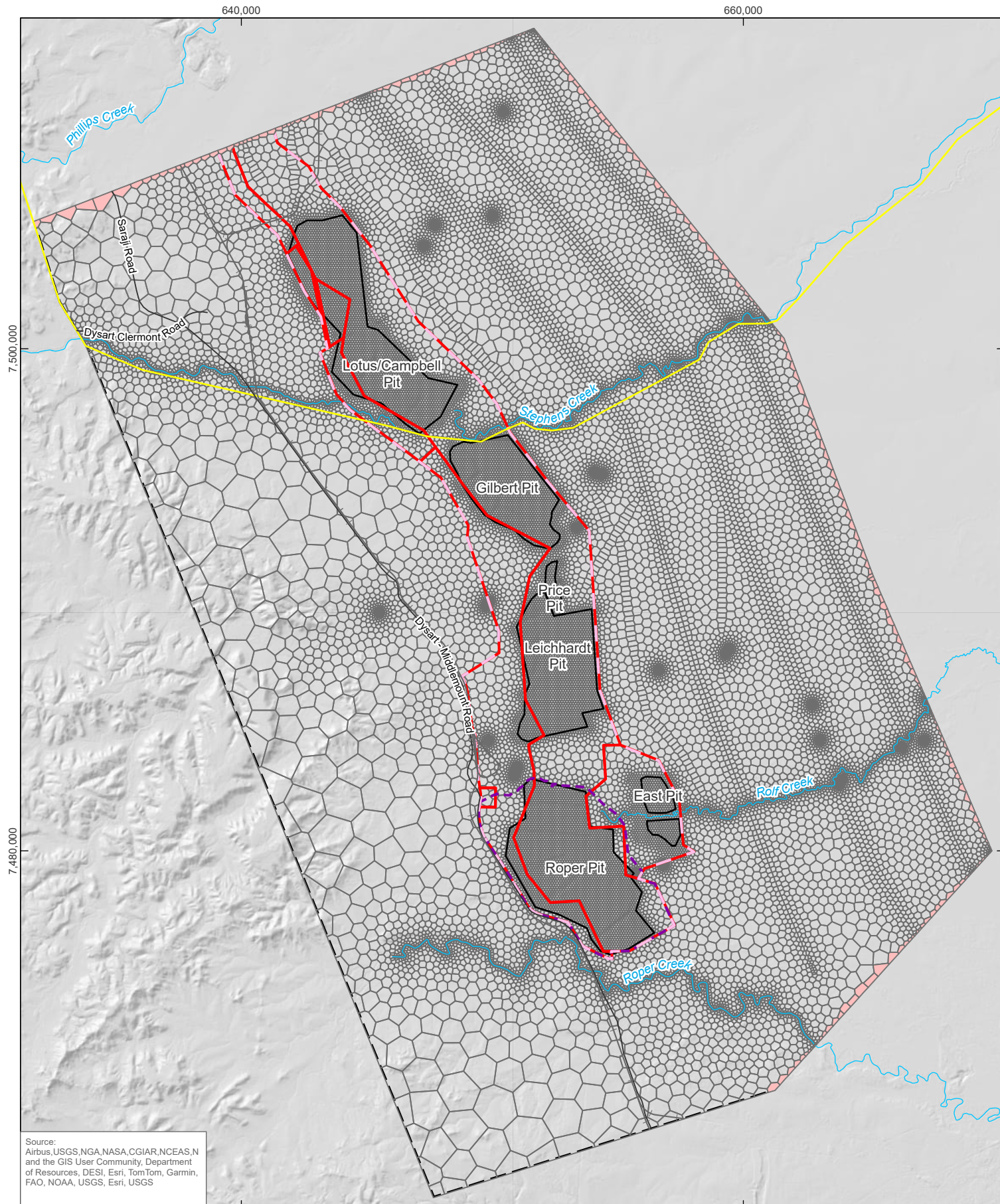


To allow stable numerical modelling of the large spatial area of the model domain, an unstructured grid with varying Voronoi cell sizes was designed using Algomesh (HydroAlgorithmics, 2014). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size. The model domain was vertically discretised into 13 layers, each layer comprising a cell count of up to 28,752. The total number of cells in the model is 243,926. This is after pinching out areas in layers 3 to 13 where a layer is not present based on the mapped geology.

The following features have been included in the grid design:

- Open cut mine areas for the SSM are represented with a 100 m Voronoi cell size constraint.
- Faults are represented using a 200 m Voronoi cell constraint.
- Alluvium areas are represented by irregular shaped Voronoi cells with resolution in a range of 100 m and 300m.





 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 21-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|--|---|
|  Railway |  General Head Boundary |
|  Major Road |  SSM Mine Lease |
|  Watercourse |  SSM EA Boundary |
|  Model Boundary |  Roper Void Rehabilitation Area |
|  Model Grid |  Central Bowen Basin Regional Model Boundary |
|  SSM Pit Extent | |

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

MODEL MESH AND BOUNDARY CONDITIONS



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FIGURE 2-1

2.3 Model Layers

The groundwater model is discretised into 13 layers.

Data sources available were:

- Public domain topography (1 second DSM).
- Public domain CSIRO depth to regolith surface.
- Public domain seamless surface and solid geology mapping.
- Client provided geology model including exploration hole locations and faulting:
 - BMA, Saraji (SRM) site geological model.
 - BMA, Saraji South site geological model.
- An overlap with the existing Saraji East version of BMA's central Bowen Basin regional groundwater model (SLR, 2022), whereby the layer structure from the southern part of the central Bowen Basin regional model was adopted in the northern part of the SSM model in the area of overlap between the two models.

Topography was 1 second data (~33m resolution). The data was modified from the source as active open cut mines were present. These were removed simply by blanking out the pit shells and linearly interpolating across.

Layers 1 and 2 represent alluvium and regolith and are spatially extensive across the model domain. These were developed using the geological model profile for base of weathering, CSIRO depth2regolith surface and the seamless surface geology mapping, i.e. regolith represented in layer 2 of the model includes the weathered portion of the Permian strata above fresh Permian bedrock. The base of weathering profile was preferentially mosaiced onto the depth2regolith surface. Where Quaternary or Tertiary alluvials were mapped, the full thickness minus 0.5m of the depth2regolith was applied and where not present a 0.5m thickness was applied. The bottom of layer 2 was set to the topography - full thickness of depth2regolith. For illustrative purposes this is shown graphically in **Figure 2-2**.

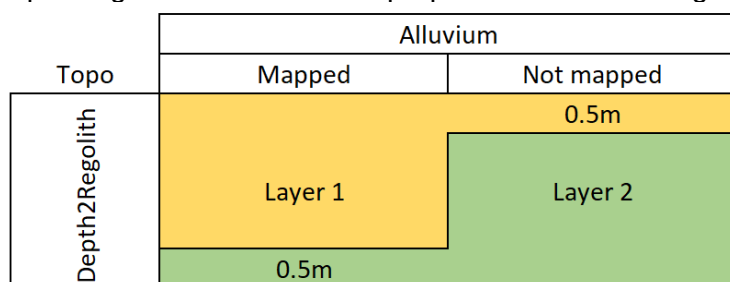


Figure 2-2 Layer 1 VS Layer 2 Thickness Depending on Alluvium Mapping

The remaining layers represent solid geology. The geological model was adopted as provided within the extent of drill holes. The geological model contains many more layers than the groundwater model uses, therefore the geological layers were simplified into a maximum/minimum elevations per major coal seam. The major coal seams considered for this operation were: D-seam, H-seam, P-seam and Q-seam. The regions between these seams are interburden layers. Outside of the geological model extents, and average seam thickness (sampled across the geological model extents) was applied regionally.

Structural trend data was extrapolated from the geological models using the neighbouring "Saraji East groundwater model" as well as publicly available solid geology mapping. The layering and average thicknesses used are summarised in **Table 2-1**.



Table 2-1 Model Layers and Thickness

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium, colluvium, Tertiary basalt	Surface cover – alluvium, colluvium and Tertiary basalt	7.1
2	Tertiary sediments, Tertiary basalt, Regolith	Tertiary and minor Triassic Clematis Group, weathered Permian, Tertiary basalt	19.8
3	Fort Cooper Coal Measures	Fort Cooper overburden	53.0
4		Fort Cooper seams (combined)	62.7
5		Fort Cooper underburden	72.5
6	Moranbah Coal Measures	Q Seam	1.0
7		Interburden	46.2
8		P Seam	1.9
9		Interburden	43.6
10		H Seam	3.7
11		Interburden	52.8
12		D Seam	5.1
13		Base of Model - aquitard	100

2.3.1 Geological Faults

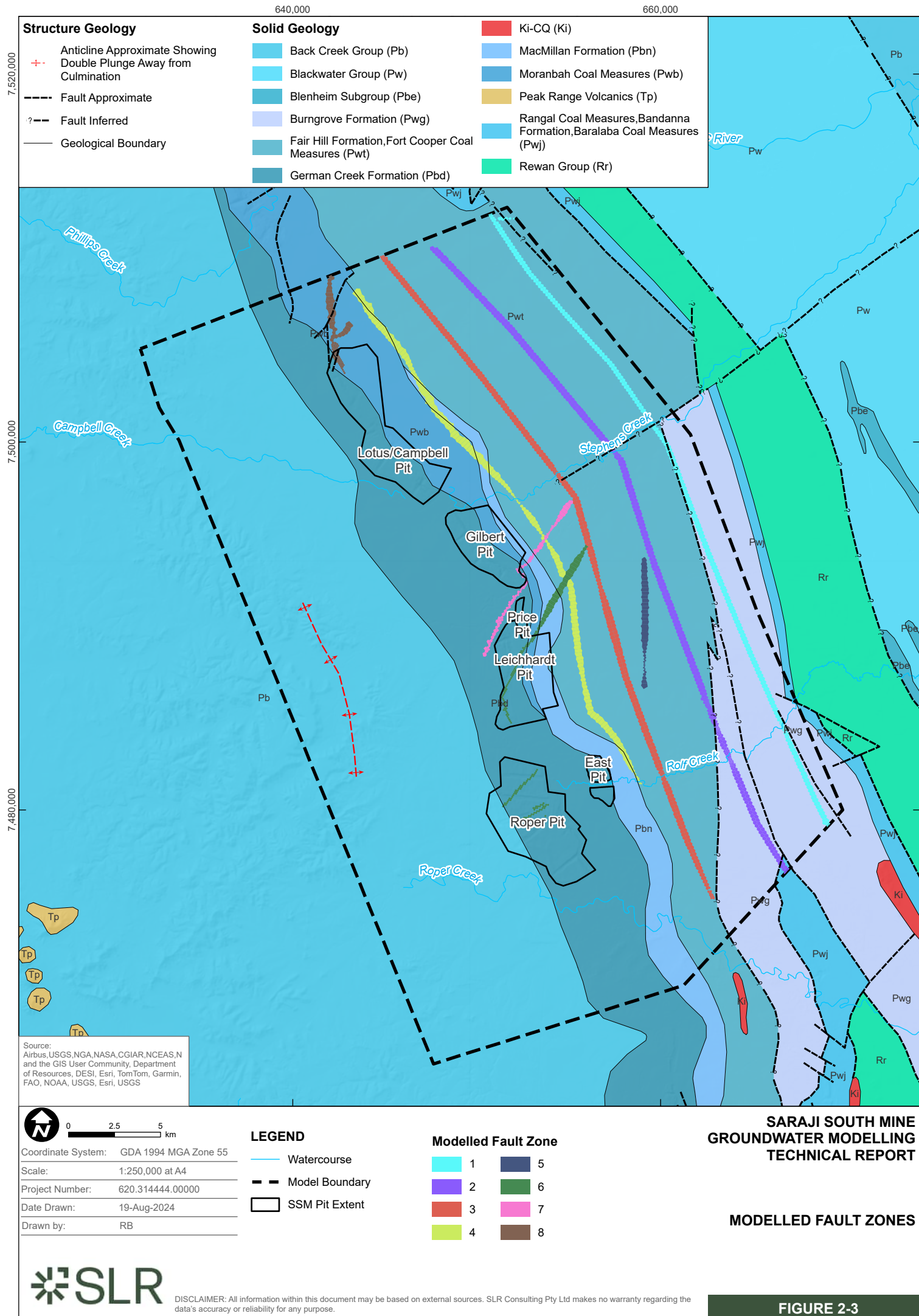
As discussed in SLR (2023), there are faults present in and around the SSM area. Mapping and site-specific geology models are used for the modelling of faults within the groundwater model domain where available.

Local fault displacements derived from the SSM geological models have also been captured in the model layer elevations at these sites. There are five key regional northwest-southeast trending fault zones included in the model:

- Extending 39 km, 9 km to the east of SSM.
- Extending 39 km, 7 km to the east of SSM.
- Extending 39 km, 4 km to the east of SSM.
- Extending 30 km, 1 km to the east of SSM.
- Shorter faults close and within the SSM area.

Mesh refinement (200m) has been used along fault lines to allow for isolated changes of hydraulic properties along fault zones during calibration. **Figure 2-3** shows the locations of geological fault zones represented in the model.





2.4 Timing

A combined steady state, transient warm-up and transient calibration model was developed, as follows:

- A steady state model with one stress period to simulate the water levels pre-mining.
- A transient warm-up model with one 10-year stress period from January 1980 to January 1990).
- A transient calibration model with 84 stress periods from January 1990 to October 2023 (one 10-year stress period from January 1990 to January 2000, four yearly stress periods from January 2000 to January 2004, and 79 quarterly stress periods from January 2004 to October 2023).

The first stress period of the model was steady-state and did not include any mining. The transient warm-up model was built to incorporate pre-1990 mining activities and their impacts on groundwater levels. The warm-up model provided appropriate starting conditions for the calibration model (i.e., starting heads and hydraulic properties). Together, the steady state, warm-up and transient calibrations comprise 86 stress periods.

A summary of the calibration validation model stress periods and simulated active mine timings is shown in **Appendix A**. The first stress period of the warm-up model was steady-state and did not include any mining. This was to simulate the pre-mining conditions within the model domain.

A transient predictive model was then developed from the end of the transient calibration model from October 2023 to January 2098. The recovery model will then start from January 2098 to January 2676 for 578 years.

To assist the model in overcoming the numerical difficulties, MODFLOW-USG Adaptive Time-Stepping (ATS) option was used. The ATS option of MODFLOW automatically decreases the time-step size when the simulation becomes numerically difficult and increases it when the difficulty passes. The minimum time step size used in the simulations was 1 day.

2.5 Model Stresses and Boundary Conditions

2.5.1 Regional Groundwater Flow

General Head Boundary (GHB) have been specified along the northern, eastern, and part of the southern model boundaries as represented in **Figure 2.1**.

The GHB boundary condition is used to represent the regional flow into and out of the model area and has been assigned using GHB cells in all layers using pre-mining head elevations. Groundwater will enter the model where the head in the GHB is higher than the modelled head in the adjacent cell and will leave the model when the water level is lower in the GHB. GHB conductance is calculated using the hydraulic conductivity and the dimensions of each GHB cell and is therefore variable in this model due to variable cell size.

SLR (2022) transient heads from BMA's central Bowen Basin regional model were employed for GHB in the area covering the northern and eastern part of the model area. The transient heads in this area were not modified during calibration. In contrast, for other areas, both the head and conductance factor had been changed during the calibration process.

No flow boundary was applied to the western boundary of the model that represents the outcrop of the Back Creek Group. No flow boundary was applied to part of the southern model boundary as well.



2.5.2 Rainfall Recharge

Diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to underlying groundwater systems was represented using the MODFLOW-USG Recharge package (RCH).

The recharge rates were established through the calibration process, with bounds based on the conceptual understanding of the system and comparing them with other groundwater models prepared for the region. Rainfall recharge was imposed as a percentage of actual rainfall from the SILO Grid Point observations. Long-term average rainfall was used for the steady-state model. The historical rainfall data were averaged on an annual basis (2000 to 2004) and on a quarterly basis (2004 to 2023) for the transient calibration model. Also, the averages of the historical rainfall data from 1980 to 1990 and from 1990 to 2000 were used for these periods. For the prediction model, long-term average rainfall was used.

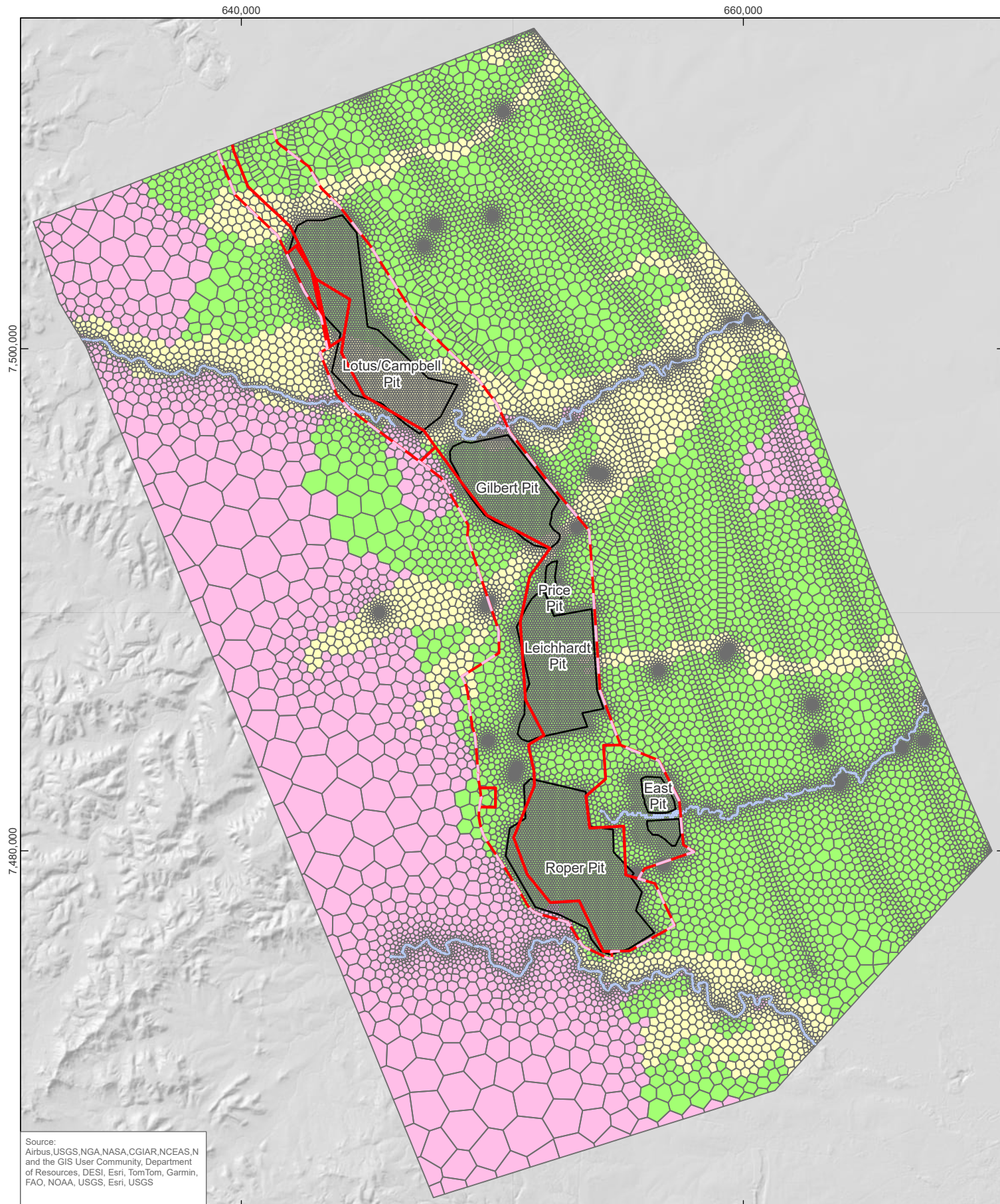
The model included 4 recharge zones, as presented in **Figure 2-4** and listed below:

- Alluvium Quaternary.
- Regolith.
- Weathered Permian.
- River.

An enhanced recharge of 100 % is applied to residual mine pit voids in the prediction model, where void lakes are not represented. No recharge is applied to constant head cells representing void lakes during recovery predictions. Recharge to mine spoil is defined as part of the calibration process.

The calibrated recharge rates are discussed in **Section 2.10**.





Source:
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Department
of Resources, DESI, Esri, TomTom, Garmin,
FAO, NOAA, USGS, Esri, USGS



Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 19-Aug-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Paramater Zone

- Alluvium Qa
- River
- Weathered Permian
- Regolith

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

MODELLLED RECHARGE ZONES



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FIGURE 2-4

2.5.3 Evapotranspiration

The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system.

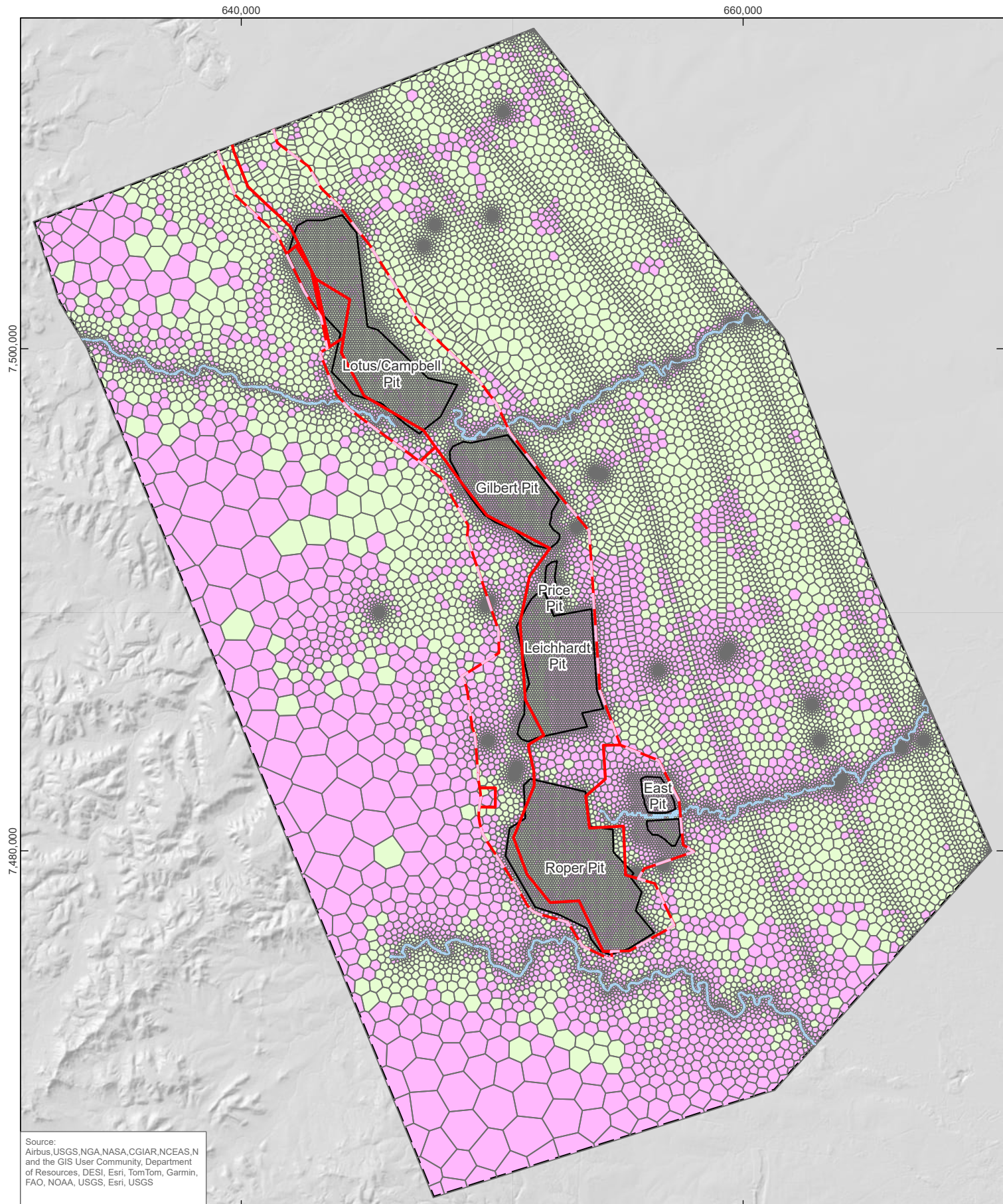
The 2020 woody vegetation extent map from the Statewide Landcover and Trees Study (SLATS) was used to identify areas that were forest and bare areas. The model included 3 EVT zones, as presented in **Figure 2-5** and listed below:

- River.
- Forest areas.
- Bare areas.

Extinction depth was set up at different depth based on vegetation type and cover based on the woody vegetation extent map. Forest areas including red gums and tall trees have a higher evapotranspiration extinction depth due to their complex root systems, stomatal regulation, longer lifespan, and greater biomass, allowing them to access water from deeper soil layers and sustain higher rates of evapotranspiration. The initial values of extinction depths were set to 10, 5, and 2 m below ground for River, forest area, and bare areas, respectively. The calibrated EVT rates and extinction depth values are discussed in **Section 2.11**.

Potential Evapotranspiration calculated using the FAO Penman-Monteith formula was imposed as a percentage of actual evapotranspiration from the SILO Grid Point observations. Long-term average EVT was used for the steady-state model. The historical EVT data were averaged on an annual basis (2000 to 2004) and on a quarterly basis (2004 to 2023) for the transient calibration model. Also, the averages of the historical EVT data from 1980 to 1990 and from 1990 to 2000 were used for these periods. For the prediction model, long-term average EVT was used.





Source:
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Department
of Resources, DESI, Esri, TomTom, Garmin,
FAO, NOAA, USGS, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 19-Aug-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

EVT Zone

-  Bare Area
-  Forest Area
-  River

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

MODELLED EVAPOTRANSPIRATION ZONES



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FIGURE 2-5

2.5.4 Time Variant Constant Head Boundary (CHD)

The MODFLOW Time Variant Constant Head Boundary (CHD) package was used to simulate the residual void water elevations. **Figure 2-6** displays the yearly variations in void lake water levels that commenced in 2011 due to the flood. For the period from 2011 to 2017, averages from the data spanning 2017 to 2023 were used. CHD values were applied to the layer of the deepest mined seam in each zone, as depicted in **Figure 2-7**.

Once a model cell has been prescribed a head condition using the CHD package, it is removed from the regular active flow cells in the model. To allow the simulation of prescribed heads for water storages during history-matching, followed by active flow modelling in the same cells in the predictive period, the MODFLOW-USG Transient IBOUND (TIB) package was used to specify transient boundary conditions. The TIB package allows specification of regular active flow cells in each stress period and facilitates the re-activation of cells previously assigned a head boundary condition.

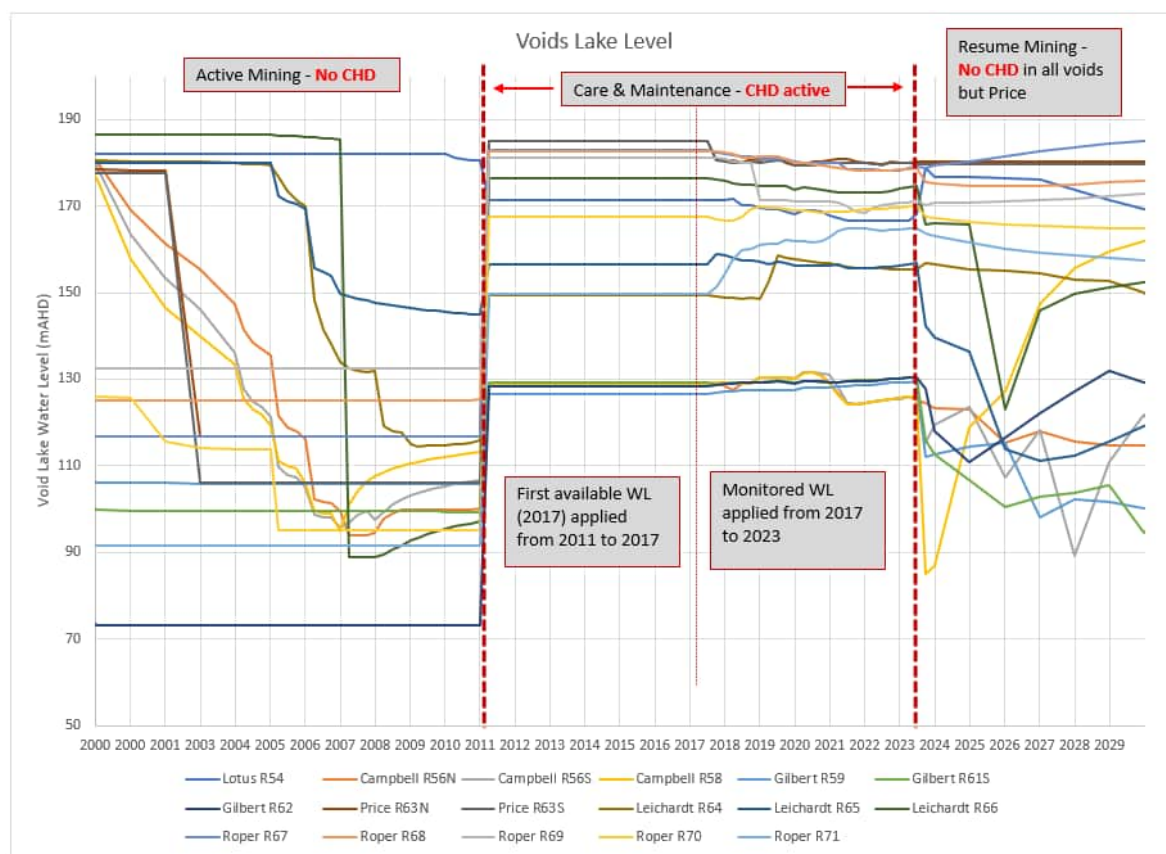
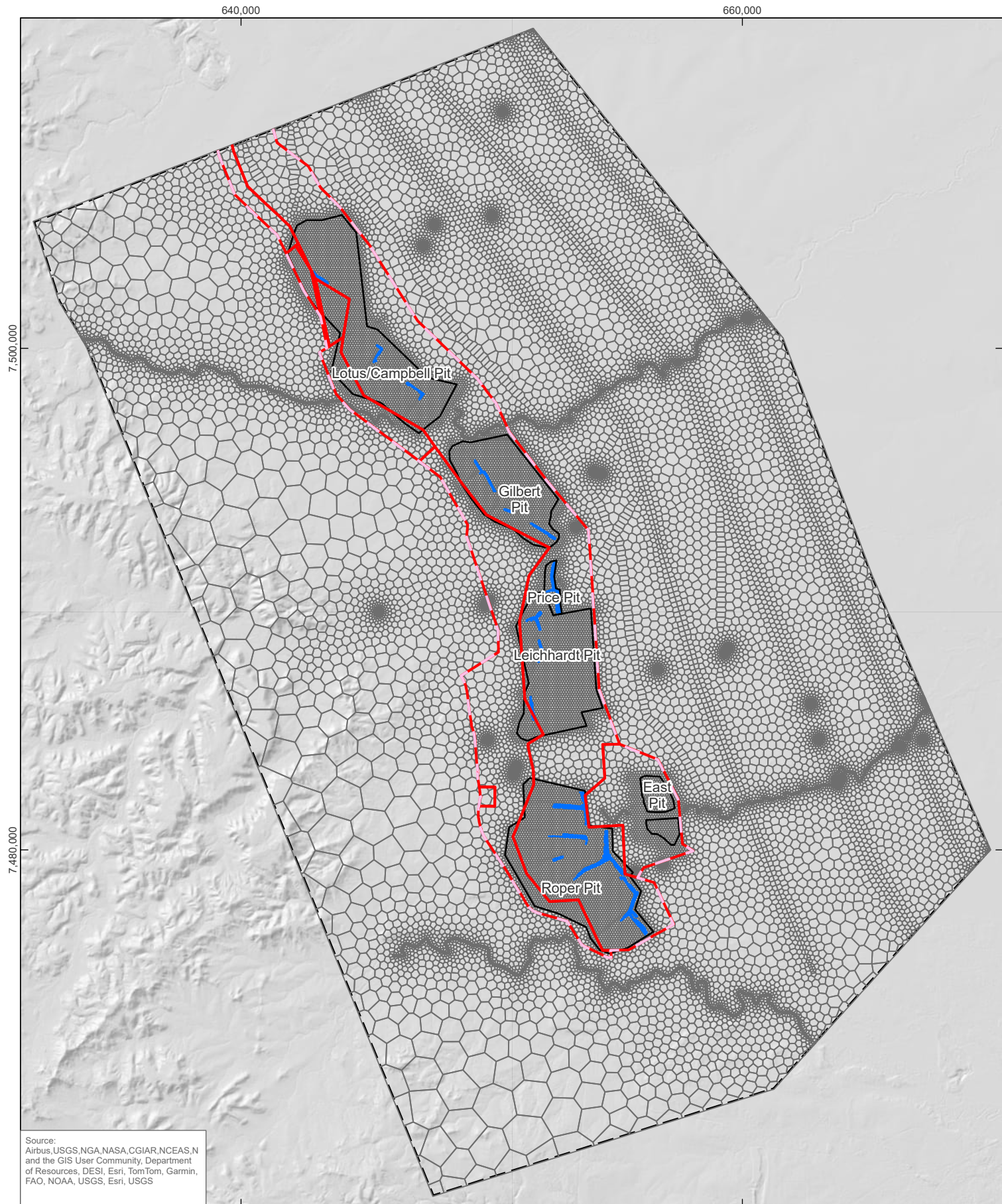


Figure 2-6 Simulated Void Lake Water Level





Source:
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Department
of Resources, DESI, Esri, TomTom, Garmin,
FAO, NOAA, USGS, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 19-Aug-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary
-  Modelled Waterbody

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

MODELLED CHD ZONE IN THE CALIBRATION PERIOD



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FIGURE 2-7

2.5.5 Mining

The MODFLOW Drain (DRN) package is used to simulate mine dewatering in the model for the SSM mines. Boundary conditions for drain cells allow one-way flow of water out of the model. When the computed head drops below the stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

For Campbell pit, Gilbert pit, Leichhardt pit, and Roper pit for both historical and future mining periods, drain cells are applied to all active layers from the surface to the base of the D seam (Layer 12 of the model) to simulate open cut mines. For East pit and Price pit, drain cells are placed to all active layers from the surface to the base of the H seam (Layer 10 of the model). Drain cells are applied to all active layers from the surface to the base of the H seam (Layer 10 of the model) and the D seam (Layer 12 of the model) for Lotus pit for historical and future mining periods, respectively.

2.5.5.1 Variation in Hydraulic Properties - Open Cut Mining

Hawkins (1998), Mackie (2009) and Fityus et, al. (2022) indicate that spoil and waste rock are more permeable than the undisturbed strata. Completed open cut mining areas will be backfilled with waste overburden as the extraction proceeds. Backfilling of open cut mine areas with spoil was also modelled using the TVM package.

The model cell properties were updated to spoil properties guided by operational mine plans. The initial horizontal hydraulic conductivity of 0.3 m/day and vertical hydraulic conductivity of 0.1 m/day is applied to the spoil. The storage parameters used for the spoil were a specific yield of 0.1 and a storage coefficient of 1.0×10^{-5} . The calibrated hydraulic parameters and storage properties are discussed in **Section 2.8** and **2.9**, respectively.

The hydraulic properties were varied with time using the Time-variant materials (TVM) package of MODFLOW-USG Transport.

2.6 Parametrisation

The model hydraulic zones (refer to **Appendix D**) have been initially parametrised in the model based on site data and previous inputs from the Saraji East version of BMA's central Bowen Basin regional model (SLR, 2022). The model's overlap with the central Bowen Basin regional model is shown in **Figure 2-1**.

The hydraulic conductivity of the Permian interburden material in the Moranbah Coal Measures reduces with depth to reflect field observations (**Figure 2-8**). As the decrease of K_x within the interburden rock units is driven by an increase in overburden pressure, the relationship between K_x and depth is different from that of coal seams. The hydraulic conductivity for the interburden material is capped at a minimum of 1.0×10^{-3} m/day and the hydraulic conductivity of the coal seams is capped at a minimum of 1.0×10^{-2} m/day.

The hydraulic conductivity of the interburden/overburden and coal seam layers decreases with depth according to Equations 1 (exponential) and Equation 2 (power). Equation 1 was also used to replicate changes in hydraulic conductivities of fault at depth.

Coal and faults: $HC = HC0 \times e^{(-0.018 \times \text{depth})}$ (Eq. 1)

Interburden (MCM): $HC = HC0 \times -2.1^{\text{depth}}$ (Eq. 3)



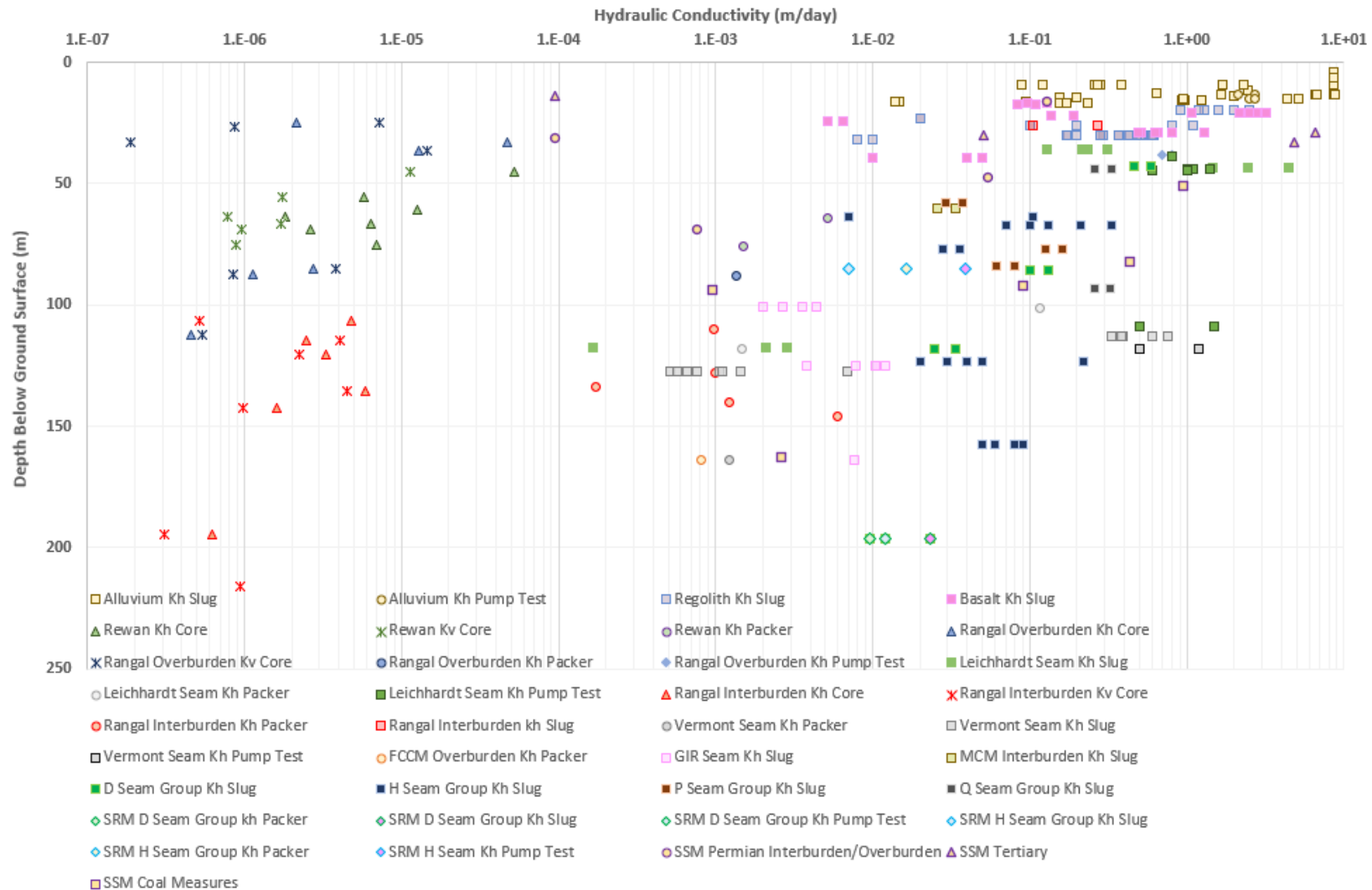


Figure 2-8 Summary of all regional hydraulic testing results



Where:

- HC is horizontal hydraulic conductivity at specific depth
- HC0 is horizontal hydraulic conductivity at depth of 0 m (intercept of the curve)
- Depth is depth of the floor of the layer (thickness of the cover material)
- Slope is a term representing slope of the formula (steepness of the curve).

HC0 was estimated for each hydraulic zone in the calibration. The slope function and coefficient of the coal and interburden depth dependence equations were not calibrated. Calibrated hydraulic parameters are presented in **Section 2.8**.

2.7 Calibration

2.7.1 Calibration Method

Automated calibration utility PESTPP-IES (White, 2018) was used to match the available water level data. The numerical algorithm that is implemented by PESTPP-IES is referred to as an “iterative ensemble smoother”. The job of an ensemble smoother is to assimilate data in a “batch” sense. To accomplish this, PESTPP-IES begins the model parameterisation process with a collection of random parameter fields drawn from the prior parameter probability distribution. Through a series of iterative adjustments, PESTPP-IES modifies the parameter realisations that make up the ensemble to satisfy calibration constraints. The results presented in this section are from the realisation that yielded the lowest simulated error (sum of squares). However, where possible, results have been provided for all realisations within the ensemble. The model variables included in the calibration were:

- Aquifer parameters including horizontal and vertical hydraulic conductivity, specific storage and specific yield.
- Stresses including recharge rates.
- Boundary conditions including evapotranspiration (EVT) rate, EVT extinction depth, and General Head Boundary (GHB) conductance factor (excluding the area covered by the Saraji East model).
- Faults horizontal and vertical hydraulic conductivity, specific storage, and specific yield.
- Horizontal and vertical hydraulic conductivity, specific storage, and specific yield of spoils.

The calibration methodology for the SSM model involved running the model numerous times using different parameter sets and investigating which model produce the best calibration statistics. An initial 46 realisations were successfully optimised. To increase the number of available realisations, an additional calibration run was conducted to produce a total of 120 realisations successfully optimised. Parameter distributions across the 120 realisations are discussed in **Section 4.0**.

The calibration statistics were calculated for each realisation and the realisation that produced the lowest Scaled Root Mean Square error (SRMS) was considered to be the best-calibrated model for the purposes of the SSM. However, because the best calibrated model was selected from the initial set of 46 realisation, there are several realisations with a slightly better SRMS. The calibration results described in this report section are from this particular realisation, refer to as “Base Model”. The remaining realisations were then used to quantify the model uncertainty with respect to simulated heads and predictive variables as discussed in **Section 4.0**.



2.7.2 Calibration Targets

The groundwater levels recorded between January 1990 to October 2023 were used as calibration targets. In all, 261 target heads were established for 53 bores from the SSM area. The calibration dataset is represented in **Figure 2-9**.

Groundwater targets were selected where:

- Valid information on bore construction or geology information was available for the site.
- Targets were manually reviewed to ensure the measurements were realistic.

During calibration, each groundwater bore was assigned a weight of 1, and the weight for each observed water level was calculated by dividing 1 by the number of groundwater levels recorded at each bore. Details on each of the observation points and their residuals are presented in **Appendix B** of this report. The locations of these bores are shown in **Figure 2-12**. The whisker plots represent the number of groundwater levels recorded at each bore.

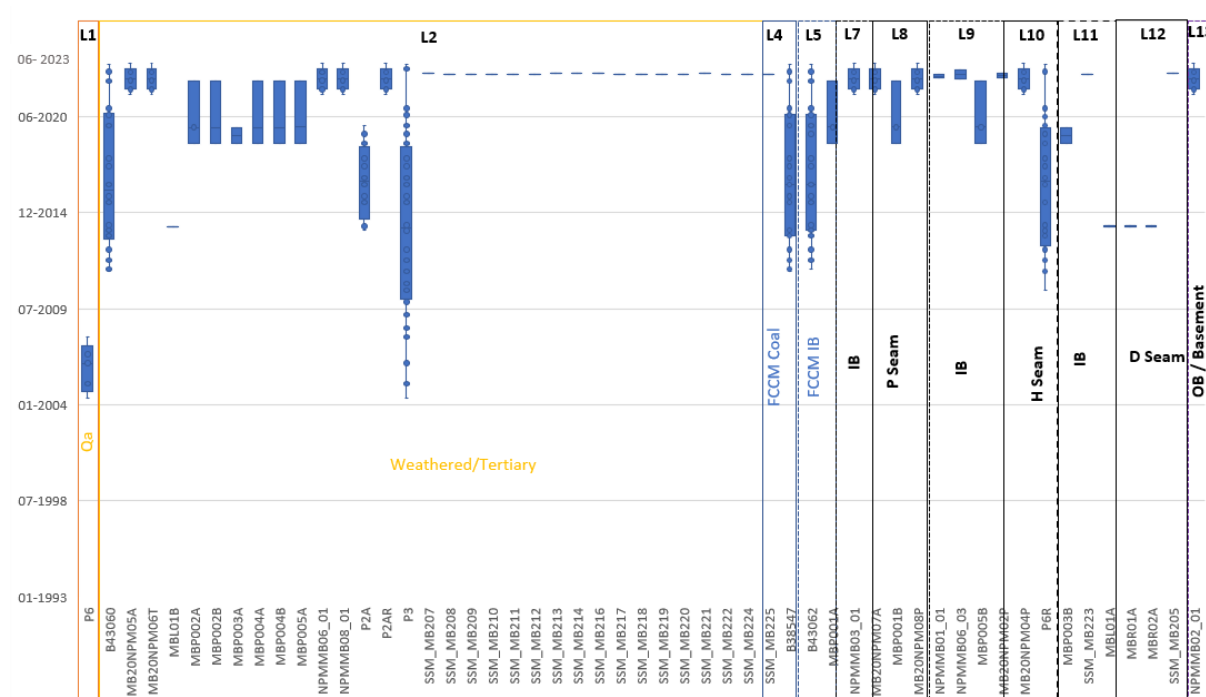


Figure 2-9 Calibration Dataset – Groundwater Level

2.7.3 Calibration Variables Ranges

Calibration ranges for model parameters are based on available data presented in SLR (2023), and literature review for reasonable ranges based on geological strata. The ranges in hydraulic parameter values provided to the calibration utility are presented on **Table 2-2**. It is noted that, except for the unconsolidated material, the value provided for Kx is Kx0 (i.e. hydraulic conductivity at surface, refer to **Section 2.6**).



Table 2-2 Calibration Parameter Bounds

Model Layer	Formation	Unit	Horizontal Hydraulic Conductivity (m/day)	Anisotropy Kv/Kh
1	Alluvium Quaternary	Surface cover	1.0×10^{-1} to $1.0 \times 10^{+1}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
1	Regolith	Surface cover	1.0×10^{-3} to 1.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
2	Regolith	Surface cover	1.0×10^{-3} to $1.0 \times 10^{+1}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
3	Fort Cooper Coal Measures	Fort Cooper overburden*	1.0×10^{-5} to $1.0 \times 10^{+2}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
4		Fort Cooper seam*	1.0×10^{-4} to 1.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
5		Fort Cooper underburden*	1.0×10^{-3} to $1.0 \times 10^{+2}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
6	Moranbah Coal Measures	Q Seam*	1.0×10^{-2} to 7.0×10^{-2}	1.0×10^{-3} to $1.0 \times 10^{+1}$
7		Interburden*	1.0×10^{-3} to $1.0 \times 10^{+2}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
8		P Seam*	1.0×10^{-2} to 5.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
9		Interburden*	1.0×10^{-3} to $1.0 \times 10^{+2}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
10		H Seam*	1.0×10^{-2} to 5.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
11		Interburden*	1.0×10^{-3} to $1.0 \times 10^{+2}$	1.0×10^{-3} to $1.0 \times 10^{+1}$
12		D Seam*	1.0×10^{-2} to 5.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
13		Base of Model *	1.0×10^{-3} to 1.0	1.0×10^{-3} to $1.0 \times 10^{+1}$
-	-	Faults*	1.0×10^{-4} to 5.0	1.0×10^{-3} to 1.0
-	-	Spoil [#]	3.0×10^{-3} to $4.0 \times 10^{+1}$	1.0×10^{-3} to $1.0 \times 10^{+1}$

*Kx value correspond to Kx0

Based on Fityus et, al., 2022.

The ranges in boundary conditions are presented for recharge in **Table 2-3**, EVT in **Table 2-4** and General Head Boundary in **Table 2-5**.



Table 2-3 Rainfall Recharge Bounds

Model Recharge Zone	% of Deep Drainage	% of Rainfall	Long-term Average Rainfall Recharge (mm/yr)
Alluvium Quaternary	0.6 to 600	0.01 to 10	0.06 to 59.92
Regolith	0.06 to 60	0.001 to 1	0.01 to 5.99
Weathered Permian	0.06 to 300	0.001 to 5	0.01 to 29.96
River	0.6 to 1200	0.01 to 20	0.06 to 119.83
Spoil	6.0 to 360	0.10 to 6	0.60 to 35.95

Table 2-4 Evaporation Rate and Extinction Depth Bounds

Model EVT Zone	EVT factor of PAN	EVT Depth (m)	Long-term Average EVT (mm/yr)
River	0.5 to 1.0	2.0 to 12.0	819.7 to 1639.4
Forest areas	0.5 to 1.0	2.0 to 8.0	819.7 to 1639.4
Bare areas	0.5 to 1.0	1.0 to 3.0	819.7 to 1639.4

Table 2-5 Calibrated General Head Boundary (GHB) Conductance Factor and Head Bounds

Model GHB Zone	GHB Conductance Factor	GHB Head Multiplier
Layer 1	0.1 to 10	0.85 to 1.15
Layer 2		0.85 to 1.15
Layer 3		0.85 to 1.15
Layer 4		0.85 to 1.15
Layer 5		0.85 to 1.15
Layer 6		0.85 to 1.15
Layer 7		0.85 to 1.15
Layer 8		0.85 to 1.15
Layer 9		0.85 to 1.15
Layer 10		0.85 to 1.15
Layer 11		0.85 to 1.15
Layer 12		0.85 to 1.15
Layer 13		0.85 to 1.15

2.7.4 Calibration Statistics

The overall transient calibration statistics for the calibration ensemble (120 realisations) are summarised in **Table 2-6**, including the statistics for the Base Model. One of the industry standard methods to evaluate the calibration of the model is to examine the statistical parameters associated with the calibration. This is done by assessing the error between the



modelled and observed (measured) water levels in terms of the root mean square (RMS). RMS is expressed as:

$$RMS = \left[1/n \sum (h_o - h_m)_i^2 \right]^{0.5}$$

where: n = number of measurements
h_o = observed water level
h_m = simulated water level

RMS is considered to be the best measure of error, if errors are normally distributed. The RMS error calculated for the Base Model realisation is 3.4 m.

The acceptable value for the calibration criterion depends on the magnitude of the change in heads over the model domain. If the ratio of the RMS error to the total head change in the system is small, the errors are considered small in relation to the overall model response(s). The total measured head change across the model domain is 80.6 m; therefore, the ratio of RMS to the total head change (i.e., scaled root mean square, SRMS) for the Base Model is 4.2%. The SRMS for the calibration ensemble ranged from 3.9 to 5.3 %, with a median of 4.3%. While there is no recommended universal SRMS error, the Australian Groundwater Modelling Guidelines suggest that setting SRMS targets such as 5 or 10 % may be appropriate in some circumstances (Barnett et al, 2012).

Table 2-6 Calibration Statistics – Calibration Ensemble Summary

Statistic	Minimum	Median	Maximum	Base Model
Mean Residual (m)	-2.01	-0.96	0.11	-0.32
Mean Absolute Residual (m)	2.11	2.49	3.22	2.3
Standard Deviation (m)	3.04	3.34	4.16	3.34
Sum of Squares (m ²)	2603.42	3181.69	4796.59	2931.49
Root Mean Square Error (RMS) (m)	3.16	3.49	4.29	3.35
Minimum Residual (m)	-17.2	-17.2	-17.2	-17.2
Maximum Residual (m)	14.83	14.83	14.83	14.83
Number of Observations	261	261	261	261
Range in Observations (m)	80.59	80.59	80.59	80.59
Scaled Standard Deviation (%)	3.77	4.14	5.16	4.15
Scaled Absolute Mean (%)	2.62	3.09	4	2.85
Scaled RMS (SRMS) (%)	3.92	4.33	5.32	4.16

Figure 2-10 presents the observed and simulated groundwater levels graphically as a scattergram for the historic transient calibration (1990 to 2023), for the Base Model.

Figure 2-11 shows the distribution of calibration residuals for the Base Model. As shown in the figure the calibration residuals in majority of the calibration data points are within ± 10 m. **Figure 2-11** indicates that in general, the model tends to slightly over predict groundwater levels.



Observed vs Computed Target Water Levels

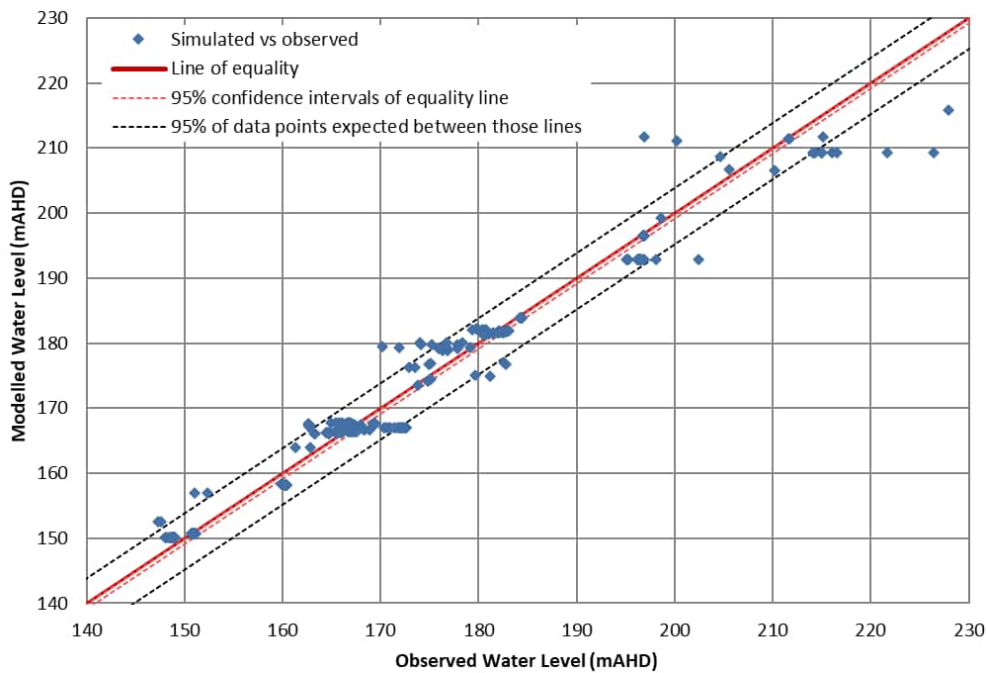


Figure 2-10 Calibration Scattergram – Base Model

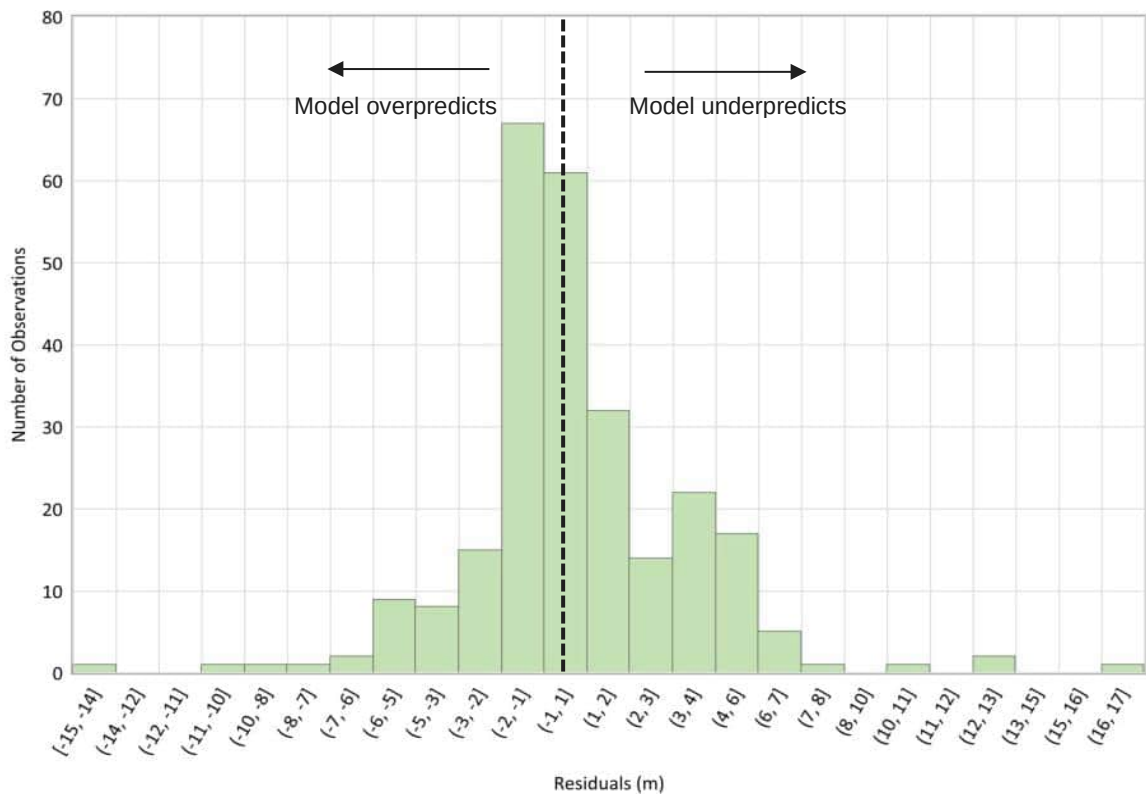


Figure 2-11 Calibration Residual Histogram Scattergram – Base Model



Table 2-7 shows the average calibration residual and absolute average residual per model layer, for the Base Model. The residual is the difference between the measured and the modelled water level at each bore. A negative residual represents an over estimation of water levels, while a positive residual represents an underestimate. **Table 2-7** shows an overall overestimation of water levels in the model layers across the model domain. The table shows layer 11 has the highest absolute average residual and layer 7 has the highest average residual.

Table 2-7 Average Residual by Model Layer – Base Model

Model Layer	Formation	Unit	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of bores
1	Alluvium, colluvium, Tertiary basalt	Surface cover	-0.1	0.3	5	1
2	Tertiary sediments, Tertiary basalt	Tertiary and minor Triassic Clematis, weathered Permian, Tertiary basalt	0.7	3.1	133	32
3*	Fort Cooper Coal Measures	Fort Cooper overburden	-	-	-	-
4		Fort Cooper seams (combined)	-0.2	0.6	38	2
5		Fort Cooper underburden	0.0	2.1	11	2
6*	Moranbah Cooper Coal Measures	Q Seam	-	-	-	-
7		Interburden	2.3	2.3	11	2
8		P Seam	1.4	2.3	12	3
9		Interburden	0.5	0.5	3	1
10		H Seam	-0.2	1.4	30	3
11		Interburden	-3.1	8.0	3	2
12		D Seam	-3.6	3.6	7	4
13		Interburden	0.4	0.4	8	1

*There are no observation bores in Laves 3 and 6.

The spatial distribution of average residuals for each bore from the transient calibrated model is shown in **Figure 2-12**. The size of the bore symbol in **Figure 2-12** is proportional to the residual (i.e. larger residual has a larger symbol size). **Figure 2-12** shows regionally there is a good match between the observed and simulated groundwater levels.



2.7.5 Calibration Fit

This section provides a discussion on the modelled to observed groundwater level trends (calibration hydrographs) for key bores across the model domain. The hydrographs allow visualising how all 120 calibrated realisations compare to observed data. A narrow realisation envelope centred around the observed data indicate a good fit for the ensemble, while a realisation envelope > 5 m from the observed data indicate a relatively poor fit for the ensemble. When the calibration envelope does not contain the observed data, it generally indicates limitations associated with the model structure or assumptions (e.g. simplifications associated with boundary conditions or parametrisation). Calibration hydrographs for the full calibration dataset are presented in **Appendix C**.

2.7.5.1 Alluvium and Regolith

Figure 2-13 presents the fit between simulated and observed water levels in alluvium bore P6. The hydrograph for bores P6 located 1.3 km next to the Gilbert pit shows a very close match between simulated and measured groundwater levels.

Figure 2-13 also presents the fit between simulated and observed heads in the two bores (B43060 and P3) within the Regolith. The hydrograph for bores P3 located 1.3 km west of the Leichhardt pit shows the model reproduces the absolute water level within 2 m of the measured data. However, the small seasonal variations are not well reproduced. The hydrograph for bore B43060 located 6.3 km east of the East pit shows the model slightly overpredicts groundwater levels at this bore by a maximum of around 2.5 m in this area. As shown in the hydrographs in **Appendix C**, regionally there is a good match between the simulated and measured groundwater levels in regolith bores.



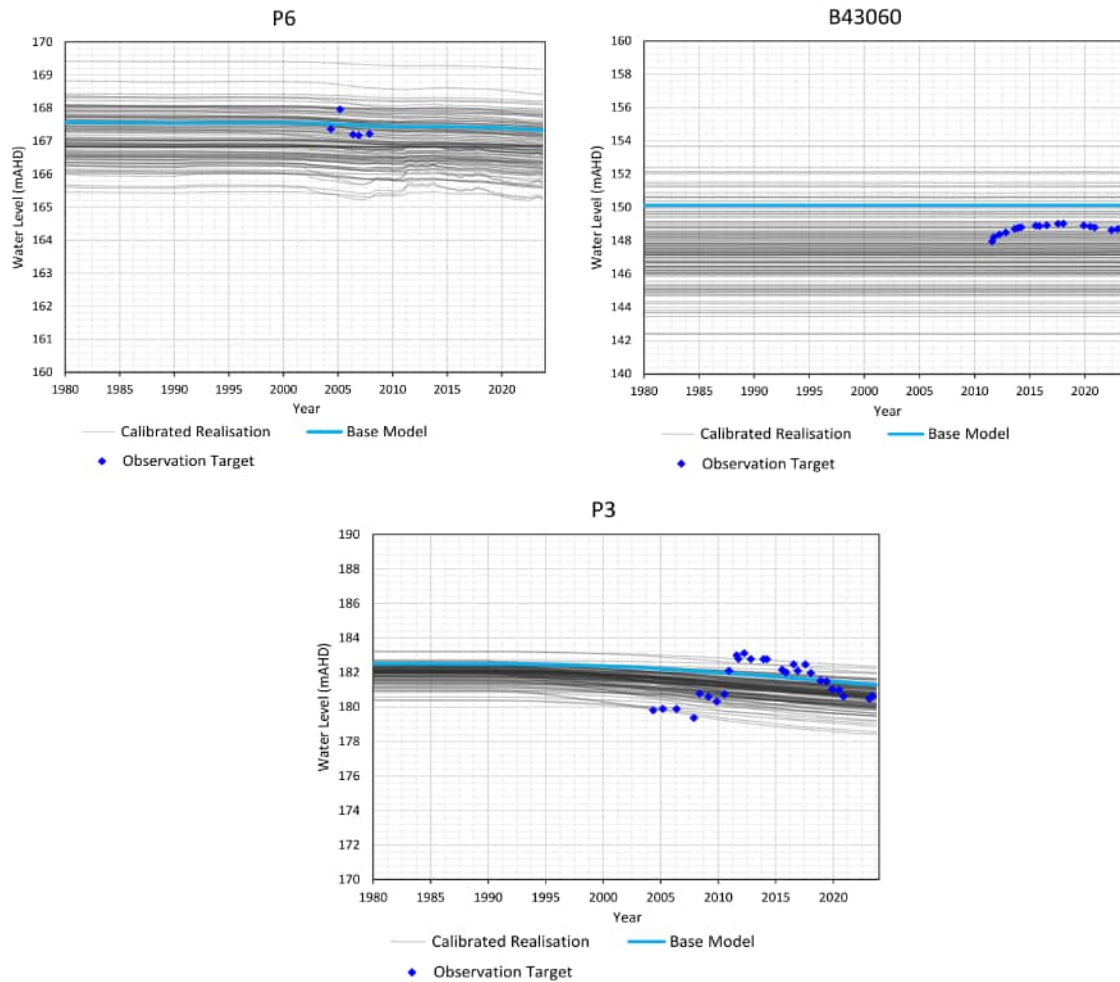


Figure 2-13 Calibration Fit - Alluvium and Regolith Bores

2.7.5.2 Interburden

The hydrographs for some of the Interburden bores are shown in **Figure 2-14**. The hydrographs shown in **Figure 2-14** for bores MB20NPM07A, NPMMB03_01, and MBP003B in the Interburden layers, located in the south of East pit, north of Leichhardt pit, and next to the price pit, respectively. The hydrographs show that the model results in a reasonable (± 2 m) fit between modelled and observed groundwater levels for bores MB20NPM07A and NPMMB03_01. At NPMMB03_01, the measured upward trend is not reproduced by the model. At bore MBP003B, the upward trend (recovery) is well reproduced but is slightly delayed. Absolute groundwater levels are underpredicted by a maximum of 10 m in this area.



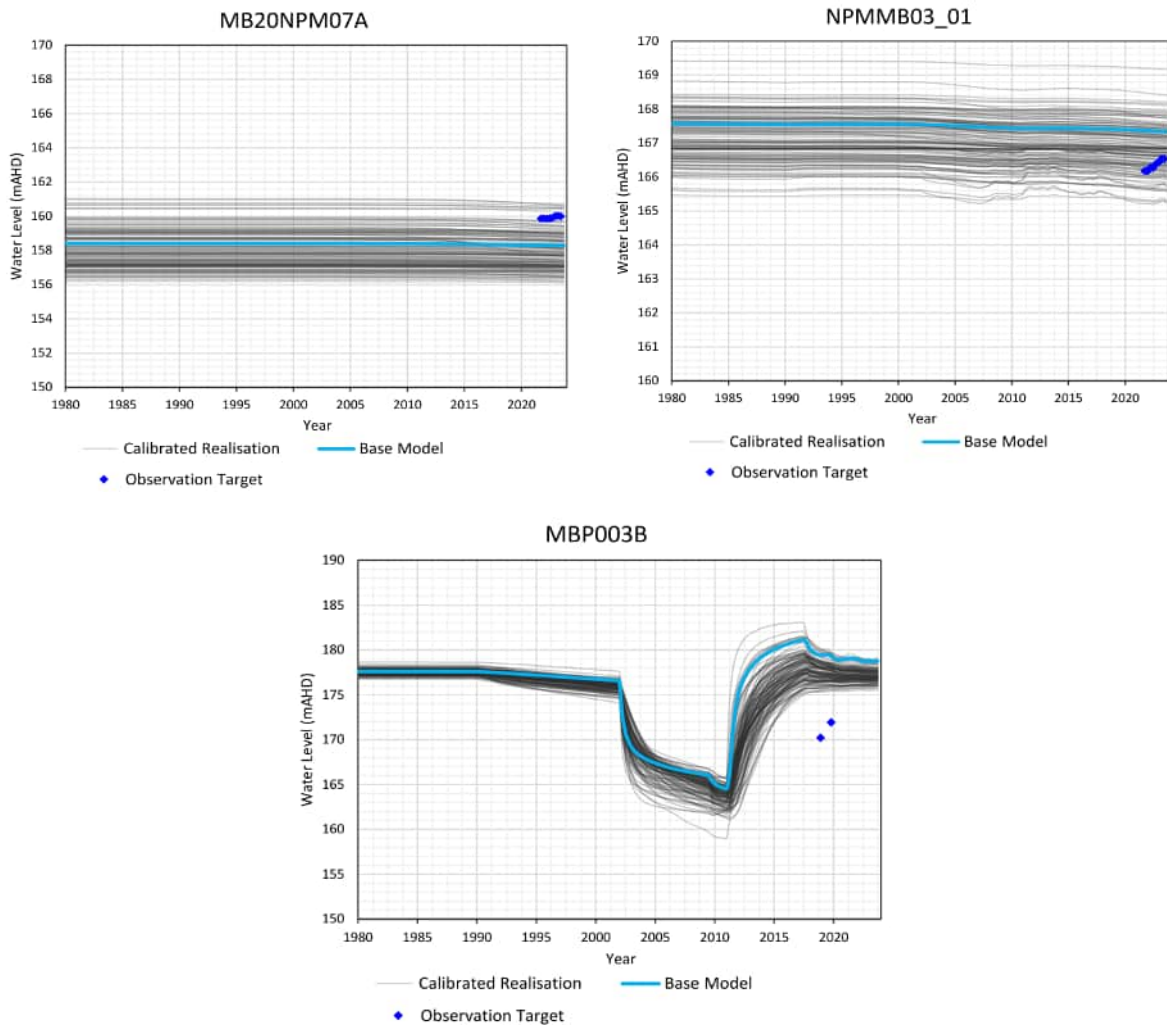


Figure 2-14 Calibration Fit - Interburden Bores

2.7.5.3 Coal Seams

The hydrographs shown in **Figure 2-15** for bores NPMMB06_03, P6R, MB20NPM04P, and MBL01A in the coal seams layers, located in the P, H, H, and D seams, respectively. The hydrographs show that the model results in a reasonable (± 3 m) fit between modelled and observed groundwater levels for bores NPMMB06_03, P6R, MB20NPM04P, and MBL01A.



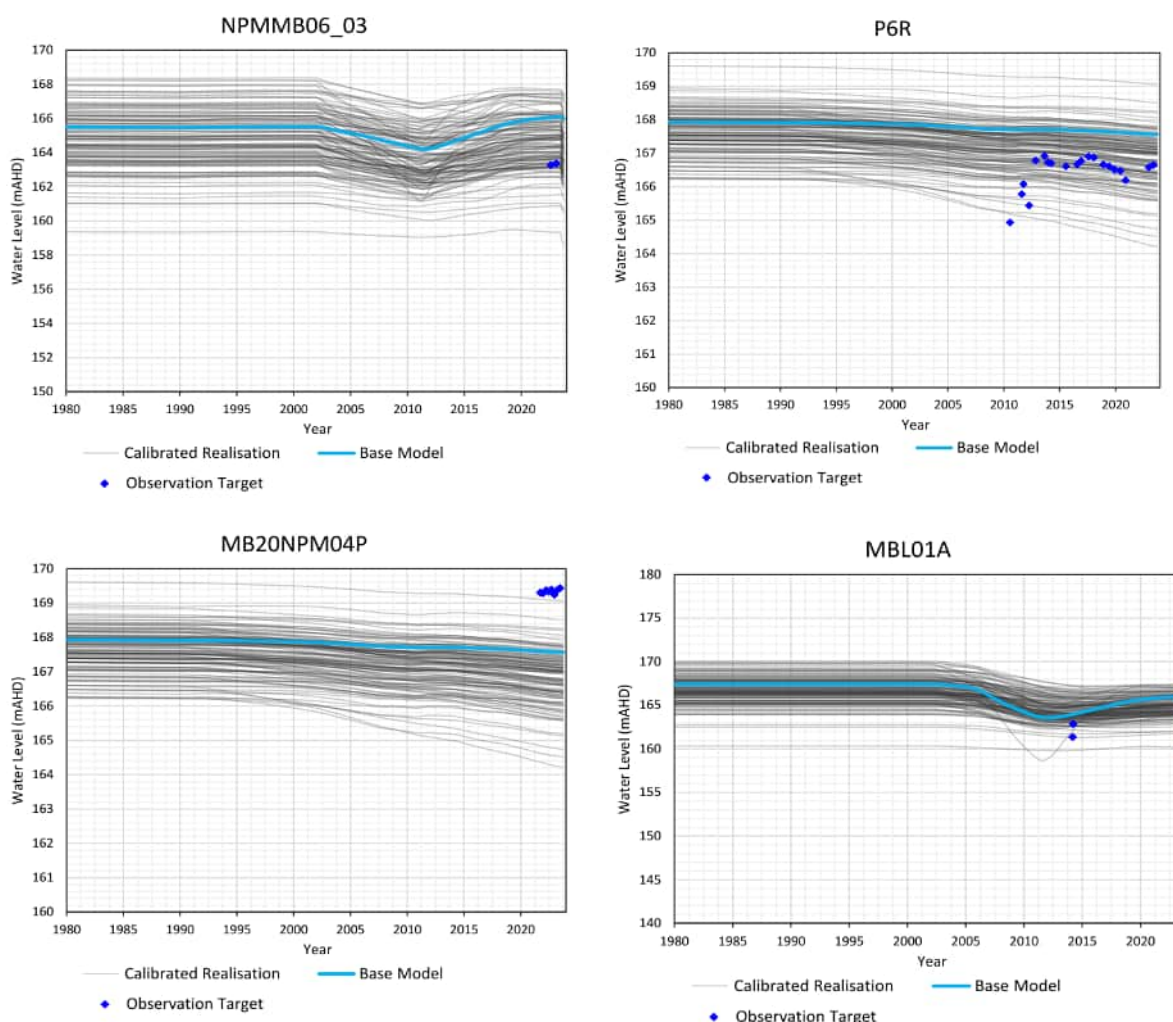


Figure 2-15 Calibration Fit – Coal Seams Bores

2.7.6 Model Water Balance

2.7.6.1 Steady State Calibration

The water balance for the steady state model calibration is shown in **Table 2-8**. The water balance for the steady-state model indicates that regional groundwater flow was the largest net inflow contributor (4.9 ML/d) followed by recharge (1 ML/d). Regional groundwater outflow is the largest source of groundwater outflow (5.55 ML/d), indicating that groundwater primarily leaves the model domain through this boundary. Another factor that contributes to outflow from the groundwater system is evapotranspiration (0.31 ML/d outflow) where the water table is within a few metres of the land surface. The mass balance error for the steady state calibration is 0.00 %, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), and indicating the model is stable and achieves an accurate numerical solution.



Table 2-8 Steady-State Model Water Balance – Base Model

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Outflow (%)
Recharge (RCH)	0.98	16.64	0.00	0.00
ET (from GW) (EVT)	0.00	0.00	0.31	5.22
Constant Head (CHD)	0.00	0.00	0.00	0.00
Regional GW Flow (GHB)	4.88	83.36	5.55	94.78
Mines (DRN)	0.00	0.00	0.00	0.00
Storage	0.00	0.00	0.00	0.00

2.7.6.2 Transient Calibration

The model water balance for the transient simulation averaged over the duration of the calibration period is presented in **Table 2-9**.

The water balance for the transient calibration period indicates that recharge to the groundwater system within the model averages 1.11 ML/day. Approximately 0.29 ML/day is lost to evapotranspiration in areas where the water table is within a few metres of the land surface.

The net flux from the GHB component is -0.68 ML/day indicating that groundwater leaves the model domain through this boundary. 1.58 ML/day is removed from the model by the Drain boundary condition that represents mining in the model. CHD inflow and outflow are 8.40 and 0.78 ML/d respectively indicating a net inflow of approximately 7.62 ML/d.

The mass balance error for the transient calibration is 0.00 %, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), and indicating the model is stable and achieves an accurate numerical solution.

Table 2-9 Transient Model Water Balance – Base Model

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Outflow (%)
Recharge (RCH)	1.11	6.56	0.00	0.00
ET (from GW) (EVT)	0.00	0.00	0.29	1.70
Constant Head (CHD)	8.40	49.79	0.78	4.62
Regional GW Flow (GHB)	4.88	28.96	5.56	32.98
Mines (DRN)	0.00	0.00	1.58	9.37
Storage	2.48	14.70	8.66	51.33

2.8 Calibrated Hydraulic Parameters

Table 2-10 provides a summary of the model layer parameter values for horizontal and vertical hydraulic conductivity for the Base Model. The distribution of hydraulic conductivity for all realisations are discussed in **Section 4.0**. The hydraulic parameter zones in all the model layers are presented in **Appendix D**.



Table 2-10 Hydraulic Conductivity – Base Model

Model Layer	Formation	Unit	Horizontal Hydraulic Conductivity (m/day)	Anisotropy Kv/Kh
1	Alluvium Quaternary	Surface cover	0.14	0.02
1	Regolith	Surface cover	0.60	0.12
2	Regolith	Surface cover	6.39	0.05
3	Fort Cooper Coal Measures	Fort Cooper overburden*	0.06	0.13
4		Fort Cooper seam*	0.0001	0.10
5		Fort Cooper underburden*	100	0.18
6	Moranbah Coal Measures	Q Seam*	0.01	0.42
7		Interburden*	1.12	0.71
8		P Seam*	5	0.28
9		Interburden*	100	0.05
10		H Seam*	0.07	0.003
11		Interburden*	0.29	0.72
12		D Seam*	0.01	0.005
13		Base of Model – aquitard*	0.19	0.002
-	-	Faults*	0.064 to 2.37	0.002 to 0.1
-	-	Spoil	0.84	0.35

*Kx value correspond to Kx0

A depth dependence equation for the coal measures was used in the numerical groundwater model and therefore the calibrated hydraulic conductivity values vary across the model domain. As shown in **Figure 2-16**, the modelled horizontal hydraulic conductivity values are all within the range of field data.



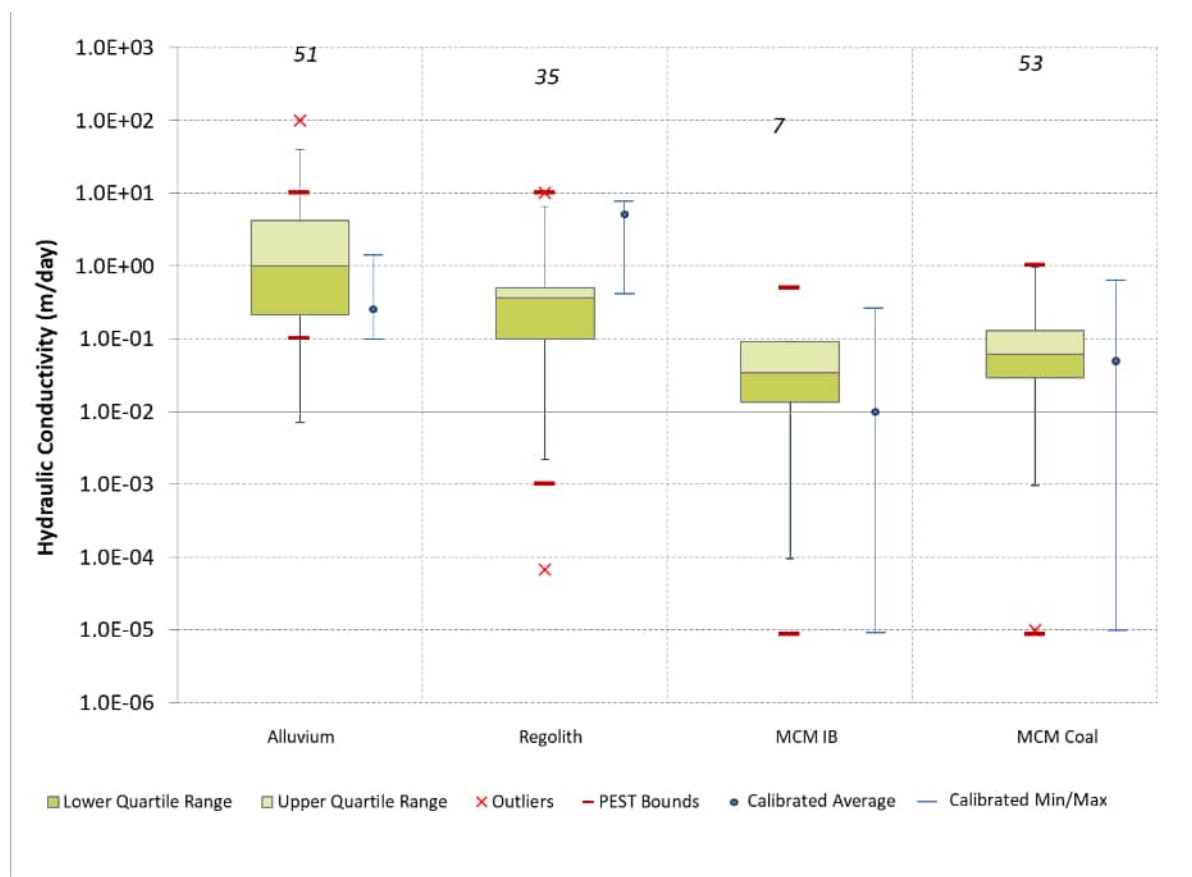


Figure 2-16 Calibrated Hydraulic Conductivity VS Site Data – All Realisations

2.9 Calibrated Storage Properties

Table 2-11 summarises the calibrated values of specific storage and specific yield for the hydrostratigraphic units.

Table 2-11 Calibrated Storage Parameters – Base Model

Model Layer	Formation	Unit	Specific Yield Sy	Specific Storage Ss (m ⁻¹)
1	Alluvium Quaternary	Surface cover	0.13	5.5 X 10 ⁻⁰⁶
1	Regolith	Surface cover	0.03	4.3 X 10 ⁻⁰⁵
2	Regolith	Surface cover	0.05	5.4 X 10 ⁻⁰⁷
3	Fort Cooper Coal Measures	Fort Cooper overburden	0.008	1.8 X 10 ⁻⁰⁷
4		Fort Cooper seam	0.002	1.1 X 10 ⁻⁰⁶
5		Fort Cooper underburden	0.002	6.1 X 10 ⁻⁰⁶
6	Moranbah Coal Measures	Q Seam	0.01	5.5 X 10 ⁻⁰⁶
7		Interburden	0.02	3.5 X 10 ⁻⁰⁶
8		P Seam	0.003	3.2 X 10 ⁻⁰⁶



Model Layer	Formation	Unit	Specific Yield Sy	Specific Storage Ss (m ⁻¹)
9		Interburden	0.006	3.8 X 10 ⁻⁰⁶
10		H Seam	0.002	1.6 X 10 ⁻⁰⁷
11		Interburden	0.008	6.5 X 10 ⁻⁰⁷
12		D Seam	0.0001	3.0 X 10 ⁻⁰⁶
13		Base of Model - aquitard	0.005	1.0 X 10 ⁻⁰⁵
	Fault		0.001 to 0.04	1.7 X 10 ⁻⁰⁷ To 1.0 X 10 ⁻⁰⁵
	Spoil		0.12	1.0 x 10 ⁻⁶

2.10 Calibrated Recharge

Table 2-12 presents the calibrated recharge rates for each zone in the model. These calibrated recharge rates have been adopted into the predictive model. The recharge zones in the model layers are presented in **Figure 2-4**. The mean annual rainfall was assumed 607 mm/year.

Table 2-12 Calibrated Rainfall Recharge – Base Model

Model Recharge Zone	% of Deep Drainage	% of Rainfall	Long-term Average Rainfall Recharge (mm/yr)
Alluvium Quaternary	22 %	0.4 %	2.20
Regolith	0.06 %	0.001 %	0.006
Weathered Permian	0.4 %	0.006 %	0.038
River	6 %	0.1 %	0.60
Spoil	26 %	0.4 %	2.57

2.11 Calibrated Evapotranspiration

Table 2-13 presents the calibrated EVT rates and EVT extinction depth for each zone in the model. These calibrated values have been adopted into the predictive model. The EVT zones in the model layers are presented in **Figure 2-5**.

Table 2-13 Calibrated Evaporation Rate and Extinction Depth Bounds

Model EVT Zone	EVT factor of PAN	EVT Depth (m)	Long-term Average EVT (mm/yr)
River	0.78	12	1,274
Forest areas	0.79	3.8	1,300
Bare areas	0.97	2	1,588

2.12 Calibrated General Head Boundary

Table 2-14 presents the calibrated General Head Boundary (GHB) conductance factor in the model, excluding the area covered by the Saraji East model, as discussed in **Section 2.5.1**.



One conductance factor value has been applied to all cells and a head multiplier per layer. These calibrated values have been adopted into the predictive model.

Table 2-14 Calibrated General Head Boundary (GHB) Conductance Factor and Head

Model GHB Zone	GHB Conductance Factor	GHB Head Multiplier
Layer 1	0.28	0.91
Layer 2		0.98
Layer 3		0.93
Layer 4		1.01
Layer 5		0.97
Layer 6		1.02
Layer 7		1.04
Layer 8		0.97
Layer 9		0.97
Layer 10		1.01
Layer 11		0.98
Layer 12		1.04
Layer 13		0.97



3.0 Predictive Modelling

Post-mining groundwater impacts at SSM were investigated for the PRCP hydrogeology assessment with a numerical groundwater recovery model.

3.1 Model Setup

The recovery stress periods of the overall model setup commence from the end of mining at SSM and were run for 578 years over 32 model stress periods. The recovery stress period setup is shown in **Table 3-1**.

Table 3-1 Recovery Model Stress Periods

Recovery Stress Periods	Recovery Stress Period Duration (Years)	Starting Year (Post-Mining at SSM)	Ending Year (Post-Mining at SSM)
1 – 18	1	1	18
19-22	5	19	38
23-26	10	39	78
27-28	50	79	178
29-32	100	179	578

The SSM final landform was replicated in the model, including areas of spoil emplacement within mined out pits and the proposed residual voids. That is, the model has been updated to reflect mining and landform changes that occur from calibration through to post-mining, including consideration of future mining and adjustments to the locations of current voids and spoil areas as relevant. At the end of mining at SSM, all the drain cells (representing SSM pit dewatering in areas of active mining) were removed from pits. Then the properties of the residual void cells were converted to values representative of void values. That is, the void cells were assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m⁻¹), to simulate free water movement within the residual void. This approach is often referred to as a 'high-K' lake.

Climate related boundary conditions (i.e. recharge and ET) in the recovery model were set constant for the duration of the recovery. Recharge and ET were not applied to the final voids in the groundwater model as the WSP (2024) water balance model used iteratively with the groundwater model accounts for these boundary conditions.

3.2 Integration with Residual Void Water Balance Model

Figure 3-1 presents a conceptual diagram of the post-mining modelling setup adopted for this hydrogeological assessment. As shown in **Figure 3-1**, the residual voids will accumulate water over time due to direct rainfall, surface water runoff and groundwater inflow from both spoil and natural rock as groundwater levels recover. Whilst the numerical groundwater model can reliably account for the groundwater inflow component, the surface components of direct rainfall, surface water runoff, as well as evaporative loss from the void lake, are considered to be better accounted for within a surface water balance model. This is due to the inherently more refined nature of simulating those surface components within a water balance model, as compared to a numerical groundwater model.

The groundwater model was therefore used to predict the following fluxes to the residual voids:



- Groundwater inflow to the pit shell from the surrounding geology, including inflow from the natural geology to the spoil backfill and inflow from the natural geology directly to the residual voids; and
- Groundwater inflow originating from the indirect catchment (i.e. areas of spoil backfill that receive rainfall recharge that then flows through the spoil into the residual voids).

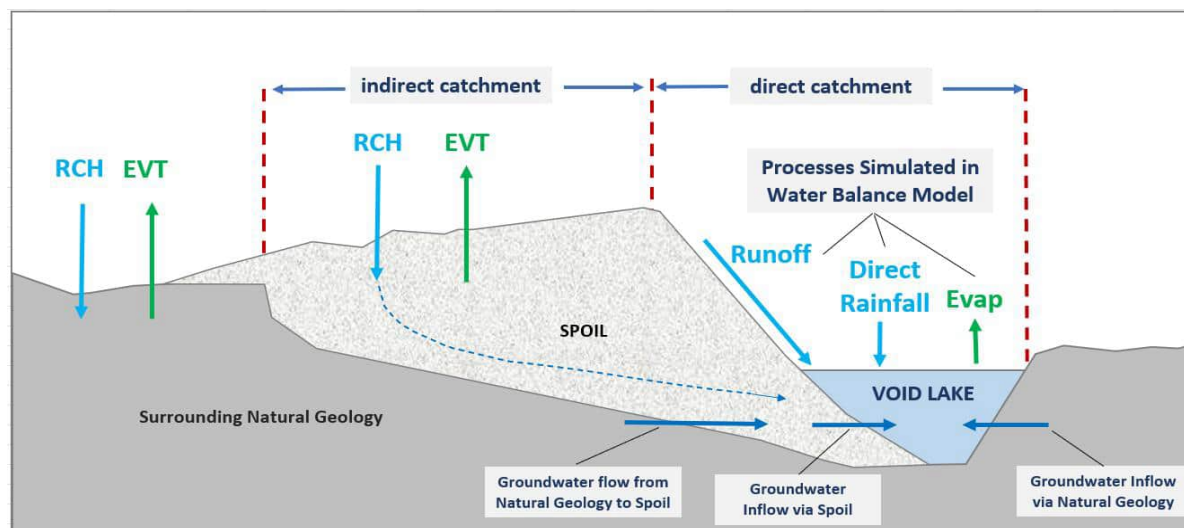


Figure 3-1 Residual Void Recovery Model Conceptual Diagram

Void water levels were not predicted by the groundwater model but were estimated by the balance between groundwater inflow and the direct rainfall and rainfall runoff from the surrounding catchment against the evaporation loss from the lake surface through iterative surface water balance modelling (WSP, 2024). The WSP (2024) surface water balance modelling included climate sensitivity and three climate scenarios reported therein were adopted for the groundwater model as instructed by BMA and shown in **Table 3-2**. That is, three sets of groundwater model predictions were generated for this hydrogeology assessment based on the three climate scenarios.

Table 3-2 Climate Scenarios Modelled

Climate Scenario	Climate Model	IPCC RCP Scenario ¹	WSP (2023) Realisation
Wetter	ACCESS1-0Q	4.5	R#1
Mid	MPI-ESM-LRQ	4.5	R#3
Drier	MPI-ESM-LRQ	8.5	R#6

1. Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway (RCP), refer https://sedac.ciesin.columbia.edu/ddc/ar5_scenario_process/RCPs.html

The iterative modelling approach was undertaken in a stepwise manner as follows, for each climate scenario (i.e. three times):

1. The water balance model for the residual void and depressed landforms prepared by WSP (2024) was first run.
2. The daily surface water inflows were combined with predicted groundwater fluxes to the residual void and depressed landforms from the groundwater model, to produce a surrogate water balance model at a lower temporal resolution (i.e., matching the stress period setup of the groundwater model).



3. The predicted void and depressed landform lake levels from the surrogate water balance model were applied as constant head boundary conditions in the groundwater model, and the groundwater model was re-run to obtain updated groundwater fluxes to the lakes.
4. The surrogate water balance model was re-run with the updated groundwater fluxes, resulting in a new set of predicted lake levels.
5. Steps 3 and 4 were repeated until the time series of predicted lake levels for the residual void and depressed landforms stopped changing substantially between iterations.
6. The converged groundwater fluxes obtained from running the groundwater model and surrogate water balance model in tandem were supplied to the WSP (2024) water balance model.
7. The resulting void lake levels calculated by the WSP (2024) water balance model were compared with the lake levels estimated by the surrogate water balance model to evaluate agreement between the two models.
8. As the lake levels produced by the two water balance models were very similar, the models were determined to have converged, and the results of the groundwater model and the WSP (2024) water balance model were adopted for reporting the PRCP.

The assessment of the iterative model outputs between the groundwater model and the water balance model indicates the northern three SSM voids achieved an appropriate level of convergence for the purpose of this assessment. However, the alignment of the models for Roper and East Pit residual voids did not achieve the same level of convergence. Reasonable efforts to align the models has been completed including development of an auto iterator, to better define the starting point, combined with numerous model iterations. The PRC Plan's approach to the area containing the Roper residual voids includes the implementation of a 'Roper Study Area' and an additional remediation milestone (RM) that provides for additional studies to be completed to inform the further development of the closure landform. The additional data produced for the Roper Study Area will provide for further development of the groundwater and water balance models by providing additional data on groundwater and revised landform designs. Based on this, the PRCP will also be amended where required. Furthermore, the East Pit residual voids are located down dip from the Roper residual voids and changes to the Roper residual voids will impact the hydrogeology and void lakes within the East Pit residual voids. Therefore, the long-term hydrogeology of East Pit residual voids, due to the uncertainty of the Roper Study Area closure landform, is also uncertain. Any remodelling of the Roper residual voids will require consideration/inclusion of the East Pit residual voids. However, as reflected in the PRCP schedule, East Pits are an approved future mining opportunity that will not be commenced prior to the completion of Roper Pit studies and any associated amendment of the PRC Plan. Therefore, prior to the mining of East Pits, the hydrogeology will have been restudied and included in any PRC Plan amendments. The potential for improvement in alignment of the models is acknowledged by BMA.

3.3 Residual Void Lake Recovery

Figure 3-2 through **Figure 3-10** provide a graphical representation of the final simulated recovery of water levels in the residual voids, based on the iterative groundwater and surface water balance modelling. Of note, there is only an approximate 0 to 27 m range in equilibrium lake elevations between the three climate scenarios. It should be noted that, predicted groundwater inflow to the voids is only approximately 10% to 20% of the total



volumetric inflow to the voids, except for the East 1 and East 2 voids, where it is about 50% (see **Section 3.4**). Therefore, within the water balance model the surface water fluxes are the dominant driver for the estimated void water levels and associated trends at most voids, and equally as dominant for the East Pit voids, rather than the predicted groundwater inflow volumes. It is noted that the results for the East Pit voids are significantly related to the modelling of the Roper voids. Additional groundwater data collection and assessment in the Roper Study Area will improve the understanding of groundwater aquifers in the area and improve the modelling calibration and reduce the uncertainty currently present within the model outputs. This will assist to inform the development of an appropriate closure landform for the Roper Study Area that minimises the potential for environmental harm. In turn, it is then expected that the model results for the East Pit voids would be revised.

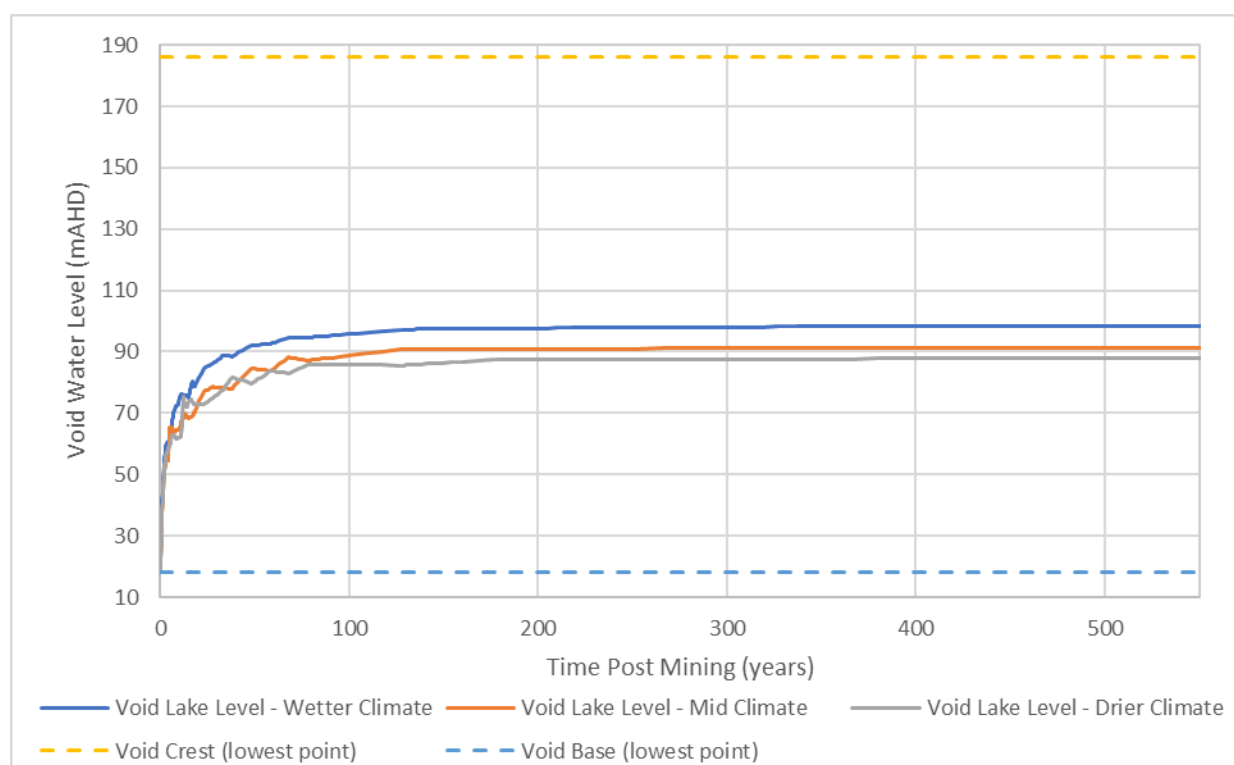


Figure 3-2 Simulated Void Water Level Recovery – Lotus/Campbell Void (based on WSP,2024)



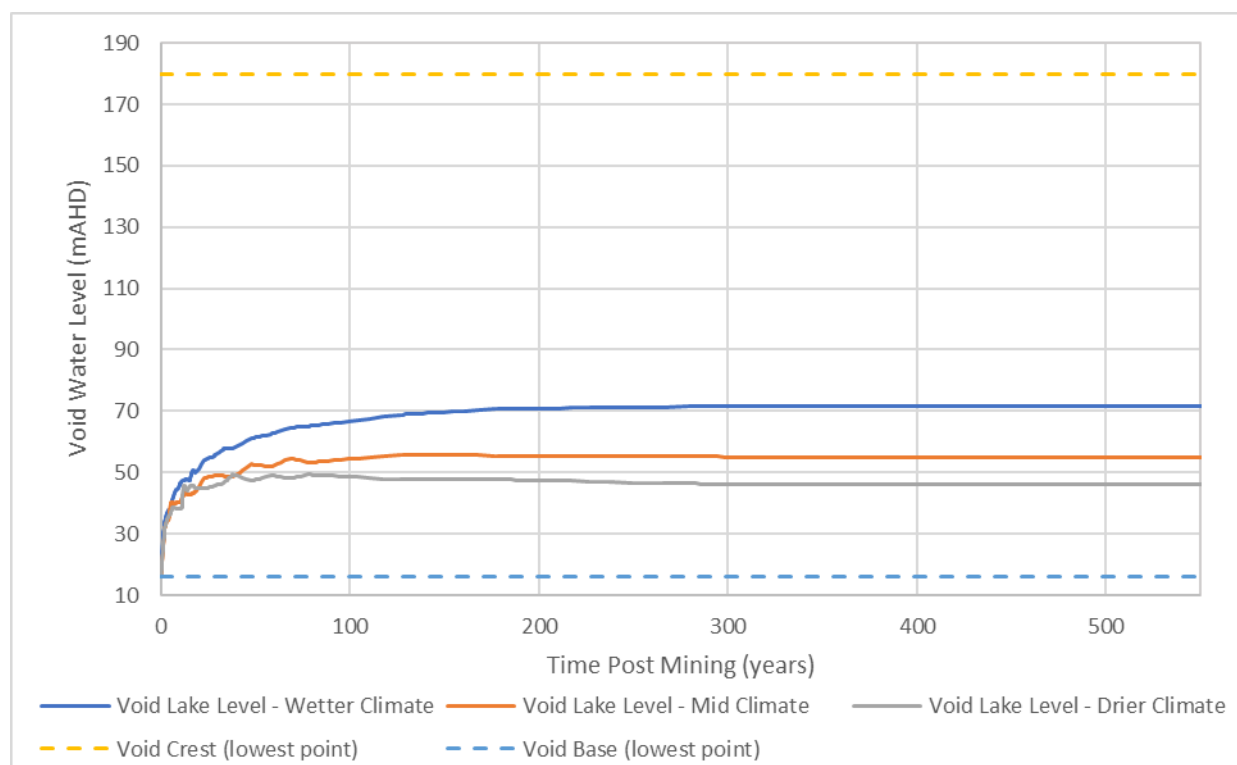


Figure 3-3 Simulated Void Water Level Recovery – Gilbert Void (based on WSP,2024)

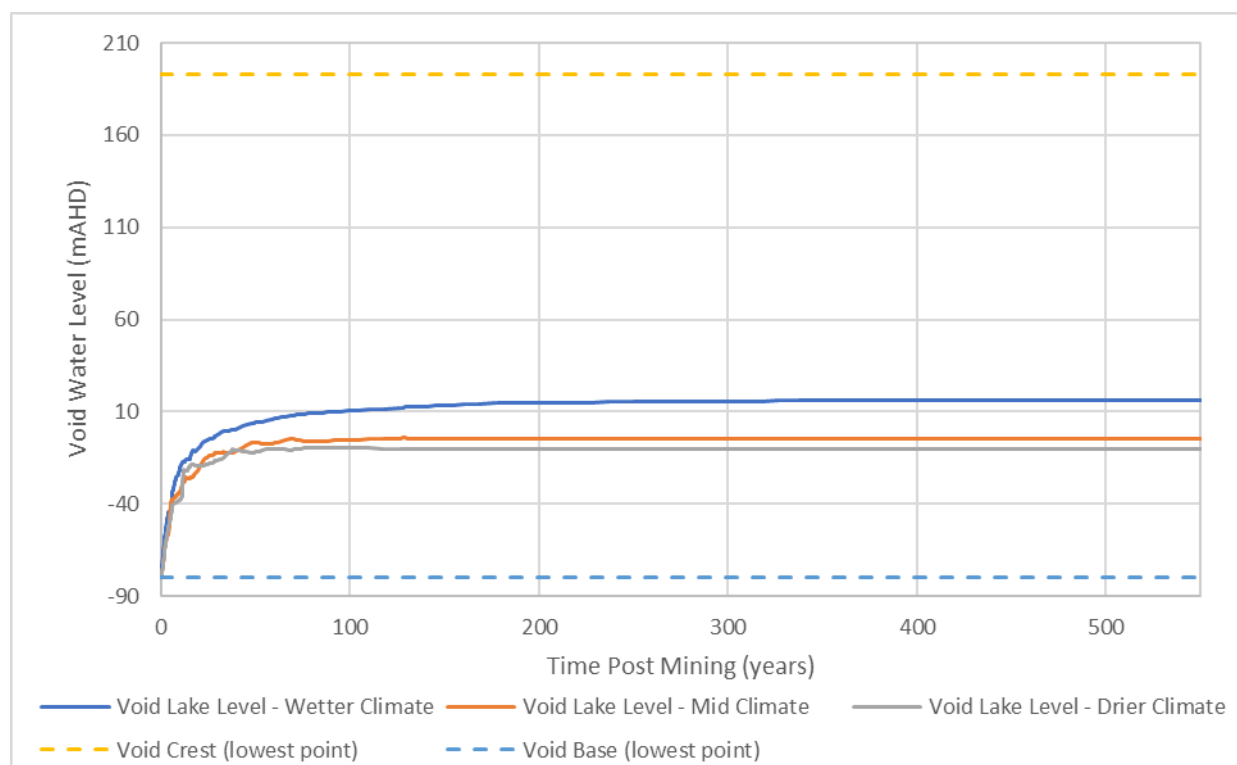


Figure 3-4 Simulated Void Water Level Recovery – Price/ Leichardt Void (based on WSP,2024)



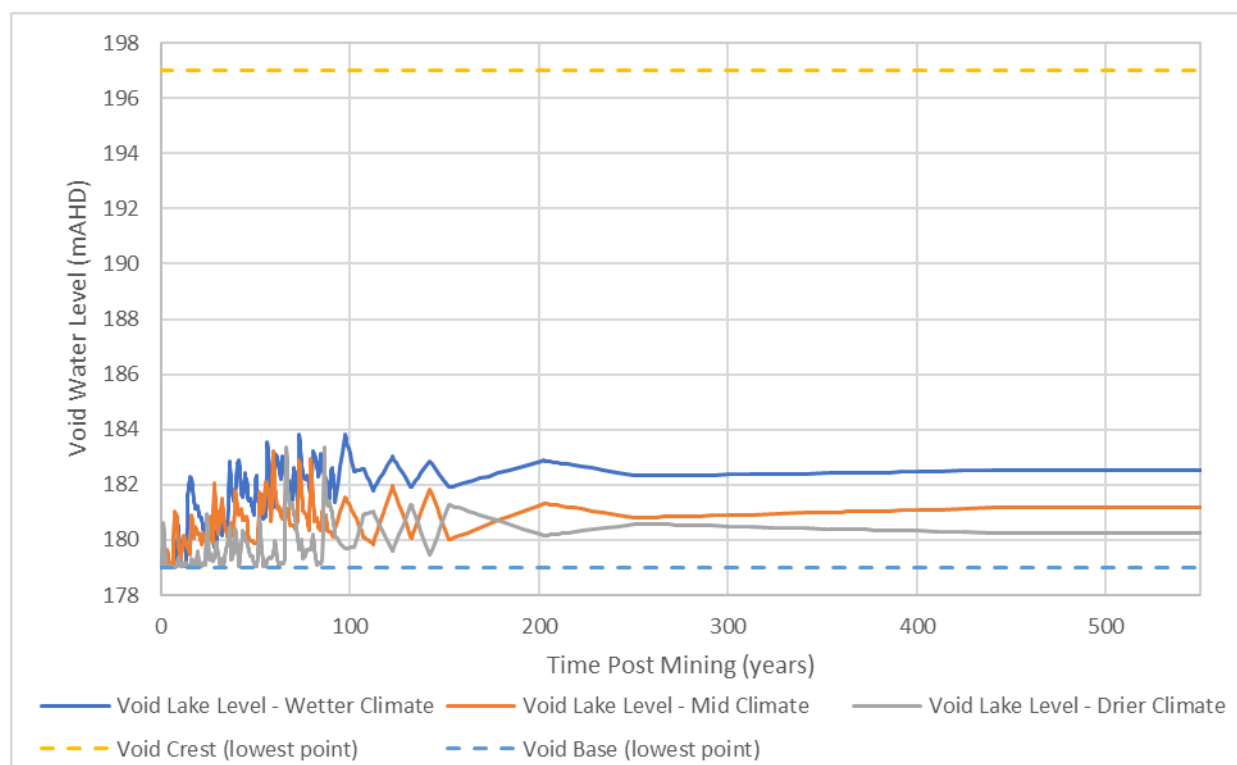


Figure 3-5 Simulated Void Water Level Recovery – Roper 1 Void (based on WSP,2024)

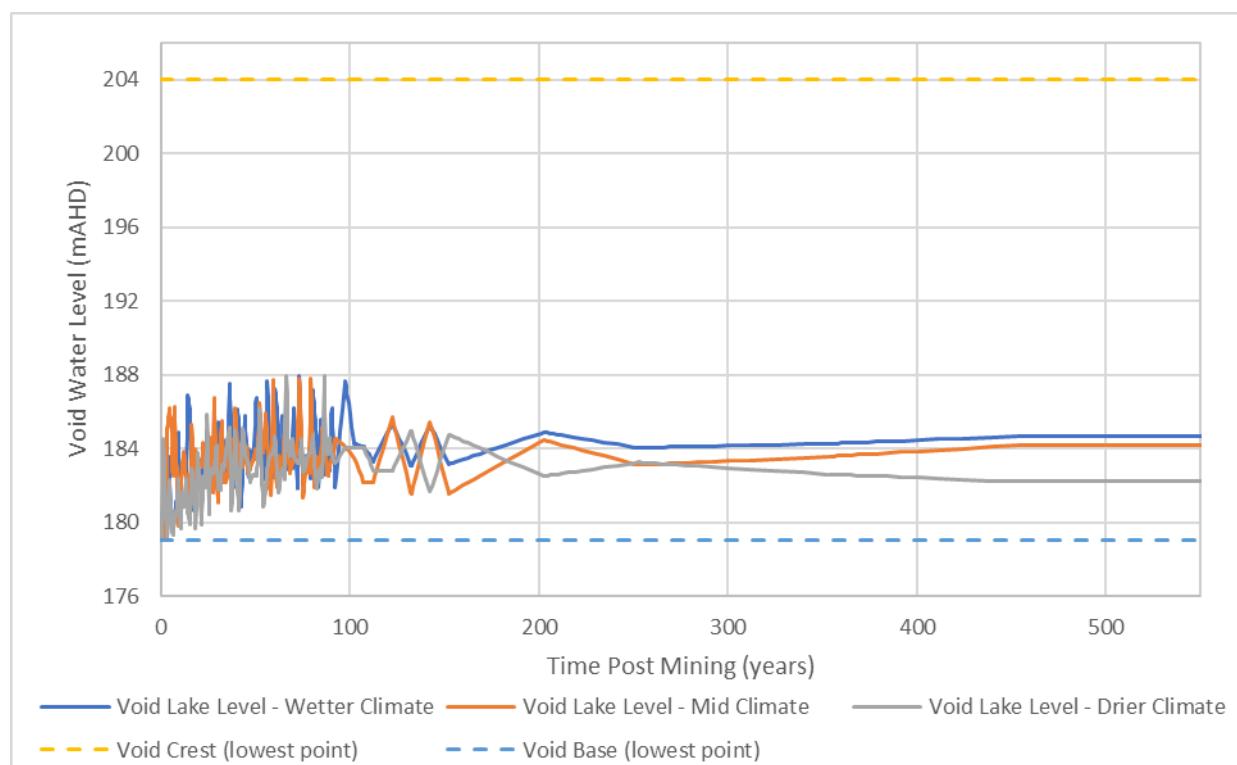


Figure 3-6 Simulated Void Water Level Recovery – Roper 2 Void (based on WSP,2024)



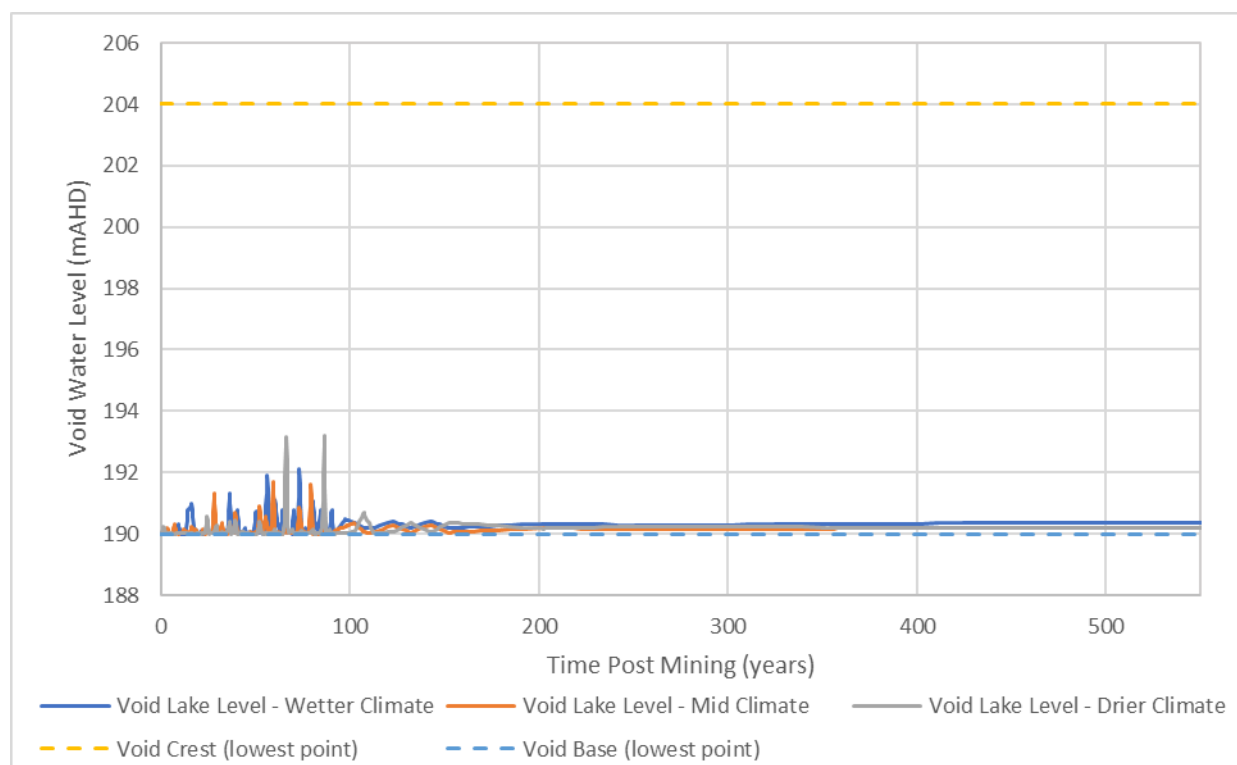


Figure 3-7 Simulated Void Water Level Recovery – Roper 3 Void (based on WSP,2024)

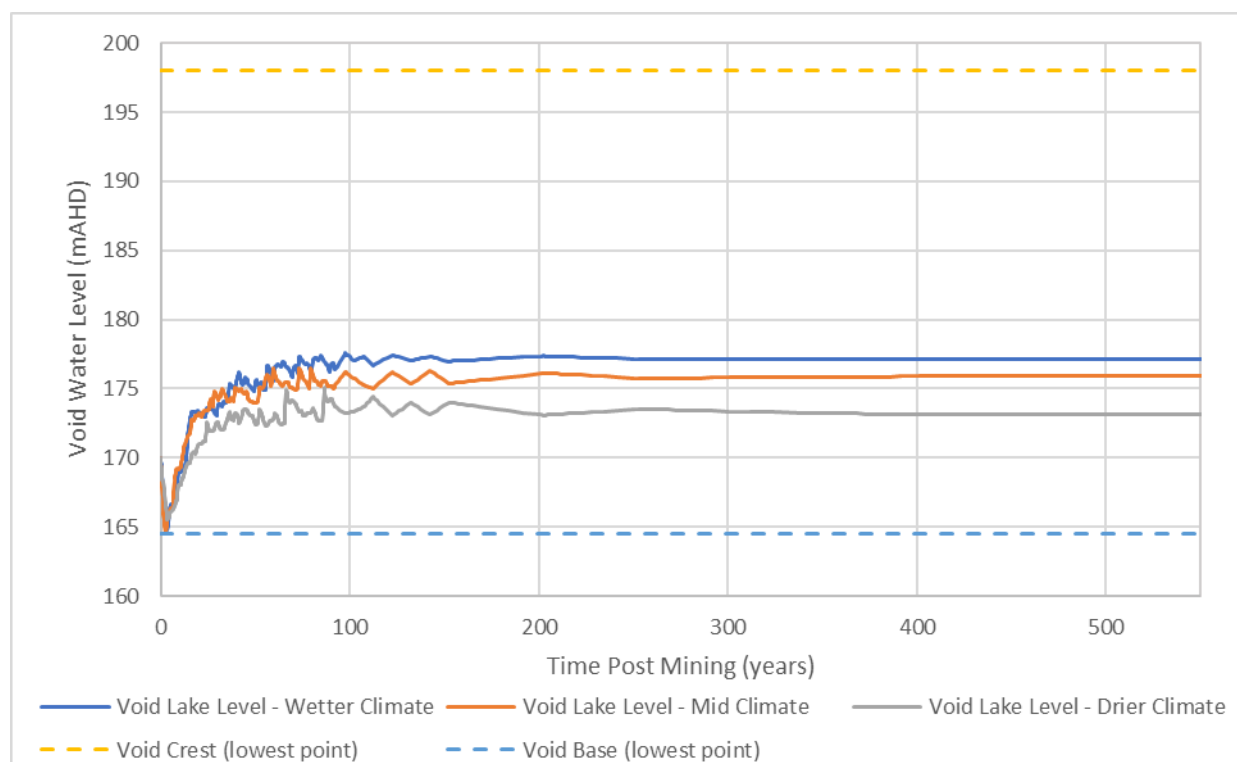


Figure 3-8 Simulated Void Water Level Recovery – Roper 4 Void (based on WSP,2024)



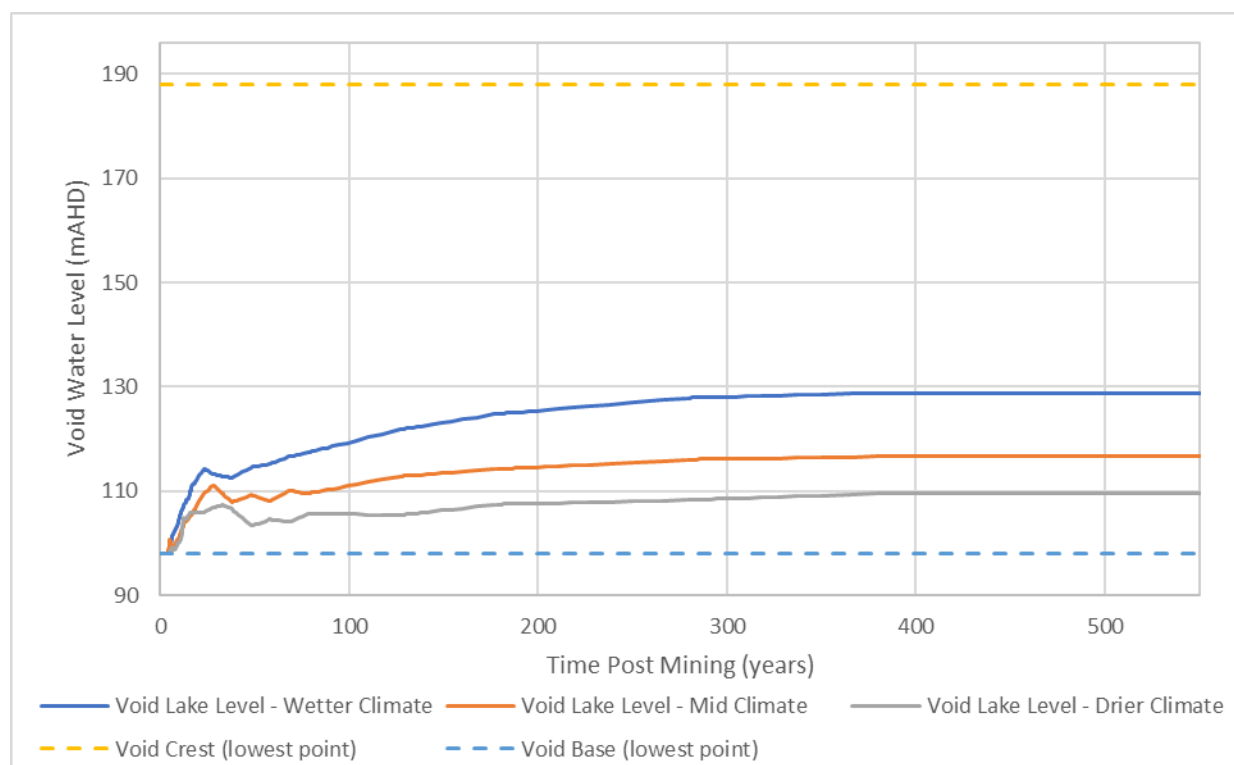


Figure 3-9 Simulated Void Water Level Recovery –East 1 Void (based on WSP,2024)

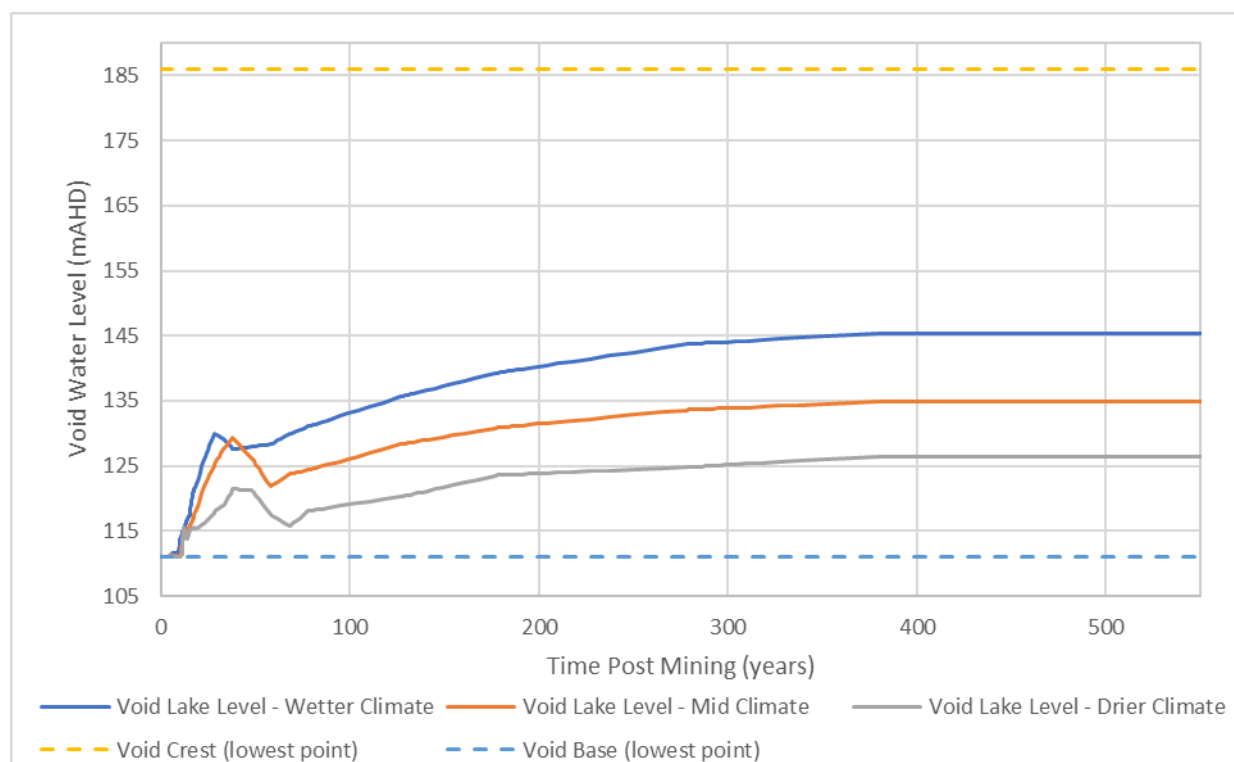


Figure 3-10 Simulated Void Water Level Recovery – East 2 Void (based on WSP,2024)



Figure 3-2 through **Figure 3-10** show that the residual void water level recovery is a process that takes decades with the recovery rate declining as the lakes reach equilibrium conditions. The majority of recovery in the voids is achieved within the first 100 years, except in Roper voids, and equilibrium water level conditions are reached after approximately 50 to 300 years for all climate scenarios represented in the groundwater model. The predicted equilibrated water levels in the residual voids are shown in **Table 3-3**.

Table 3-3 Equilibrated Water Levels in the Residual Voids (based on WSP,2024)

Climate Scenario	Residual Void	Initial water level (mAHD)	Approximate time to equilibrium (years)	Equilibrium water level (mAHD)
Wetter	Lotus/Campbell	18	115	98
	Gilbert	16	110	71
	Price/Leichhardt	-80	167	16
	Roper 1	179	56	182
	Roper 2	179	56	184
	Roper 3	190	56	190
	Roper 4	170	56	177
	East 1	98	247	129
	East 2	111	252	145
Mid	Lotus/Campbell	18	115	91
	Gilbert	16	110	55
	Price/Leichhardt	-80	167	-5
	Roper 1	179	56	181
	Roper 2	179	56	184
	Roper 3	190	56	190
	Roper 4	170	56	176
	East 1	98	247	116
	East 2	111	252	135
Drier	Lotus/Campbell	18	115	88
	Gilbert	16	110	46
	Price/Leichhardt	-80	167	-11
	Roper 1	179	56	180
	Roper 2	179	56	183
	Roper 3	190	56	190
	Roper 4	170	56	173
	East 1	98	247	109
	East 2	111	252	126



The freeboard for each of the residual voids (i.e. the difference in elevation between the long-term water levels in the residual voids and the landform crest elevation) is as shown in **Table 3-4**. Predicted void lake levels remain significantly below the surface 'spill' level for each of the residual voids.

Table 3-4 Predicted Freeboard in the Residual Voids at Equilibrium

Climate Scenario	Residual Void	Freeboard (m)
Wetter	Lotus/Campbell	88
	Gilbert	109
	Price/Leichhardt	177
	Roper 1	15
	Roper 2	20
	Roper 3	14
	Roper 4	21
	East 1	59
	East 2	41
Mid	Lotus/Campbell	95
	Gilbert	125
	Price/Leichhardt	198
	Roper 1	16
	Roper 2	20
	Roper 3	14
	Roper 4	22
	East 1	72
	East 2	51
Drier	Lotus/Campbell	98
	Gilbert	134
	Price/Leichhardt	204
	Roper 1	17
	Roper 2	21
	Roper 3	14
	Roper 4	25
	East 1	79
	East 2	60

The difference in elevation between the long-term water levels in the residual voids and the lowest point of the base of the shallow geologic formations (weathered regolith; model Layer



2) adjacent to the voids is shown in **Table 3-5**. Predicted residual void lake levels remain significantly below the base of the shallow geologic formations for Lotus/Campbell, Gilbert, and Price/Leichhardt residual voids, even with the temporal fluctuations in void water levels predicted by the WSP (2024) water balance model. That is, there is never the potential for a flux of water to leave the residual voids and enter the shallow/unconsolidated geologic formations.

Predicted residual void lake levels are slightly below the base of the shallow geological formations for Roper 2, Roper 3, East 1, and East 2 residual voids. This suggests a possibility of water flowing out of the residual voids and into the shallow geological formations. For the Roper 1 and Roper 4 residual voids, predicted residual void lake levels are higher than the base of the shallow geological formations. So, there is a potential for a flux of water to leave the residual voids and enter the shallow geologic formations. However, as noted in **Section 3.2**, Roper Voids and East Pits are subject to revision and further modelling will need to be undertaken in the future.

Table 3-5 Predicted Difference between Residual Void Water Levels and Shallow Formations

Climate Scenario	Residual Void	Lowest Elevation of Base of Model Layer 2 Adjacent Void (mAHD)	Difference Between Void Lake Level and Lowest Elevation of Base of Model Layer 2 Adjacent Void (M) ¹	
			Start of Post-Mining	Post-Mining Equilibrium
Wetter	Lotus/Campbell	155.3	137.3	57.3
	Gilbert	150.6	134.6	79.6
	Price/Leichhardt	163.2	243.2	147.2
	Roper 1	169.1	-9.9	-12.9
	Roper 2	194.1	15.1	10.1
	Roper 3	197.2	7.2	7.2
	Roper 4	163.4	-6.6	-13.6
	East 1	152.0	54.0	23.0
	East 2	155.1	44.1	10.1
Mid	Lotus/Campbell	155.3	137.3	64.3
	Gilbert	150.6	134.6	95.6
	Price/Leichhardt	163.2	243.2	168.2
	Roper 1	169.1	-9.9	-11.9
	Roper 2	194.1	15.1	10.1
	Roper 3	197.2	7.2	7.2
	Roper 4	163.4	-6.6	-12.6
	East 1	152.0	54.0	36.0
	East 2	155.1	44.1	20.1
Drier	Lotus/Campbell	155.3	137.3	67.3
	Gilbert	150.6	134.6	104.6



Climate Scenario	Residual Void	Lowest Elevation of Base of Model Layer 2 Adjacent Void (mAHD)	Difference Between Void Lake Level and Lowest Elevation of Base of Model Layer 2 Adjacent Void (M) ¹	
			Start of Post-Mining	Post-Mining Equilibrium
	Price/Leichhardt	163.2	243.2	174.2
	Roper 1	169.1	-9.9	-10.9
	Roper 2	194.1	15.1	11.1
	Roper 3	197.2	7.2	7.2
	Roper 4	163.4	-6.6	-9.6
	East 1	152.0	54.0	43.0
	East 2	155.1	44.1	29.1

1. A positive number means the base of Model Layer 2 is that many metres higher than the void lake level

3.4 Residual Void Groundwater Inflow

The final predicted groundwater inflows to the residual voids from the groundwater model are shown on **Figure 3-11** through **Figure 3-19**, with inflows partitioned between that which flows into the residual voids through spoil, and that which flows into the residual voids through surrounding natural geological formations.

In approximately the first 50 years post-mining, groundwater levels are predicted to remain suppressed, particularly within the spoil around each residual void that is yet to saturate to a significant degree. During this time, groundwater fluxes to the voids are largely controlled by the difference between the predicted spoil groundwater levels and the predicted WSP (2024) residual void lake levels that rise and fall periodically (refer **Figure 3-2** through **Figure 3-10**) according to:

- the day-on-day climatic simulation within the WSP (2024) water balance model; and
- how the daily timestep water balance results are translated to the groundwater model's more simplified stress period setup.

Accordingly, there are periods of variable groundwater inflow and outflow predicted by the groundwater model in the first 24 years post-mining at Lotus/Campbell void, 6 years post-mining at Gilbert void, the whole post-mining duration at Roper 1 and Roper 2 voids, 1 year post-mining at Roper 4 void, 14 years post-mining at East 1 void, and 39 years post-mining at East 2 void for the mid climate scenario.

There are periods of variable groundwater inflow and outflow predicted by the groundwater model in the first 34 years post-mining at Lotus/Campbell void, 18 years post-mining at Gilbert void, the whole post-mining duration at Roper 1 and Roper 2 voids, 1 year post-mining at Roper 4 void, 18 years post-mining at East 1 void, and 29 years post-mining at East 2 void for the wetter climate scenario.

There are periods of variable groundwater inflow and outflow predicted by the groundwater model in the first 39 years post-mining at Lotus/Campbell void, 13 years post-mining at Gilbert void, the whole post-mining duration at Roper 1 and Roper 2 voids, 1 year post-mining at Roper 4 void, 14 years post-mining at East 1 void, and 39 years post-mining at East 2 void for the drier climate scenario.



Note that Price/Leichhardt and Roper 3 voids do not show periods of net variable groundwater inflow and outflow, maintaining net groundwater inflow and outflow fluxes, respectively, at all times of the simulation.

Over these periods, rainfall derived surface water captured in the residual voids (per the WSP water balance model) is predicted to move into the spoil, as the groundwater levels in the surrounding in-pit spoil backfill (and natural geological formations) slowly recover from mining activities. All predicted outflows from the Lotus/Campbell, Gilbert, and Price/Leichhardt residual voids over this time occur to the spoil, that is, there is no predicted outflow from these voids to the natural geological formations in the whole post-mining duration.

It is noted that any form of further backfilling of residual voids above the groundwater level as a means to attempt to limit this early post-closure void water discharge will likely result in poorer environmental outcomes, as water in the backfilled voids will have a hydraulic head gradient toward the surrounding groundwater system. This will facilitate discharge outwards to the surrounding environment, in the absence of the hydraulic control (sink) caused by a relatively deep void lake that is maintained by evaporation in the long term (SLR, 2022b).

Predicted outflows are expected from the voids of Roper 1, Roper 2, Roper 3, and Roper 4 to natural geological formations in the whole post-mining period. Additionally, there are predicted outflows from East 1 and East 2 voids to natural geological formations within the first 15 years post-mining. Additional groundwater data collection and assessment in the Roper Study Area will improve the understanding of groundwater aquifers in the area and improve the modelling calibration and reduce the uncertainty currently present within the model outputs. This will assist to inform the development of an appropriate closure landform for the Roper Study Area that minimises the potential for environmental harm.

As groundwater levels in the spoil and natural geology recover to elevations above some of the void lakes and lake levels stabilise, the direction of flow out of those void lakes stabilises and long-term groundwater inflow to the lakes is established after 24 years post-mining at Lotus/Campbell void, 6 years post-mining at Gilbert void, 1 year post-mining at Roper 4 void, 14 years post-mining at East 1 void, and 39 years post-mining at East 2 void for the mid climate scenario. Model results indicate that this inflow comes mostly via the spoil, originating mainly as local rainfall recharge applied to the spoil.



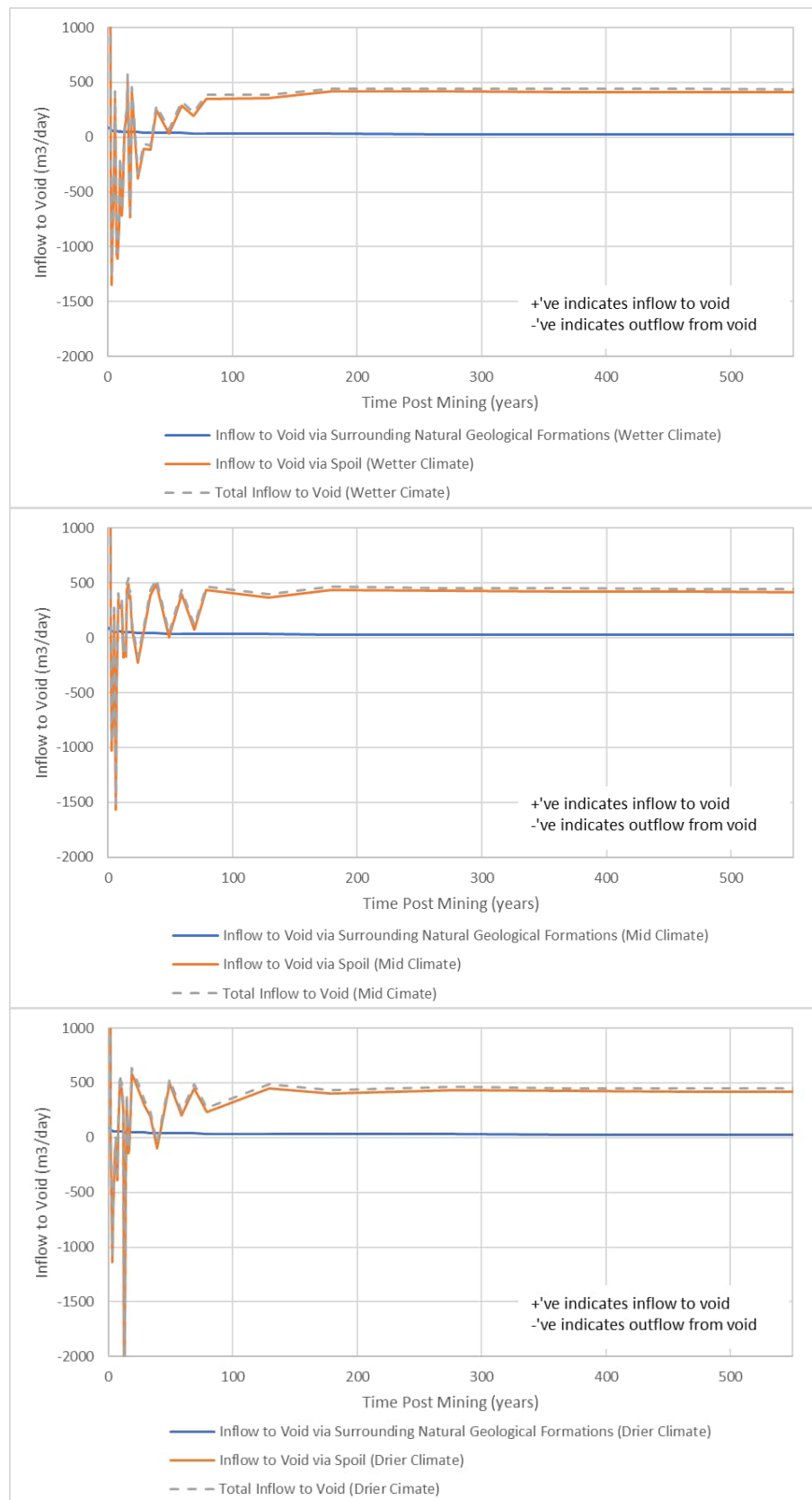


Figure 3-11 Predicted Void Groundwater Inflows – Lotus/Campbell Void



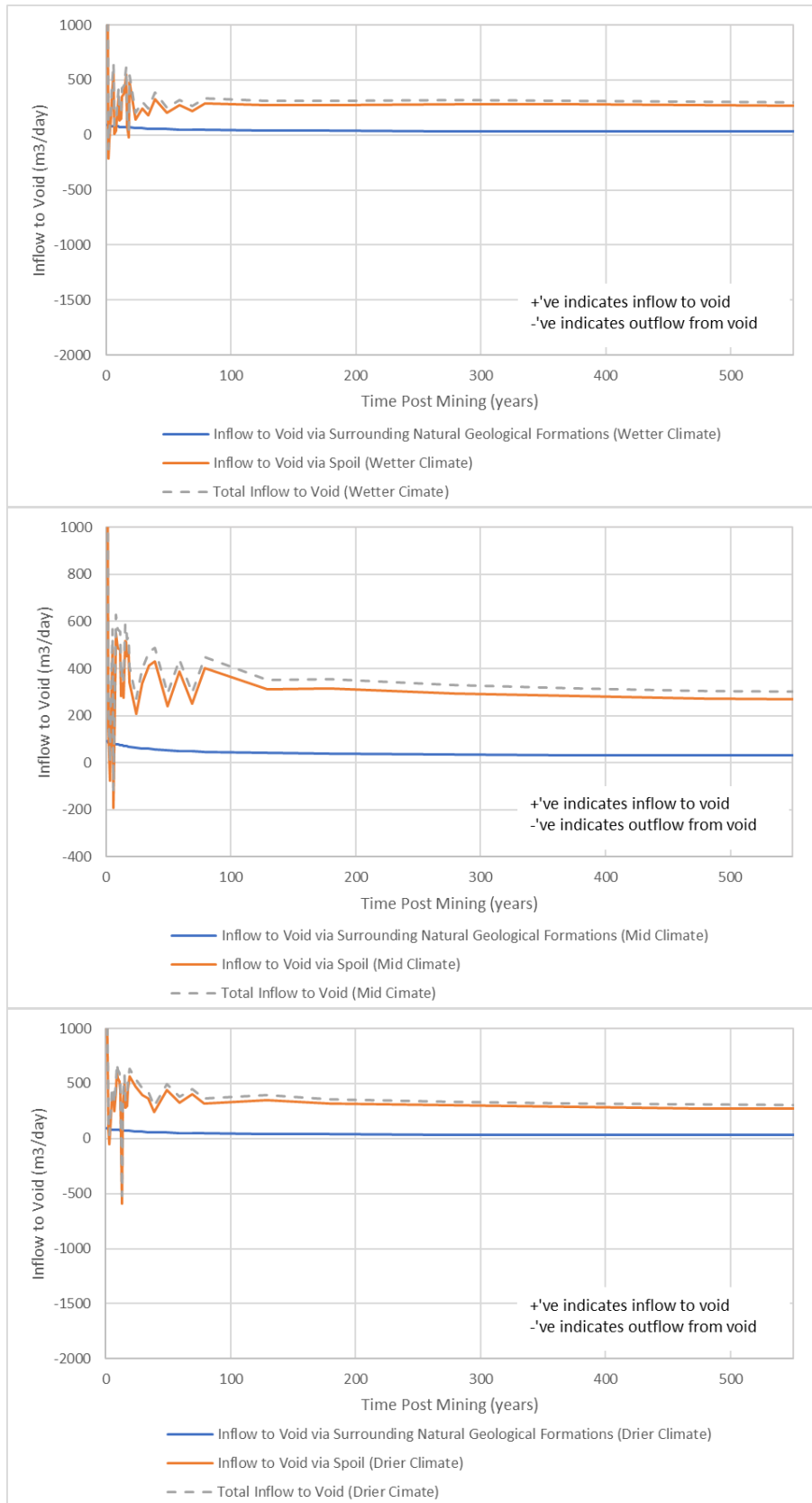


Figure 3-12 Predicted Void Groundwater Inflows – Gilbert Void



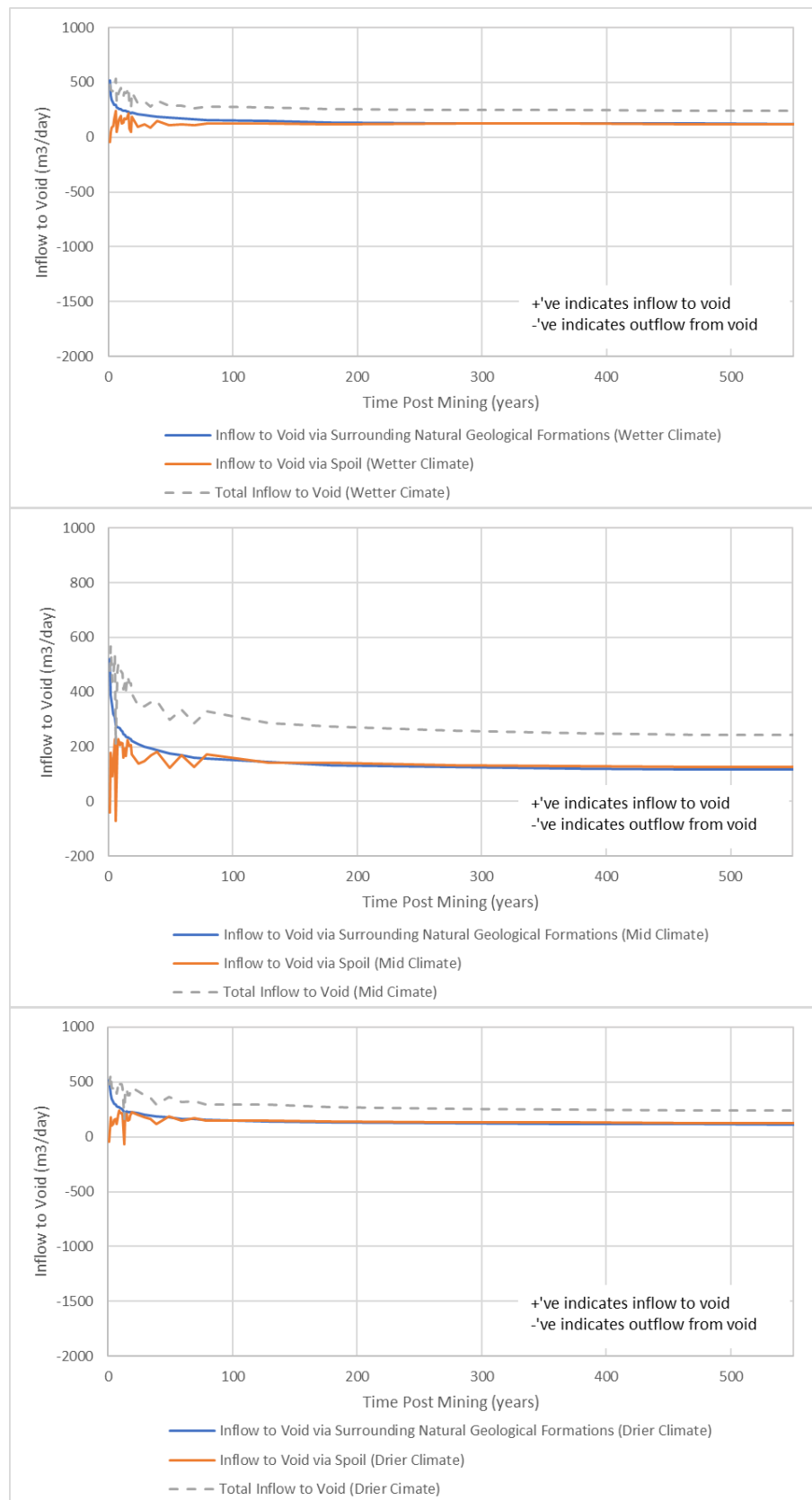


Figure 3-13 Predicted Void Groundwater Inflows – Price\Leichardt Void



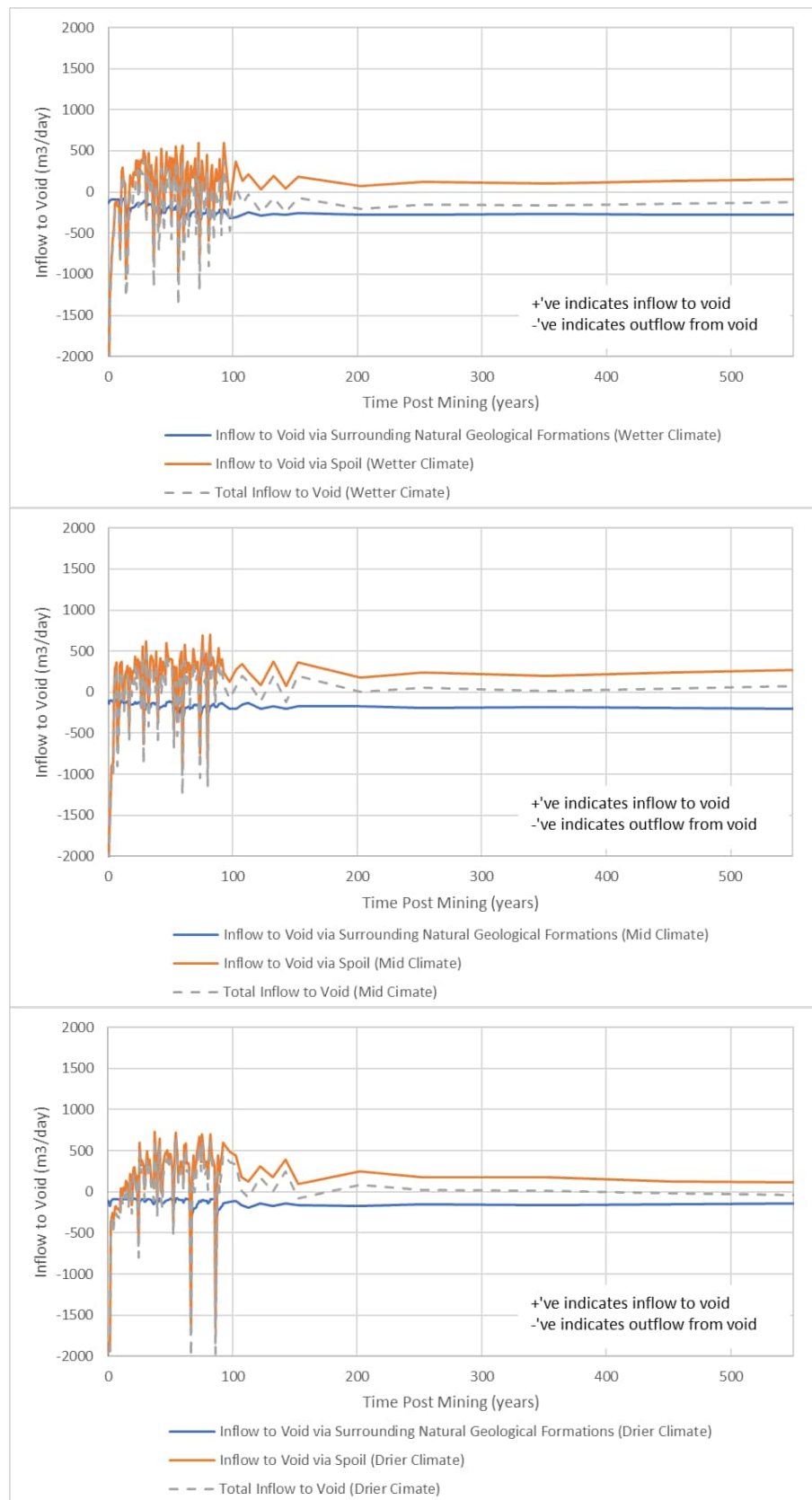


Figure 3-14 Predicted Void Groundwater Inflows – Roper1 Void



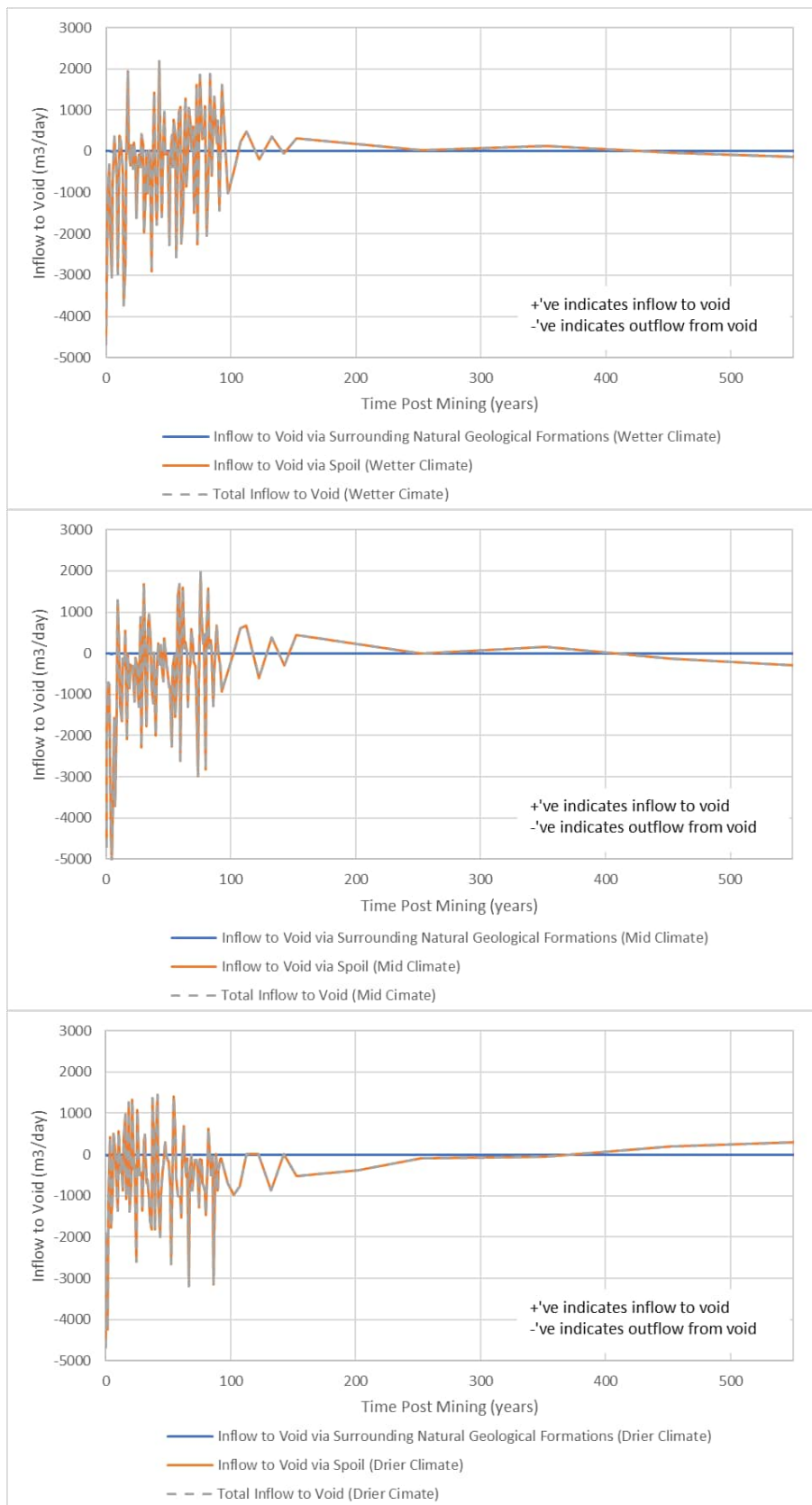


Figure 3-15 Predicted Void Groundwater Inflows – Roper2 Void



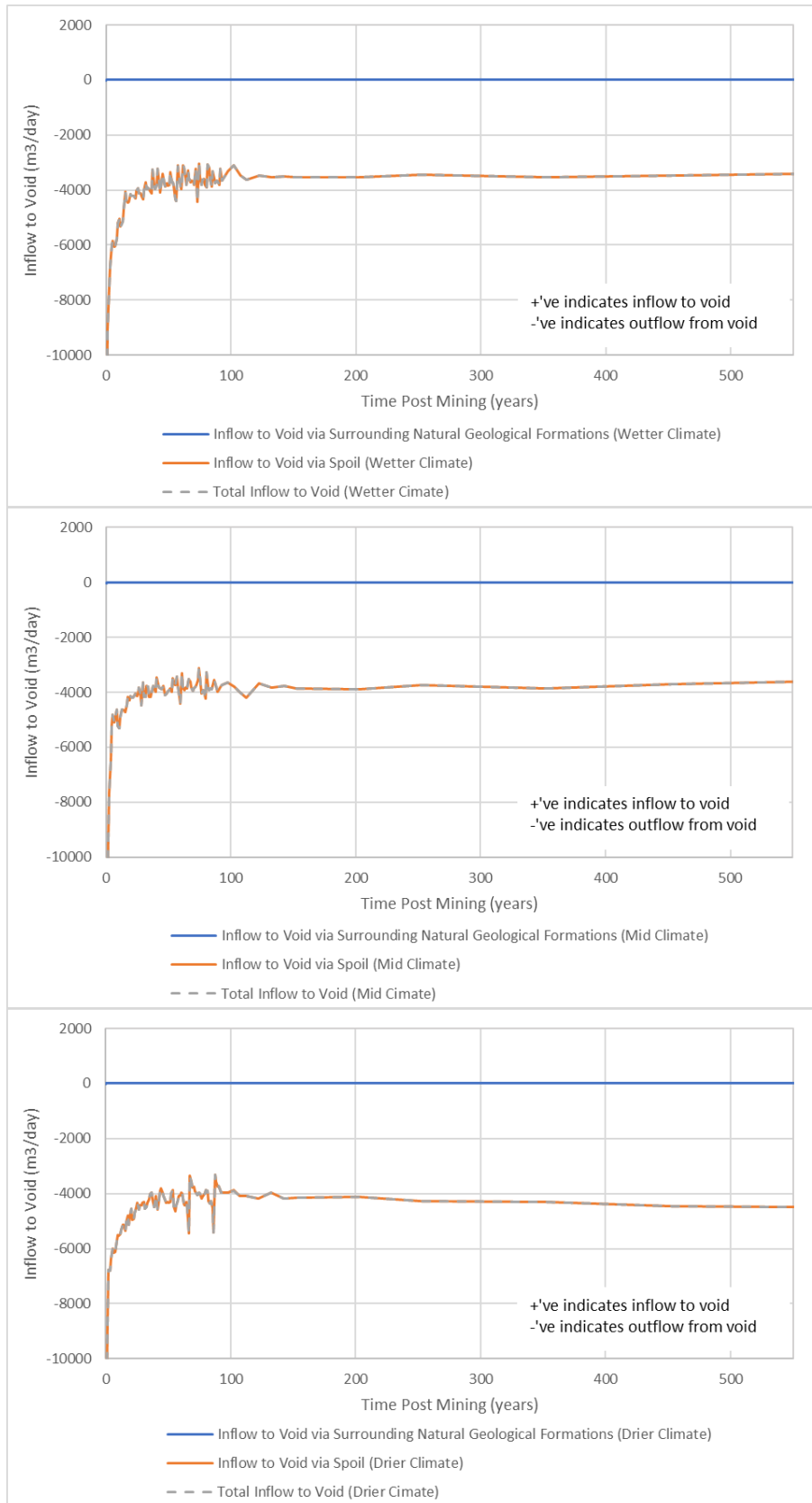


Figure 3-16 Predicted Void Groundwater Inflows – Roper3 Void



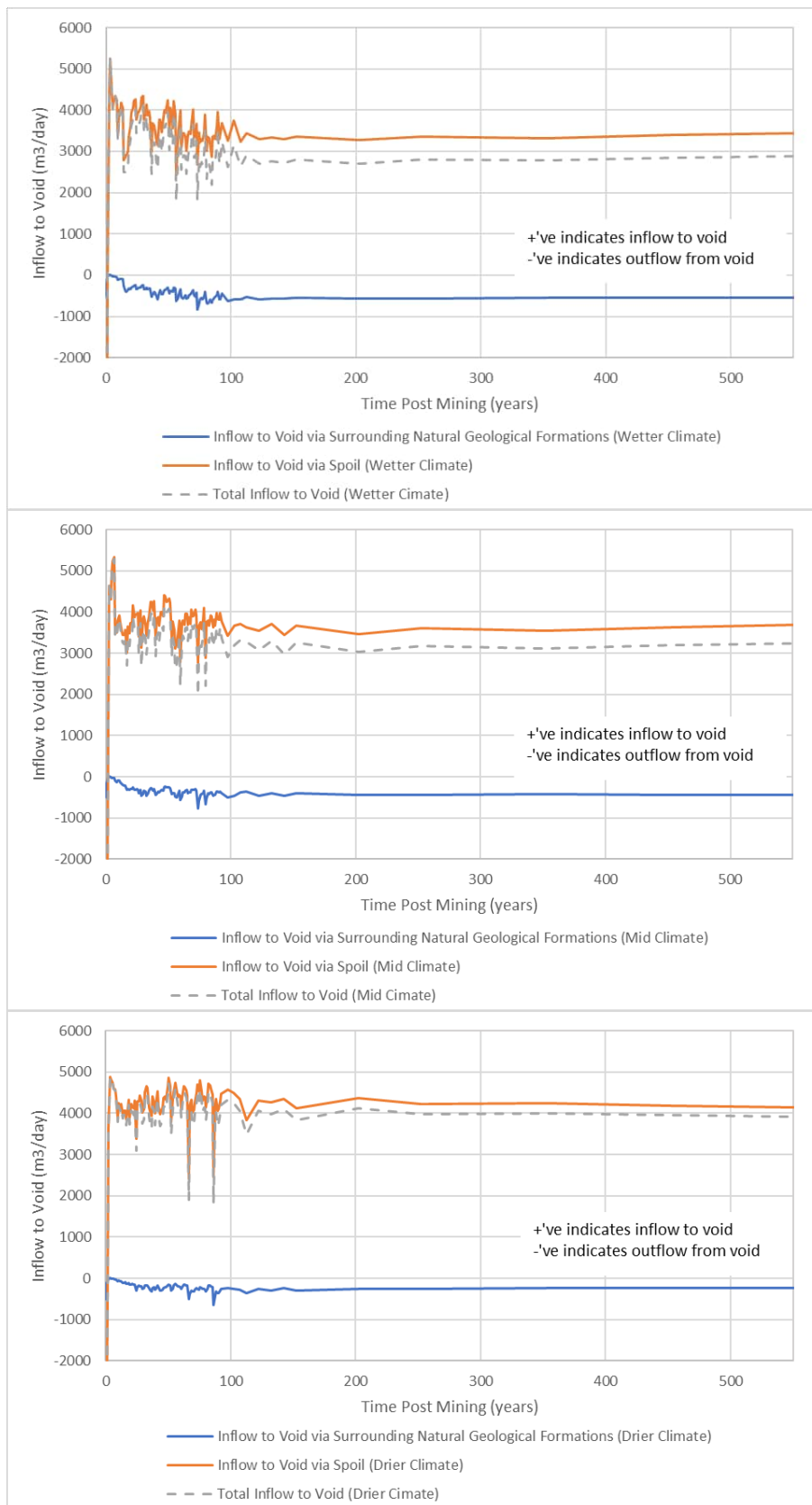


Figure 3-17 Predicted Void Groundwater Inflows – Roper4 Void



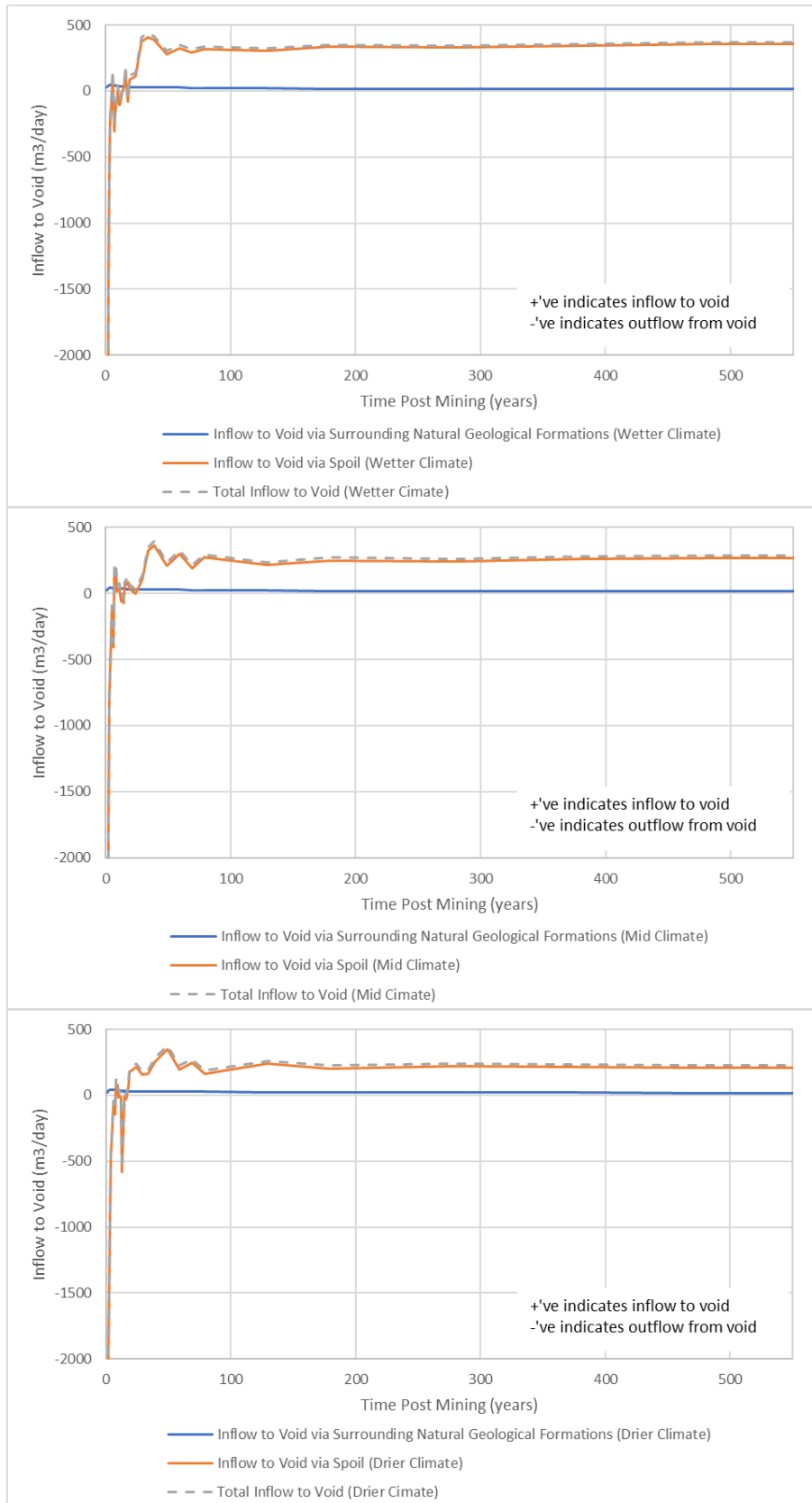


Figure 3-18 Predicted Void Groundwater Inflows – East 1 Void



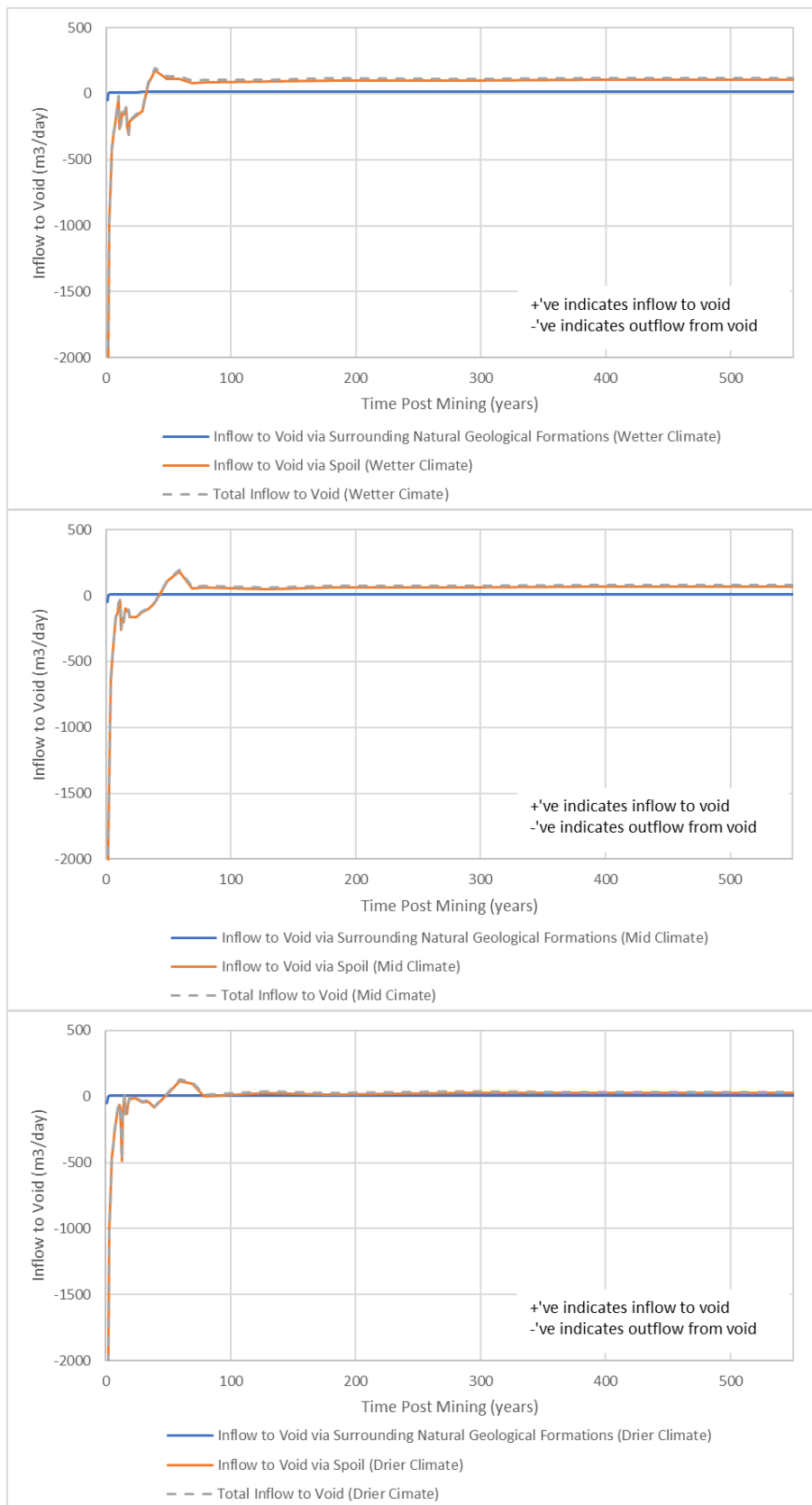


Figure 3-19 Predicted Void Groundwater Inflows – East2 Void



Predicted equilibrium groundwater inflows to each of the voids for the three climate scenarios are presented in **Table 3-6**. Model results indicate that, for most voids, more than 79% of the long term groundwater inflow to the voids comes via the spoil, with between 2% and 29% of this inflow originating as local recharge applied to the spoil, and between 71% and 98% coming from natural geological formations before moving through the spoil into the residual void lakes. Price/Leichhardt is distinct in having a much lower contribution to the void from spoil, with around 50% of the total inflows coming from local recharge applied to the spoil and the other 50% originating from natural geological formations.

An exception to this are the Roper Voids, which, as a whole, act as a source to the groundwater system. That is, the Roper Voids predicted to be a source of recharge to the local groundwater system. Additional groundwater data collection and assessment in the Roper Study Area will improve the understanding of groundwater aquifers in the area and improve the modelling calibration and reduce the uncertainty currently present within the model outputs. This will assist to inform the development of an appropriate closure landform for the Roper Study Area that minimises the potential for environmental harm.

Excluding the Roper and East voids, the equilibrium groundwater inflows to each of the voids shown in **Table 3-6** represent approximately 10% to 20% of the total volumetric inflow to each residual void's water balance (WSP, 2024), indicating that the groundwater volumetric contribution these residual voids are very small in comparison to surface water (rainfall and runoff) contribution. For the East 1 and East 2 voids, groundwater inflows account for about 50% of the total volumetric inflow.

In regards to the results presented in **Table 3-6** for the Roper Voids, it is noted that the two models are not converged for the Roper Voids as discussed in **Section 3.2**. Therefore, the groundwater inflow/outflow results presented for the Roper Voids are subject to future further modelling as part of planned work for the Roper Study Area.



Table 3-6 Equilibrium Groundwater Inflow to the Residual Voids

Climate Scenario	Residual Void	Equilibrium Inflow Rate – Spoil (m ³ /day) ¹			Equilibrium Inflow Rate – Natural Geological Formations (m ³ /day) ³	Equilibrium Inflow Rate – Total (m ³ /day)
		From Natural Geological Formations into Spoil	From Rainfall Recharge on Spoil	Total Inflow from Spoil to Residual Void ²		
Wetter	Lotus/Campbell	289.2	118.7	409.0	26.4	435.3
	Gilbert	201.6	62.5	265.5	30.6	296.1
	Price/Leichhardt	53.3	66.1	119.9	120.6	240.5
	Roper Voids	-82.0	120.4	38.4	-829.3	-790.9
	East 1	346.0	7.9	353.9	12.6	366.5
	East 2	102.0	5.8	107.8	12.4	120.3
Mid	Lotus/Campbell	295.6	118.7	415.3	27.7	443.1
	Gilbert	205.4	62.5	269.4	31.6	300.9
	Price/Leichhardt	58.6	66.1	125.3	116.8	242.1
	Roper Voids	-72.9	120.4	429.0	-165.4	-859.2
	East 1	261.2	7.9	269.2	17.3	286.4
	East 2	64.7	5.8	70.5	12.2	82.7



Climate Scenario	Residual Void	Equilibrium Inflow Rate – Spoil (m ³ /day) ¹			Equilibrium Inflow Rate – Natural Geological Formations (m ³ /day) ³	Equilibrium Inflow Rate – Total (m ³ /day)
		From Natural Geological Formations into Spoil	From Rainfall Recharge on Spoil	Total Inflow from Spoil to Residual Void ²		
Drier	Lotus/Campbell	299.0	118.7	418.5	27.7	446.3
	Gilbert	208.2	62.5	271.8	30.8	302.7
	Price/Leichhardt	60.0	66.1	126.6	111.6	238.2
	Roper Voids	-66.2	120.4	54.1	-374.7	-320.6
	East 1	202.8	7.9	210.8	18.1	228.9
	East 2	21.3	5.8	27.1	7.0	34.2

Notes:

1. Includes a component of groundwater from natural geological formations that moves into spoil, and a component of groundwater derived from local recharge on spoil, before discharging to the residual void lakes; refer **Figure 3-1**.
2. Any volumetric discrepancy between total inflow from spoil and the sum of the spoil inflow components is related to small ongoing residual changes in spoil storage occurring in the model as well as losses to evapotranspiration through spoil and rounding errors. Such discrepancies are typically less than 1% of the total spoil inflow.
3. Directly from natural geological formations into residual void lakes.



3.5 Predicted Groundwater Levels – Mid Climate Scenario

Groundwater level predictions and associated discussion presented herein is focussed primarily on the Mid Climate scenario with the Drier and Wetter scenario's reported as sensitivities.

3.5.1 Groundwater Levels - General

The predicted equilibrium water table elevation adjacent to the residual voids is shown on **Figure 3-20** for the Mid Climate scenario. Predicted groundwater levels for the Fort Cooper Coal Seams, Q, P, H and D Seams of the Permian Coal Measures (model layers 4, 6, 8, 10, and 12, respectively) outside of the residual voids are shown on **Figure 3-22** through to **Figure 3-25**, again at equilibrium for the Mid Climate scenario.

Groundwater levels surrounding the final void are controlled by the predicted residual void lake levels, which in turn are controlled by the rate of evaporation from the void lakes balancing mostly surface inflows and some groundwater inflows to the lakes (WSP, 2024), including a component of groundwater that moves out of the natural geological formations into the residual voids via the spoil (refer **Table 3-6**). The conceptual relationship between these components is displayed in **Figure 3-1**. That is, predicted groundwater levels are a function of predicted lake levels, which as discussed in **Section 3.2** are dominantly controlled by surface water fluxes and maintained by evaporation.

The water table is predicted to remain depressed in the immediate vicinity of the Lotus/Campbell, Gilbert, Price/Leichhardt, East 1, and East 2 voids in the long term, driven by the ongoing groundwater discharge to the residual void lakes and governed by the lake elevations themselves. That is, long term inwards groundwater flow gradients are maintained post-mining for the water table at these voids.

For Roper 1, there is a gradient to the natural geological formations on the north and east, however the water table is predicted to remain depressed near the void on the south and west sides. Roper 2 shows a gradient from the spoil to the void on the north and east, with the water table expected to stay depressed close to the void on the south and west. For Roper 3, a gradient is present from the void to the spoil area on all sides. In the case of Roper 4, a gradient exists to the natural geological formations on the east, however the water table is predicted to remain depressed near the void on the west and south. Additionally, there is a gradient from the spoil to the void on the north side of Roper 4.

Predicted groundwater levels for the Fort Cooper Seams, Q, P, H and D Seams of the Permian Coal Measures indicate again that groundwater levels in the Permian sequence are predicted to remain depressed in the immediate vicinity of the Lotus/Campbell, Gilbert, Price/Leichhardt, East 1, and East 2 voids in the long term, driven by the ongoing groundwater discharge to the residual void lakes and governed by the lake elevations themselves.

The Fort Cooper Coal seam is predicted to remain 'dry' in the long term across most of the SSM Area, with some saturation present in the east of the Price/Leichhardt void.

The Q seam is predicted to remain 'dry' in the long term across most of the SSM Area, with some saturation present in the east and south of the East 1 and East 2 voids.

The P Seam is predicted to remain unsaturated across much of the SSM Area, however remains saturated along the eastern margin of the SSM Area, east of the residual voids.

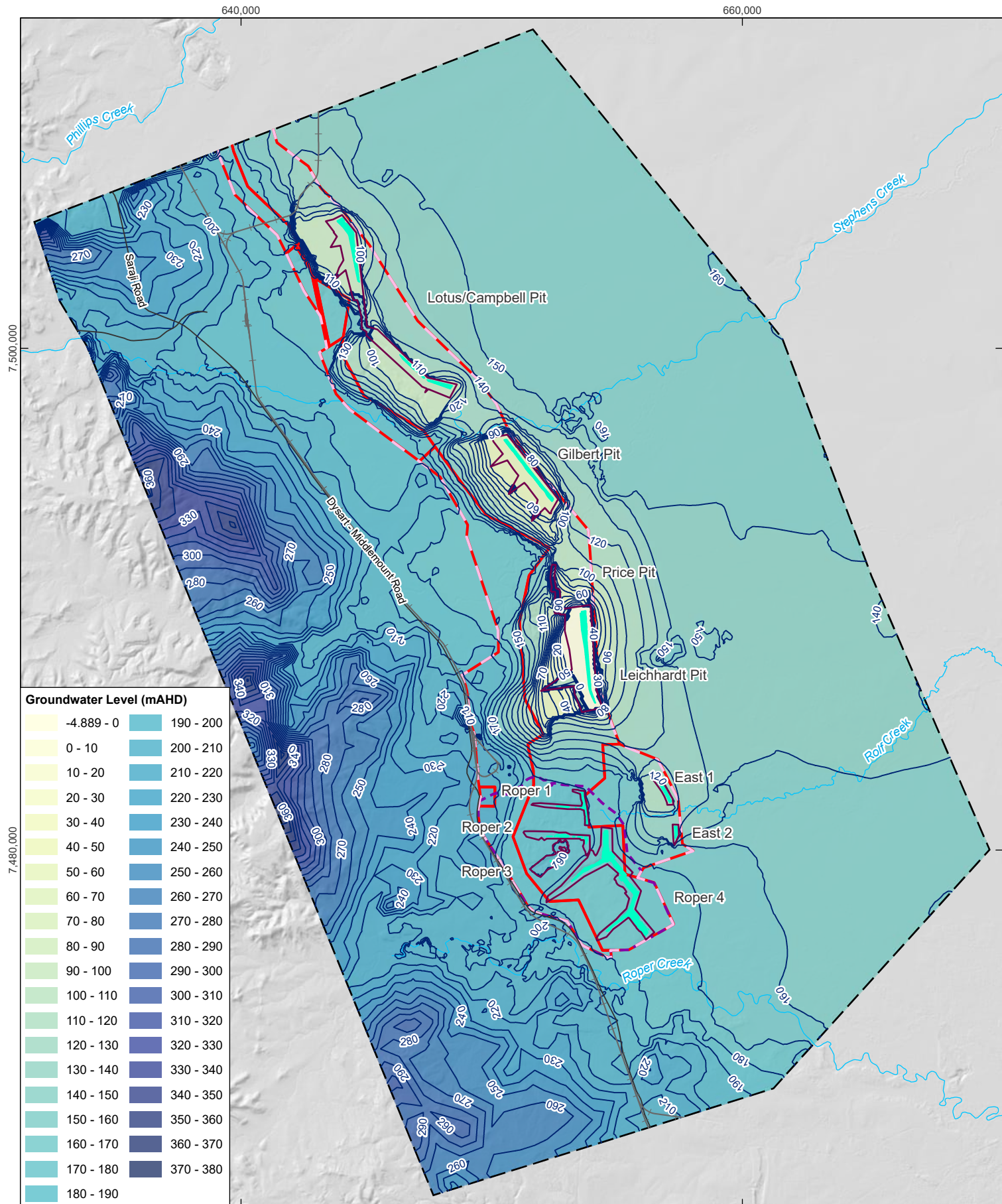


Flow gradients towards the East 1, East 2, and Price/Leichhardt voids are apparent in the P Seam.

The H Seam is predicted to remain unsaturated across much of the SSM Area, except along the eastern margin, east of the residual voids, where it remains saturated. Flow gradients towards the Lotus/Campbell, Gilbert, Price/Leichhardt, East 1, and East 2 voids are evident in the H Seam. The H Seam is expected to stay unsaturated across much of the Roper Study Area but will remain saturated along the eastern margin of these voids and part of the northern areas of Roper 1 and Roper 3 voids. Flow gradients outward from the Roper 1, Roper 2, Roper 3, and Roper 4 voids are apparent in the H Seam.

D Seam levels show saturation across most of the SSM Area. There is an outward gradient on the north and east of Roper 1, but the water table is predicted to remain inwards to the void on the other side of Roper 1. Similarly, there is an outward gradient on the north and east sides of Roper 2, with the water table expected to stay depressed close to the void on the opposite side. For Roper 3, an outward gradient to spoil is present on all sides of the void. In the case of Roper 4, there is an outward gradient to the natural geological formations on the east side, but the water table is predicted to remain depressed near the void on the west and south sides. Additionally, there is an inward gradient on the north side of Roper 4.





 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 19-Aug-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHd)
-  Void Extent
-  Void Lake
-  SSM Mine Lease
-  SSM EA Boundary

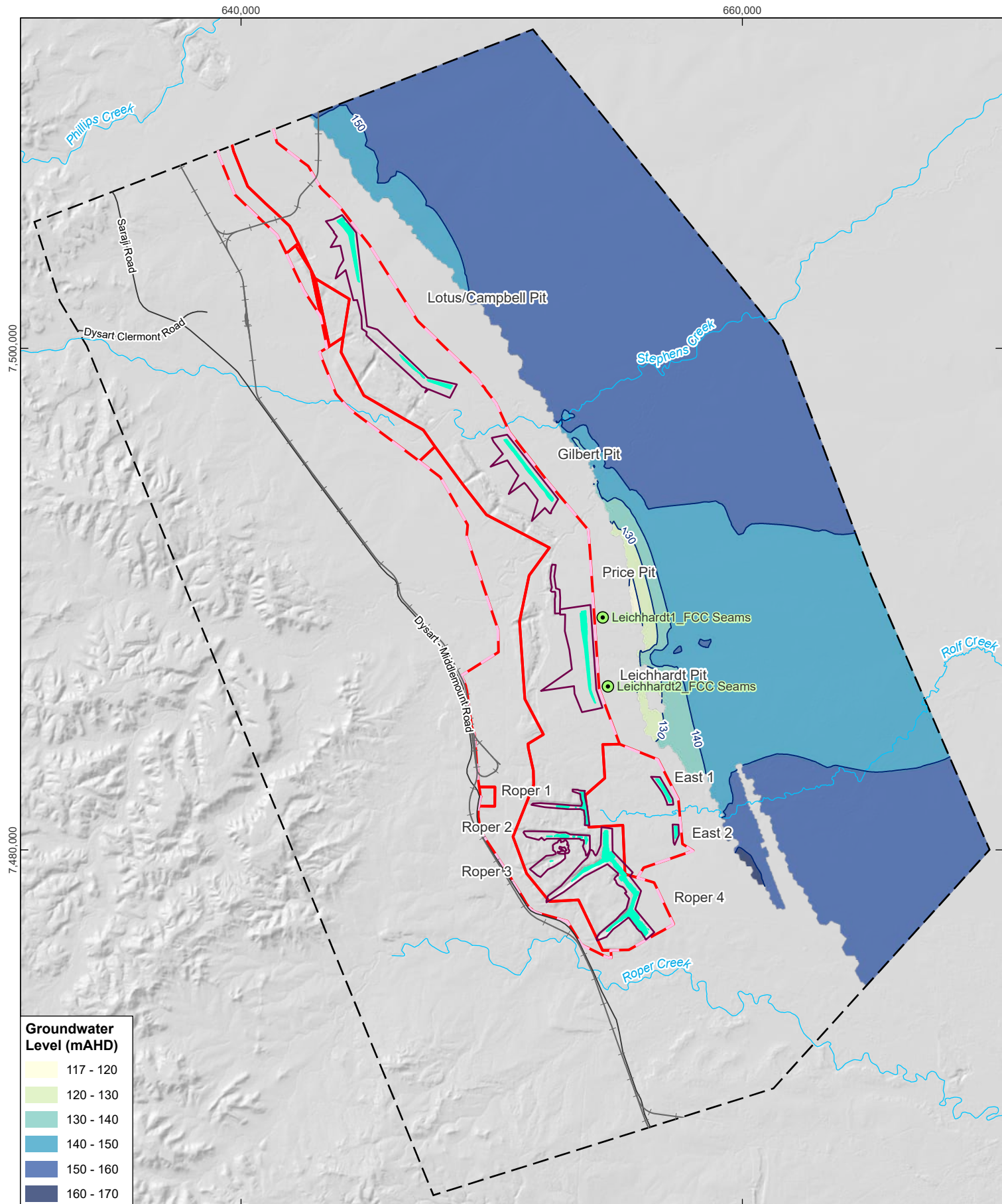
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE ELEVATION – POST-MINING EQUILIBRIUM (MID CLIMATE SCENARIO)



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FIGURE 3-20

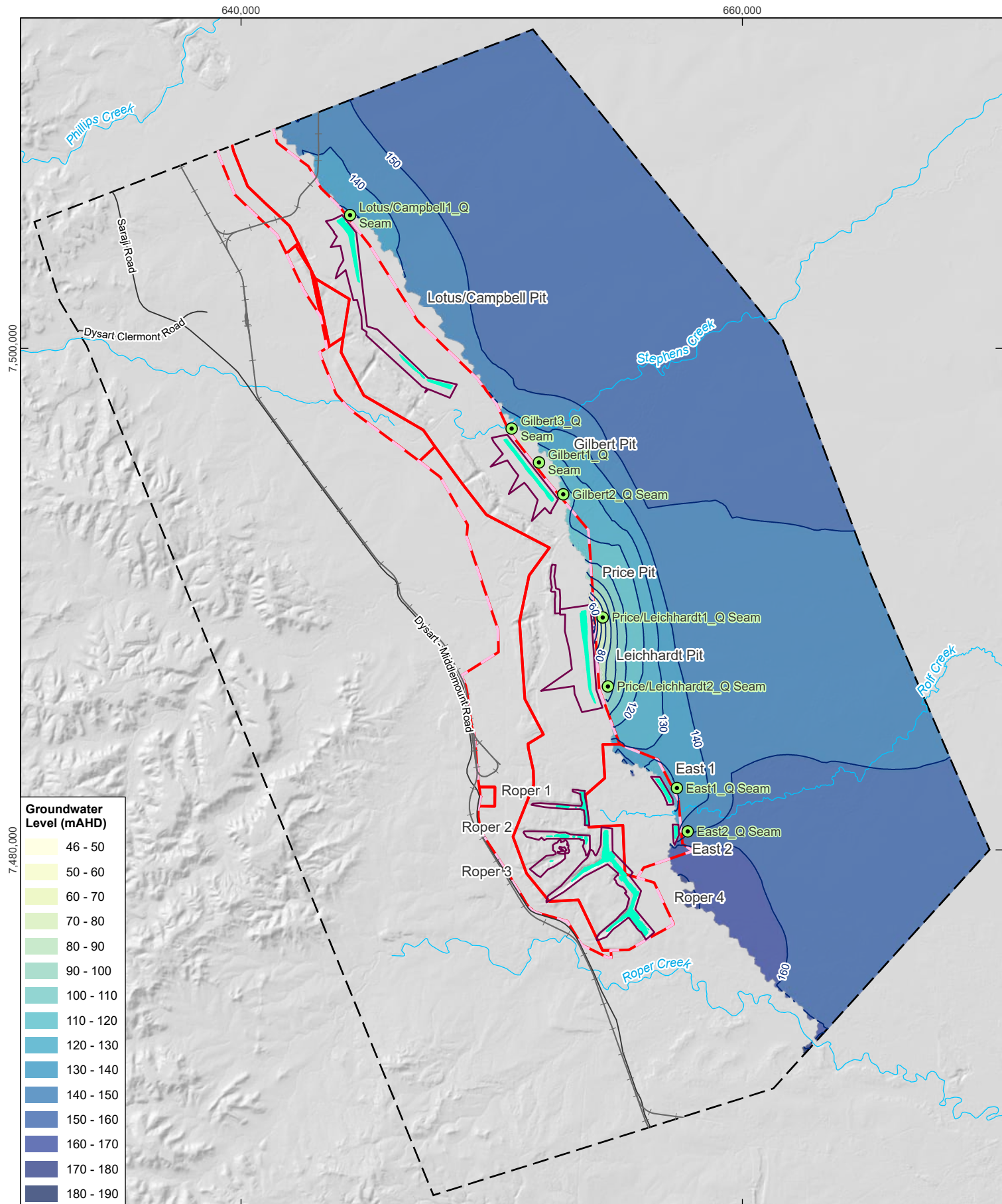


Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB



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FIGURE 3-21



Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- Hydrograph Location
- Groundwater Contour (mAHd)
- Railway
- Void Extent
- Major Road
- Void Lake
- Watercourse
- SSM Mine Lease
- Model Boundary
- SSM EA Boundary

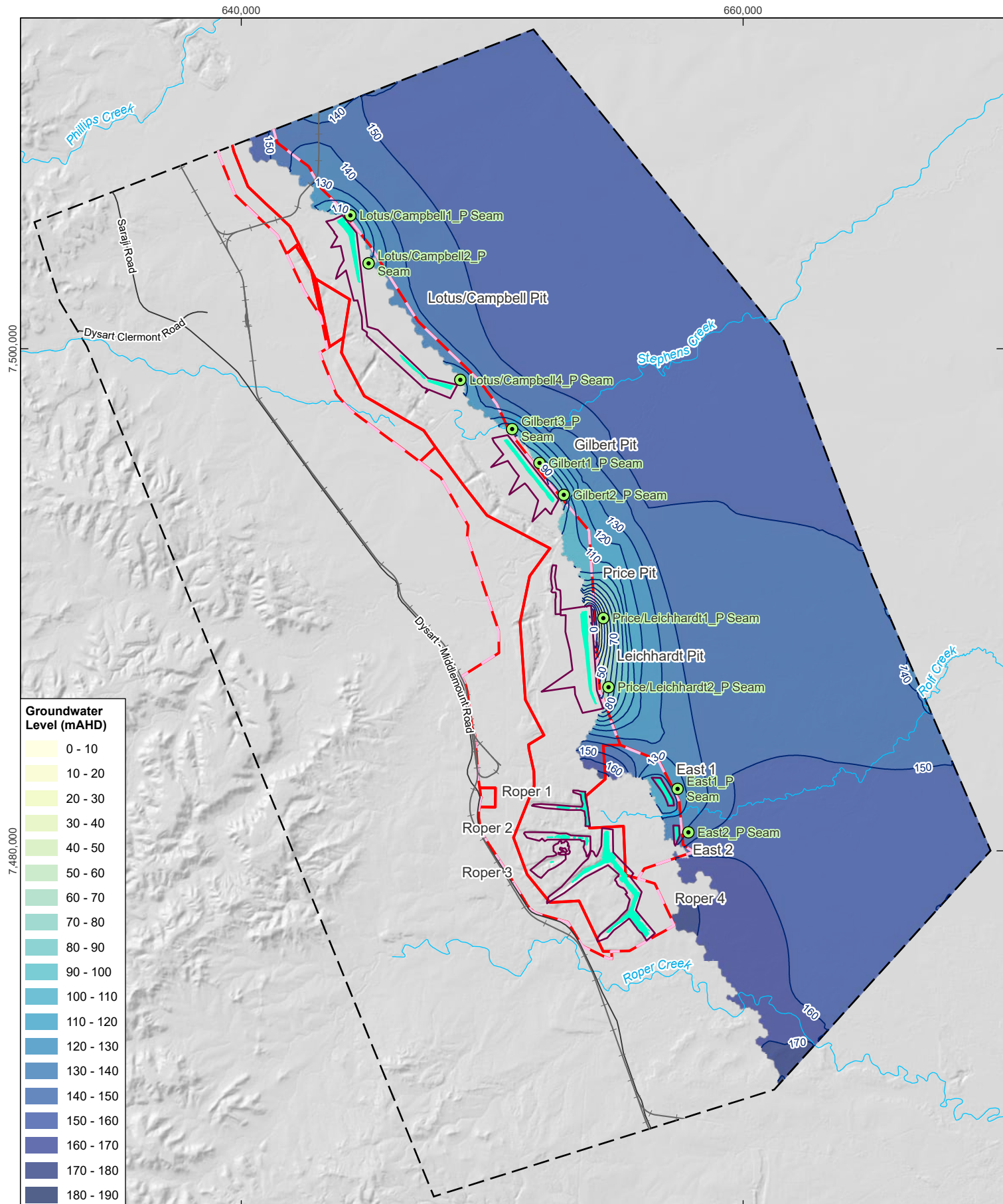
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE Q SEAM (LAYER 6) – POST-MINING EQUILIBRIUM (MID CLIMATE SCENARIO)



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FIGURE 3-22

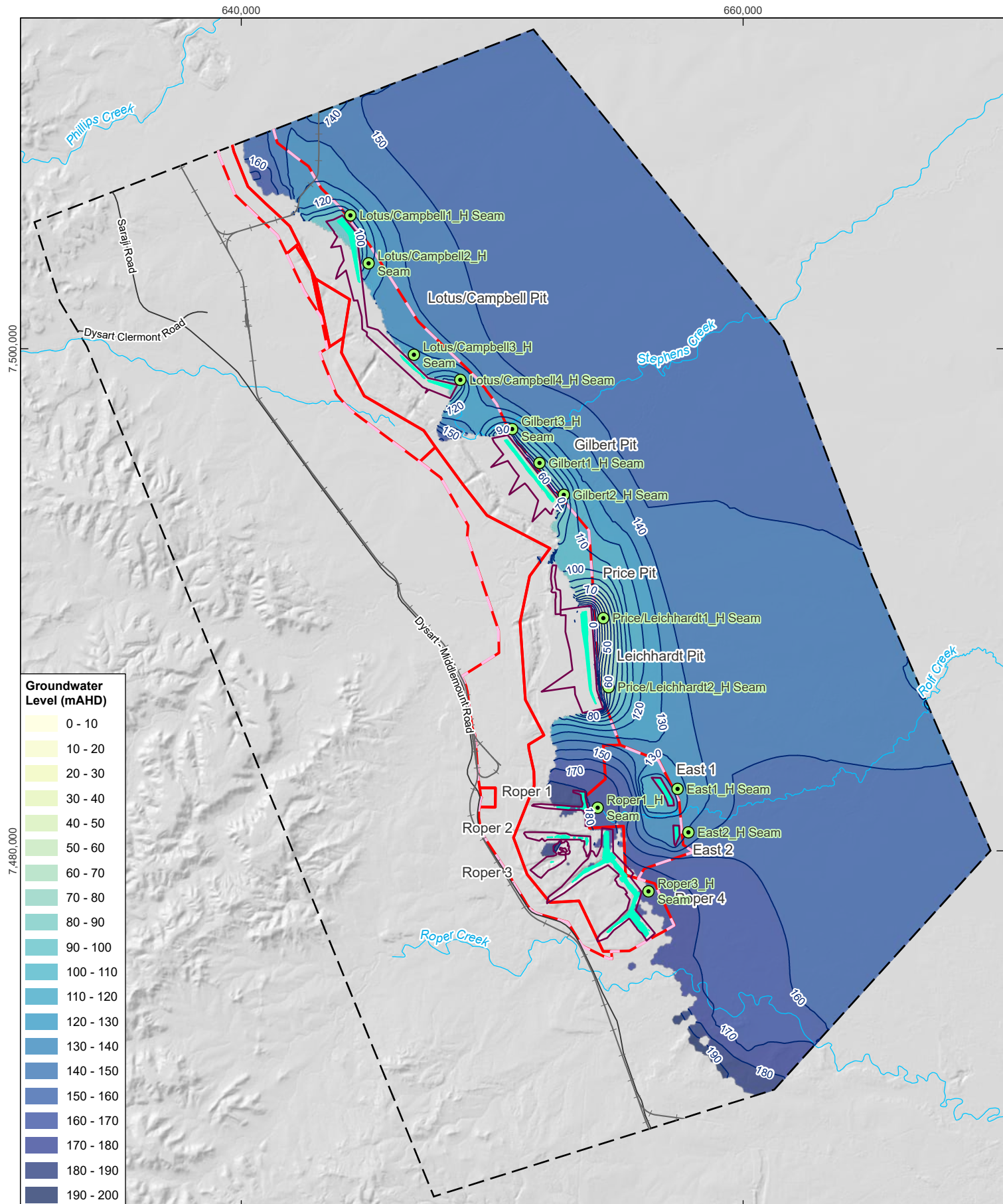


Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB



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FIGURE 3-23



Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- Hydrograph Location
- Railway
- Major Road
- Watercourse
- Model Boundary
- Groundwater Contour (mAHd)
- Void Extent
- Void Lake
- SSM Mine Lease
- SSM EA Boundary

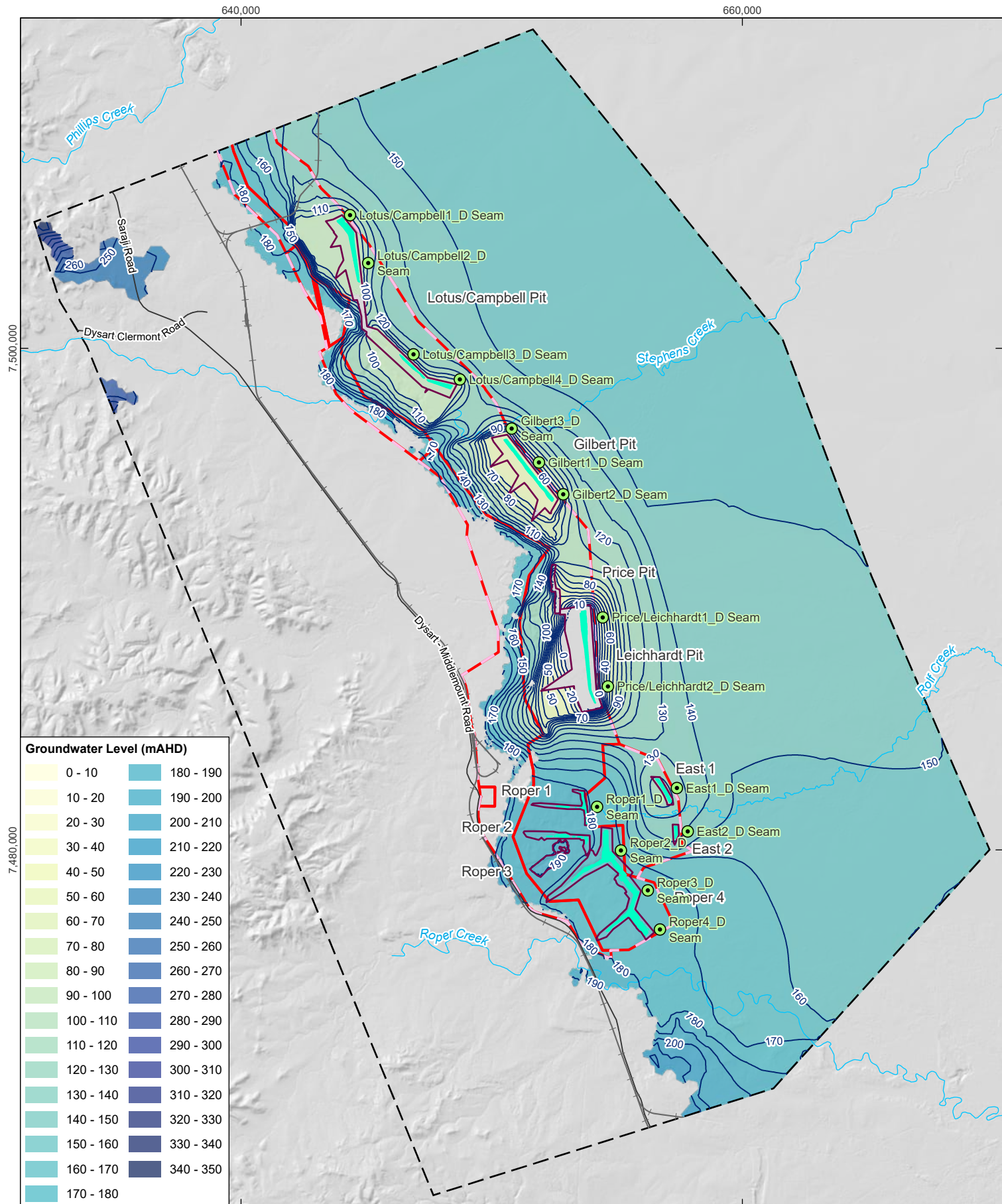
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE H SEAM (LAYER 10) – POST-MINING EQUILIBRIUM (MID CLIMATE SCENARIO)



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FIGURE 3-24



Coordinate System: GDA 1994 MGA Zone 55
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Drawn by: RB



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FIGURE 3-25

Predictive hydrographs showing the change in groundwater levels over time for the Fort Cooper Seams, Q, P, H and D Seams of the Permian Coal Measures just outside (east) of the residual voids are shown as **Figure 3-26** through **Figure 3-40**, with the hydrograph locations shown on **Figure 3-21** through to **Figure 3-25**. Given their relatively significant north-south strike length, four sets of predictive hydrographs have been generated for Lotus/Campbell and Roper voids, three sets for Gilbert void, and two sets for Price/Leichhardt void, as shown in the figures. In **Figure 3-26** through **Figure 3-40**, the green line represents the groundwater level in the related model layer.

The hydrographs demonstrate that the vast majority of groundwater level drawdown in the Permian Coal Measures occurs as a result of active extractive mining operations. The hydrographs demonstrate very little effect on groundwater levels from the residual void inflow flux variability in the early post-closure period as shown and discussed in **Section 3.4**.

- For the Lotus/Campbell residual void:
 - The Fort Cooper Seam does not exist at the Lotus/Campbell residual void because the Fort Cooper Seam layer is pinched out at this location.
 - At the northern end of the residual void (hydrograph site Lotus/Campbell 1), Figure 3-26, lake levels are predicted to recover to approximately 12 m of the predicted P Seam groundwater elevation just outside the void, approximately 10 m of the predicted H Seam groundwater elevation just outside the void, and approximately 10 m of the predicted D Seam groundwater elevation just outside the void. The Q Seam is predicted to remain dry with its base more than 45 m above the void lake level.
 - At the central end of the residual void (hydrograph site Lotus/Campbell 2), Figure 3-27, lake levels are predicted to recover to approximately 23 m of the predicted H Seam groundwater elevation just outside the void, and approximately 19 m of the predicted D Seam groundwater elevation just outside the void. The P Seam is predicted to remain dry with its base more than 45 m above the void lake level. The Q Seam does not exist at the central end of the residual void (hydrograph site Lotus/Campbell 2) because the Q Seam layer is pinched out at this location.
 - At the central end of the residual void (hydrograph site Lotus/Campbell 3), Figure 3-28, lake levels are predicted to recover to approximately 35 m of the predicted H Seam groundwater elevation just outside the void, and approximately 25 m of the predicted D Seam groundwater elevation just outside the void. The Q Seam and P Seam do not exist at the central end of the residual void (hydrograph site Lotus/Campbell 3) because the Q Seam and P Seam layers are pinched out at this location.
 - At the southern end of the residual void (hydrograph site Lotus/Campbell 4), Figure 3-29, lake levels are predicted to recover to approximately 32 m of the predicted P Seam groundwater elevation just outside the void, approximately 16 m of the predicted H Seam groundwater elevation just outside the void, and approximately 13 m of the predicted D Seam groundwater elevation just outside the void. The Q Seam does not exist at the southern end of the residual void (hydrograph site Lotus/Campbell 4) because the Q Seam layer is pinched out at this location.
- For the Gilbert residual void:
 - The Fort Cooper Seam does not exist at the Gilbert residual void because the Fort Cooper Seam layer is pinched out at this location.



- At the northern end of the residual void (hydrograph site Gilbert 1), Figure 3-30, lake levels are predicted to recover to approximately 35 m of the predicted P Seam groundwater elevation just outside the void, approximately 31 m of the predicted H Seam groundwater elevation just outside the void, and approximately 26 m of the predicted D Seam groundwater elevation just outside the void. The Q Seam is predicted to remain dry with its base more than 79 m above the void lake level.
- At the central end of the residual void (hydrograph site Gilbert 2), Figure 3-31, lake levels are predicted to recover to approximately 57 m of the predicted Q Seam groundwater elevation just outside the void, approximately 33 m of the predicted P Seam groundwater elevation just outside the void, approximately 30 m of the predicted H Seam groundwater elevation just outside the void, and approximately 29 m of the predicted D Seam groundwater elevation just outside the void.
- At the southern end of the residual void (hydrograph site Gilbert 3), Figure 3-32, lake levels are predicted to recover to approximately 47 m of the predicted P Seam groundwater elevation just outside the void, approximately 42 m of the predicted H Seam groundwater elevation just outside the void, and approximately 34 m of the predicted D Seam groundwater elevation just outside the void. The Q Seam is predicted to remain dry with its base more than 91 m above the void lake level.
- For the Price/Leichhardt residual void:
 - At the northern end of the residual void (hydrograph site Price/Leichhardt 1), Figure 3-33, lake levels are predicted to recover to approximately 83 m of the predicted Q Seam groundwater elevation just outside the void, approximately 47 m of the predicted P Seam groundwater elevation just outside the void, approximately 46 m of the predicted H Seam groundwater elevation just outside the void, and approximately 46 m of the predicted D Seam groundwater elevation just outside the void. The Fort Cooper Seam is predicted to remain dry with its base more than 141 m above the void lake level.
 - At the southern end of the residual void (hydrograph site Price/Leichhardt 2), Figure 3-34, lake levels are predicted to recover to approximately 100 m of the predicted Q Seam groundwater elevation just outside the void, approximately 75 m of the predicted P Seam groundwater elevation just outside the void, approximately 72 m of the predicted H Seam groundwater elevation just outside the void, and approximately 63 m of the predicted D Seam groundwater elevation just outside the void. The Fort Cooper Seam is predicted to remain dry with its base more than 170 m above the void lake level.
- For the Roper residual voids:
 - The Fort Cooper Seam, Q Seam, and P Seam do not exist at the Roper residual voids because the Fort Cooper Seam, Q Seam and P Seam layers are geologically cropped out at these locations.
 - At the northern end of the residual voids (hydrograph site Roper 1), Figure 3-35, lake levels are predicted to recover to approximately 6 m above the predicted H Seam groundwater elevation just outside the void, and approximately 5 m above the predicted D Seam groundwater elevation just outside the void.
 - At the central end of the residual voids (hydrograph site Roper 2), Figure 3-36, lake levels are predicted to recover to approximately 13 m above the predicted D



Seam groundwater elevation just outside the void. The H Seam does not exist at the central end of the residual voids (hydrograph site Roper 2) because the H Seam layer is geologically cropped out at this location.

- At the central end of the residual voids (hydrograph site Roper 3), Figure 3-37, lake levels are predicted to recover to approximately 15 m above the predicted H Seam groundwater elevation just outside the void, and approximately 15 m above the predicted D Seam groundwater elevation just outside the void.
- At the southern end of the residual voids (hydrograph site Roper 4), Figure 3-38, lake levels are predicted to recover to approximately 1 m above the predicted D Seam groundwater elevation just outside the void. The H Seam does not exist at the southern end of the residual voids (hydrograph site Roper 4) because the H Seam layer is pinched out at this location.
- For the East 1 residual void, Figure 3-39, lake levels are predicted to recover to:
 - approximately 13 m of the predicted Q Seam groundwater elevation just outside the void
 - approximately 7 m of the predicted P Seam groundwater elevation just outside the void
 - approximately 7 m of the predicted H Seam groundwater elevation just outside the void
 - approximately 7 m of the predicted D Seam groundwater elevation just outside the void.
 - The Fort Cooper Seam does not exist at the East 1 residual void because the Fort Cooper Seam layer is geologically cropped out at this location.
- For the East 2 residual void, Figure 3-40, lake levels are predicted to recover to:
 - approximately 11 m of the predicted Q Seam groundwater elevation just outside the void
 - approximately 6 m of the predicted P Seam groundwater elevation just outside the void
 - approximately 5 m of the predicted H Seam groundwater elevation just outside the void
 - approximately 5 m of the predicted D Seam groundwater elevation just outside the void.
 - The Fort Cooper Seam does not exist at the East 2 residual void because the Fort Cooper Seam layer is geologically cropped out at this location.



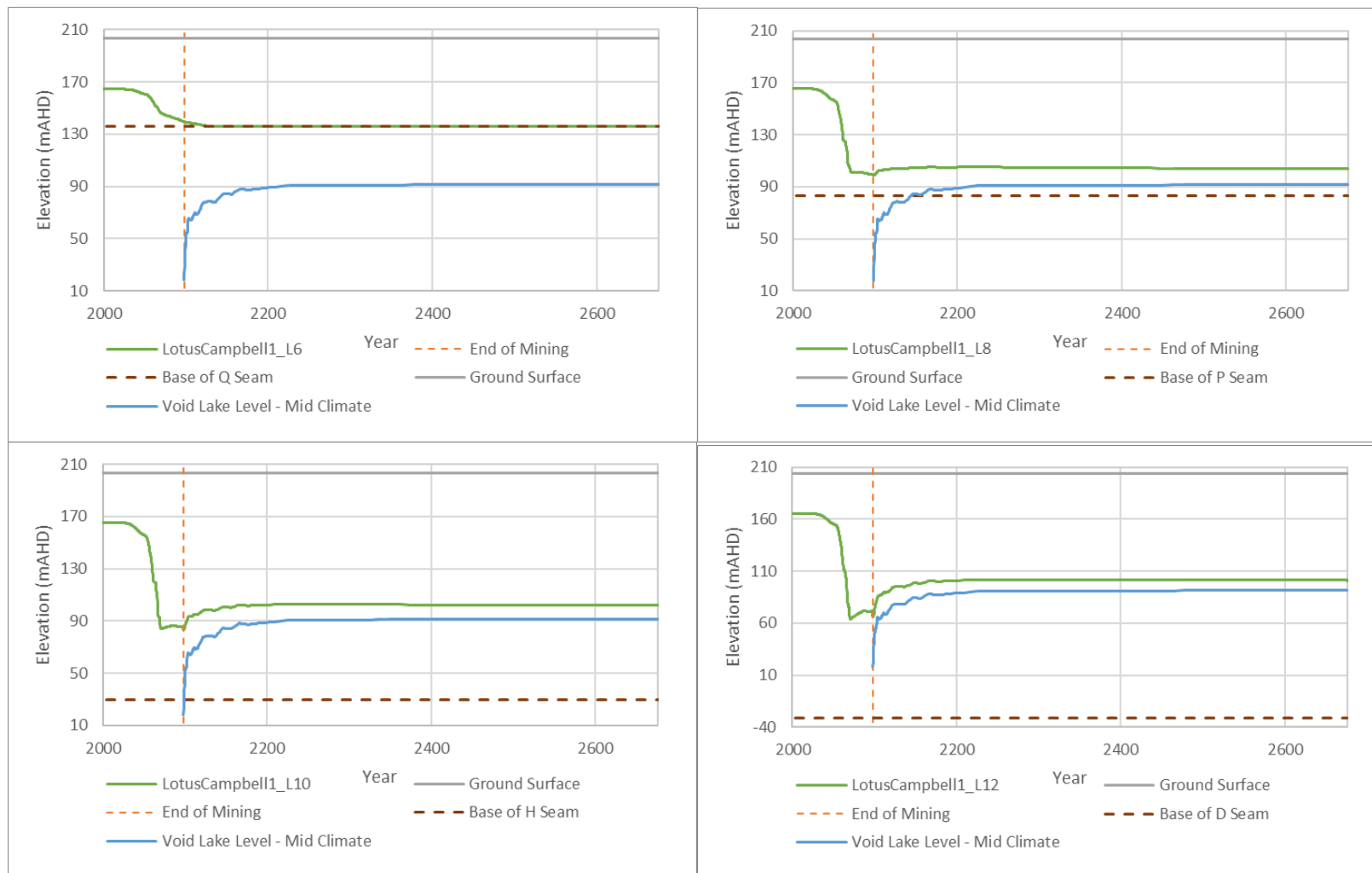


Figure 3-26 Coal Measures Predictive Hydrographs adjacent LotusCampbell Void (north)



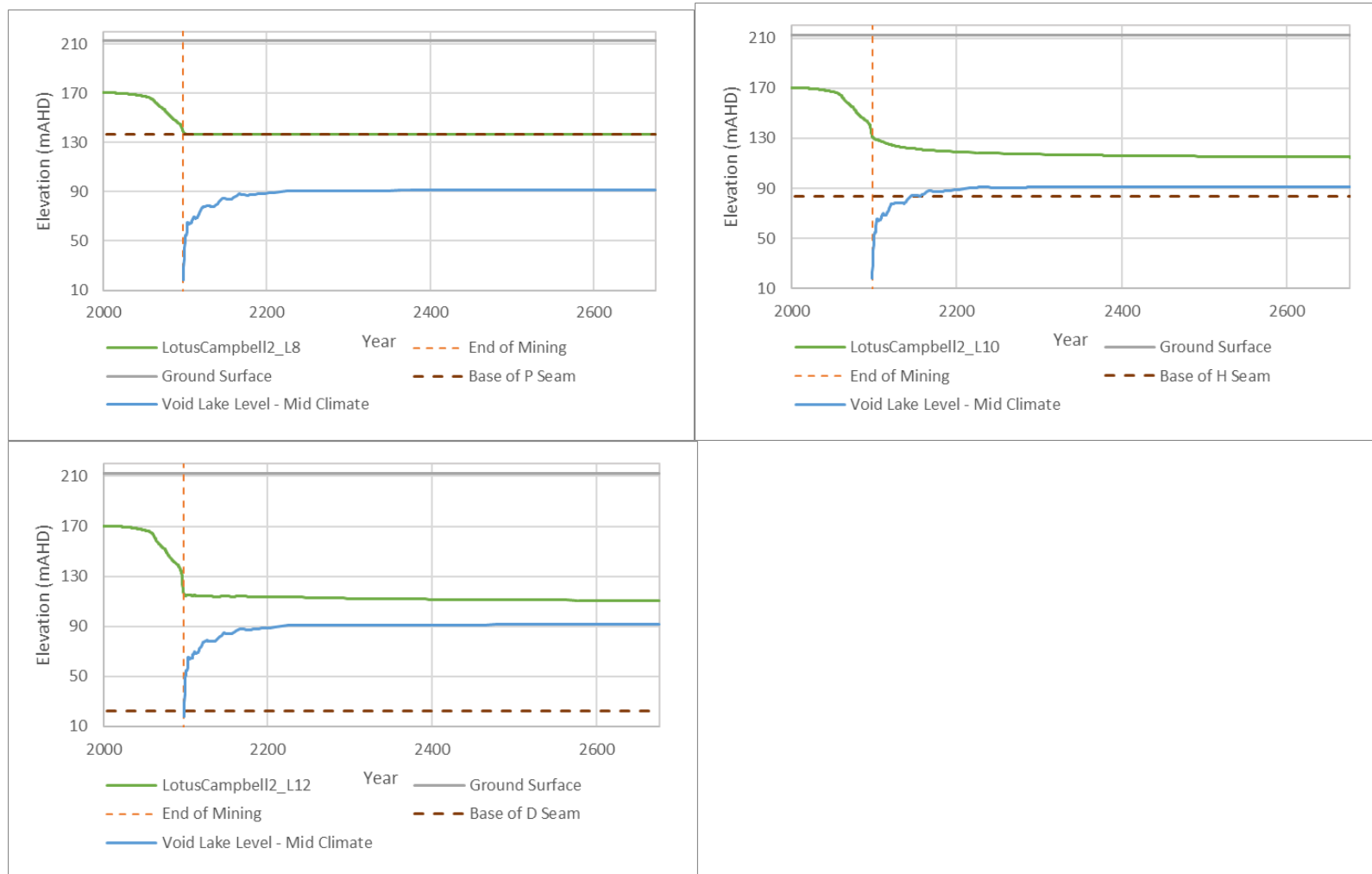


Figure 3-27 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (centre1)



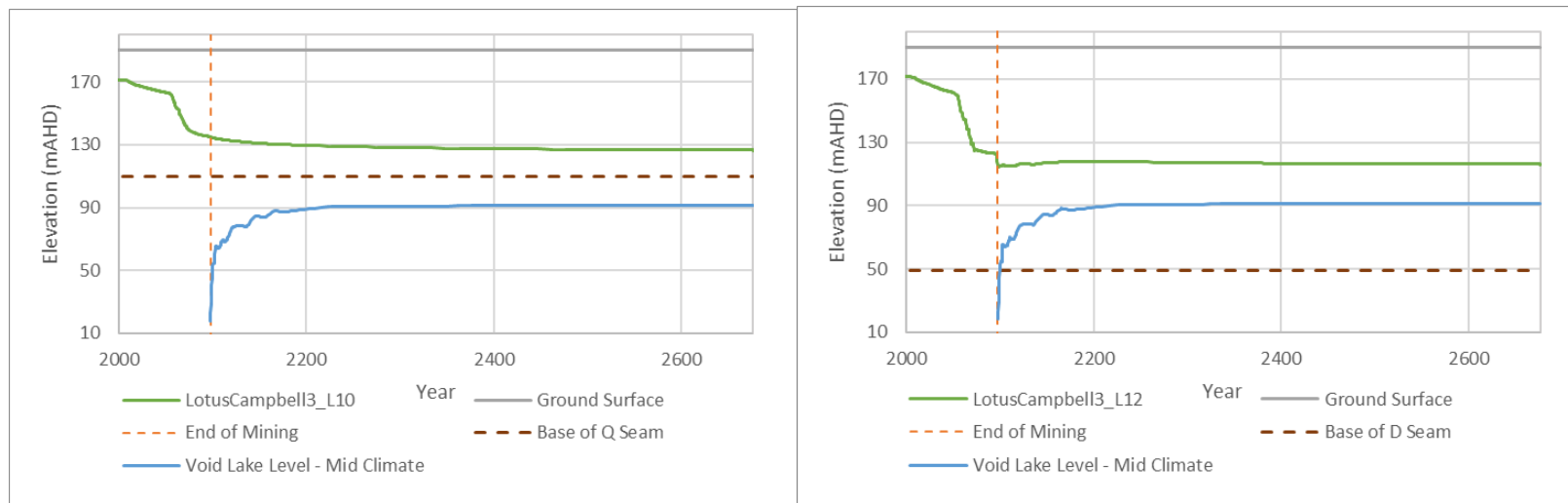


Figure 3-28 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (centre2)



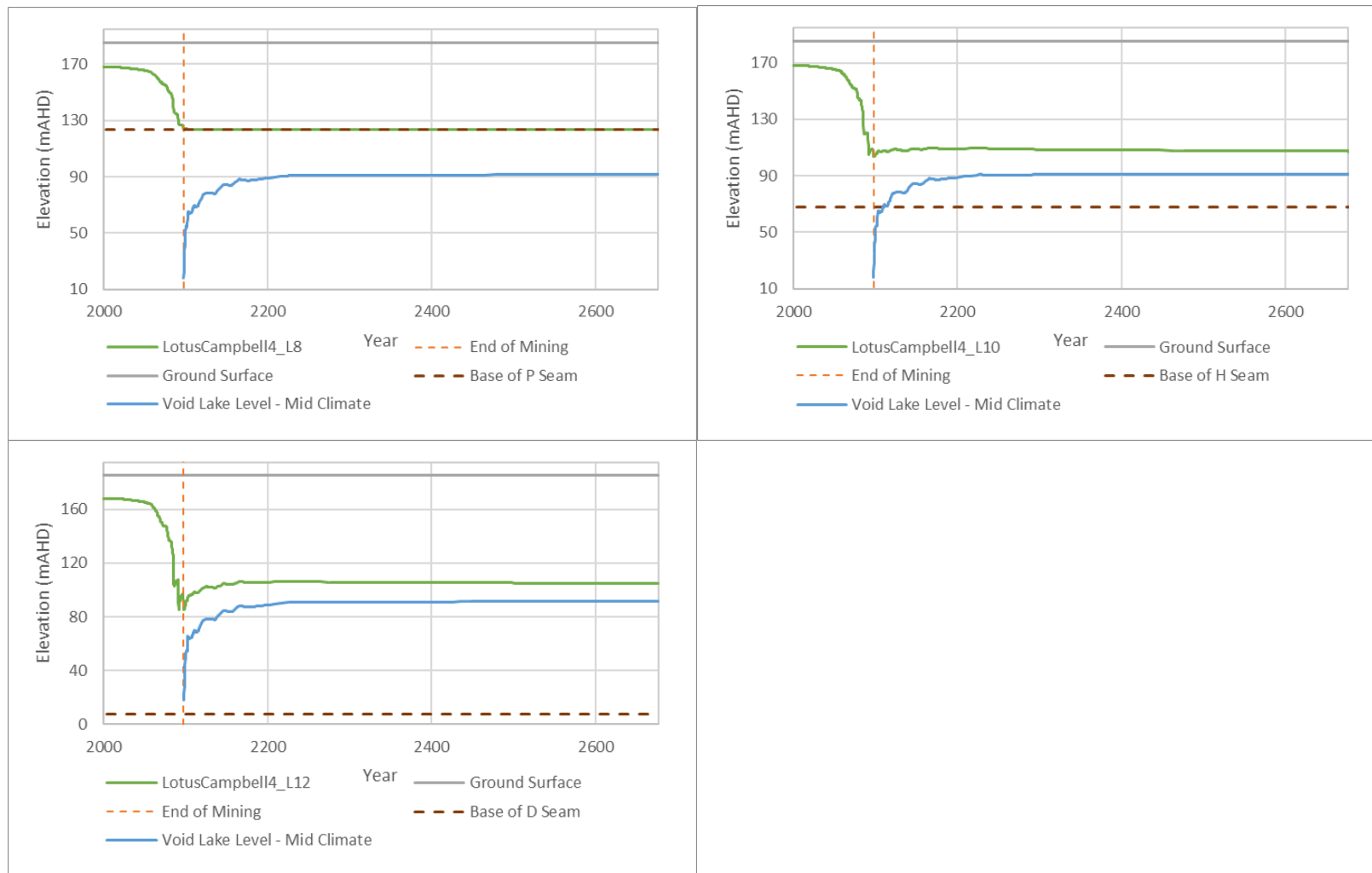


Figure 3-29 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (south)



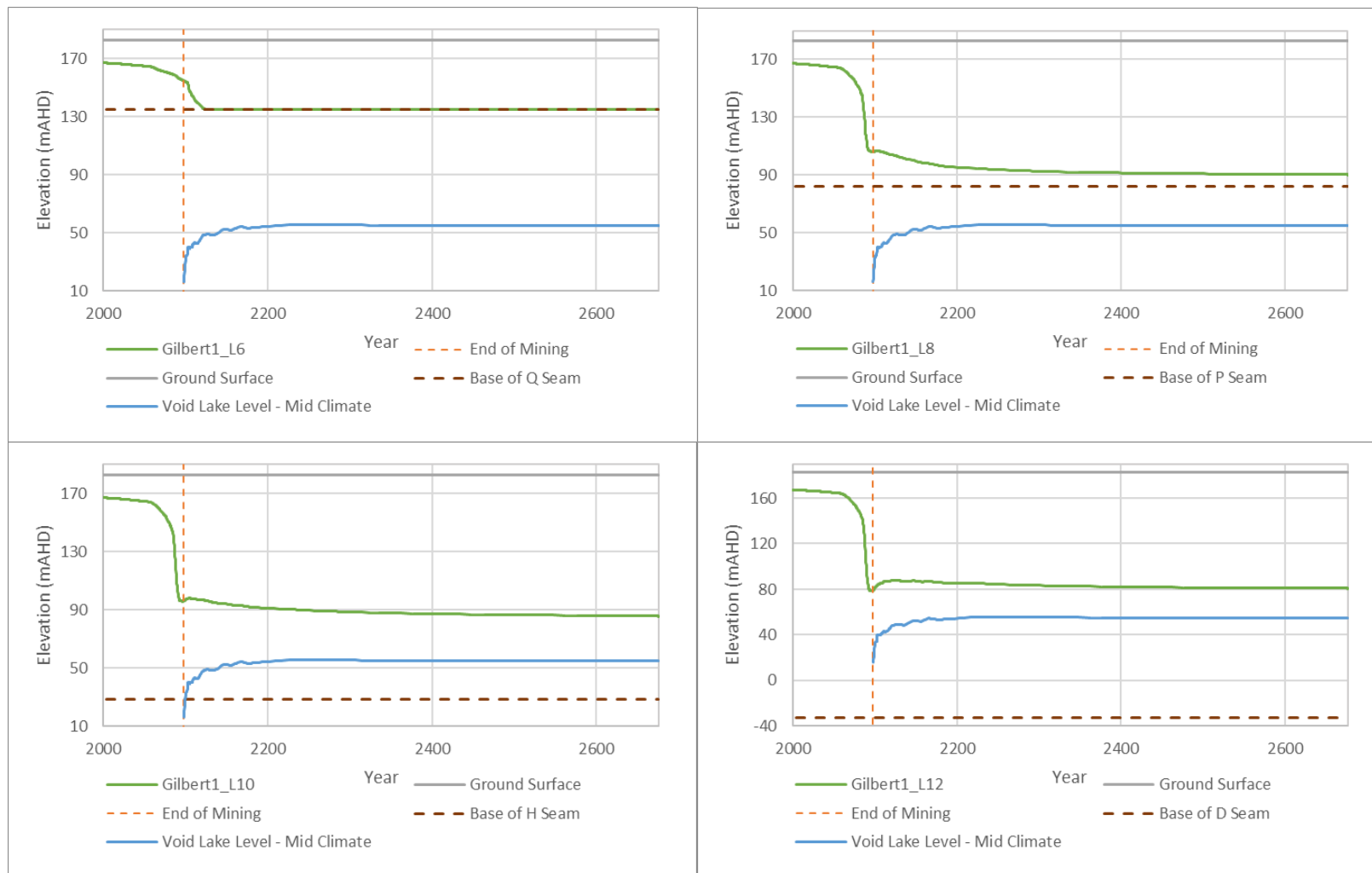


Figure 3-30 Coal Measures Predictive Hydrographs adjacent Gilbert Void (north)



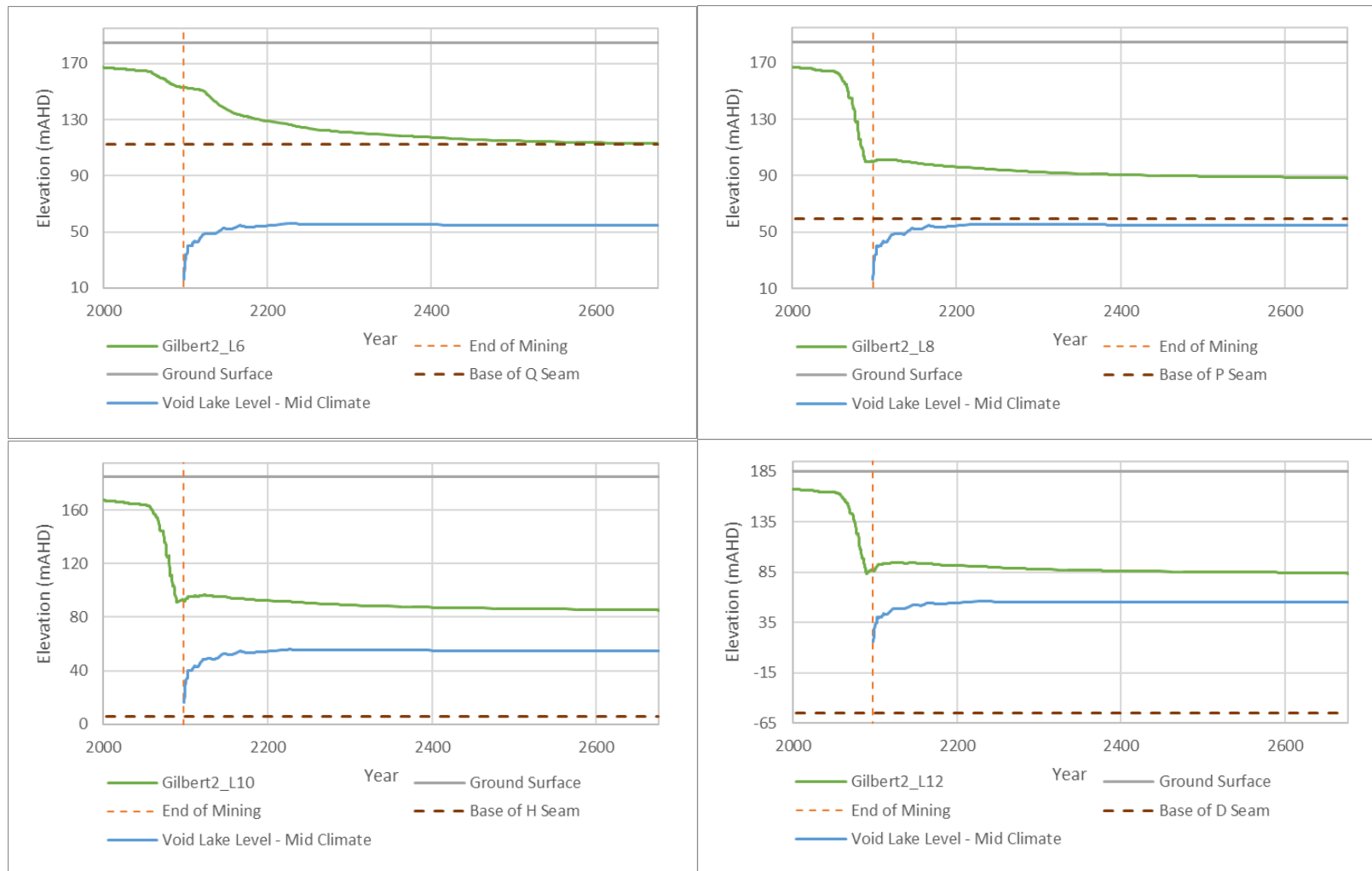


Figure 3-31 Coal Measures Predictive Hydrographs adjacent Gilbert Void (centre)



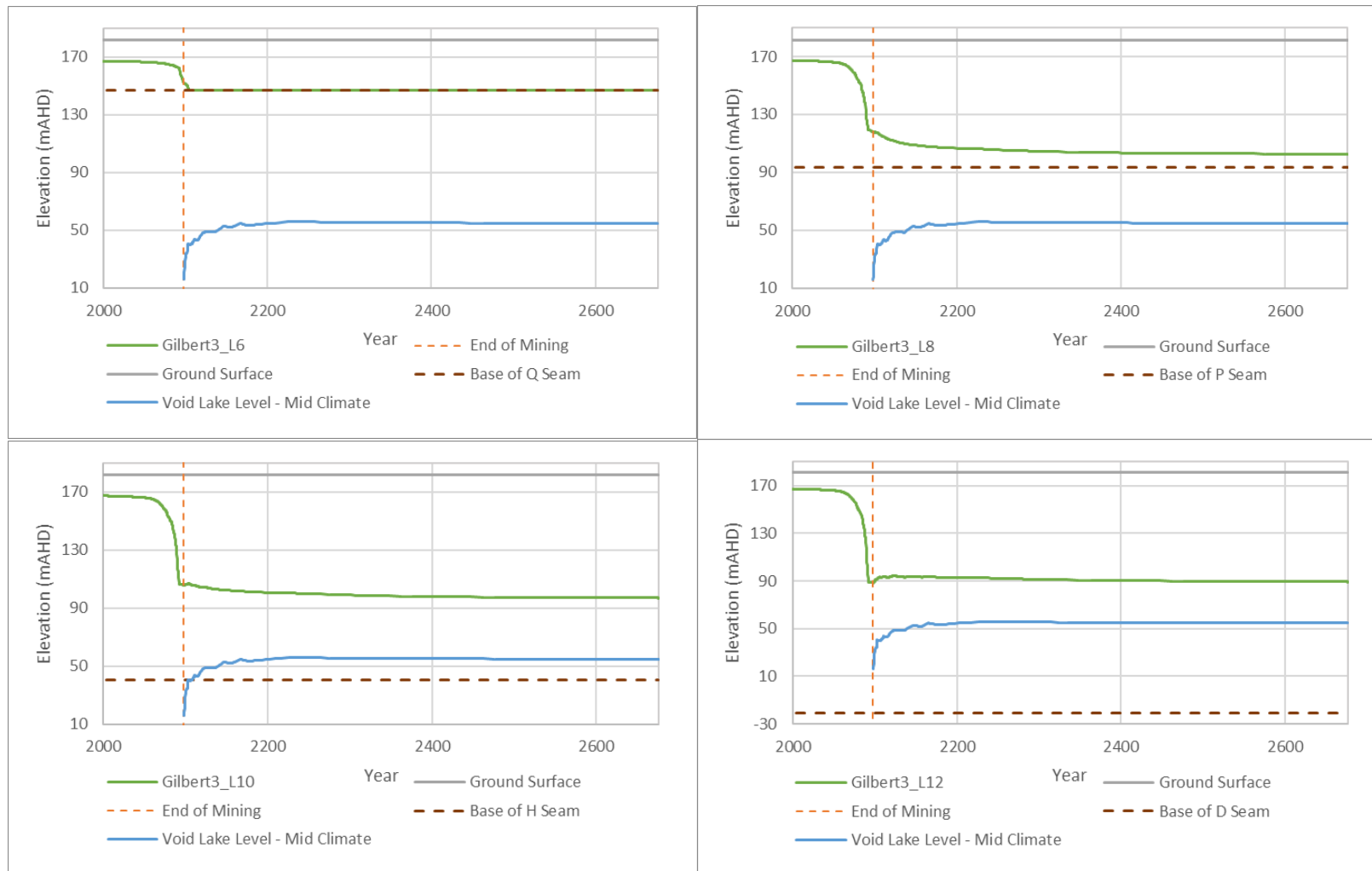


Figure 3-32 Coal Measures Predictive Hydrographs adjacent Gilbert Void (south)



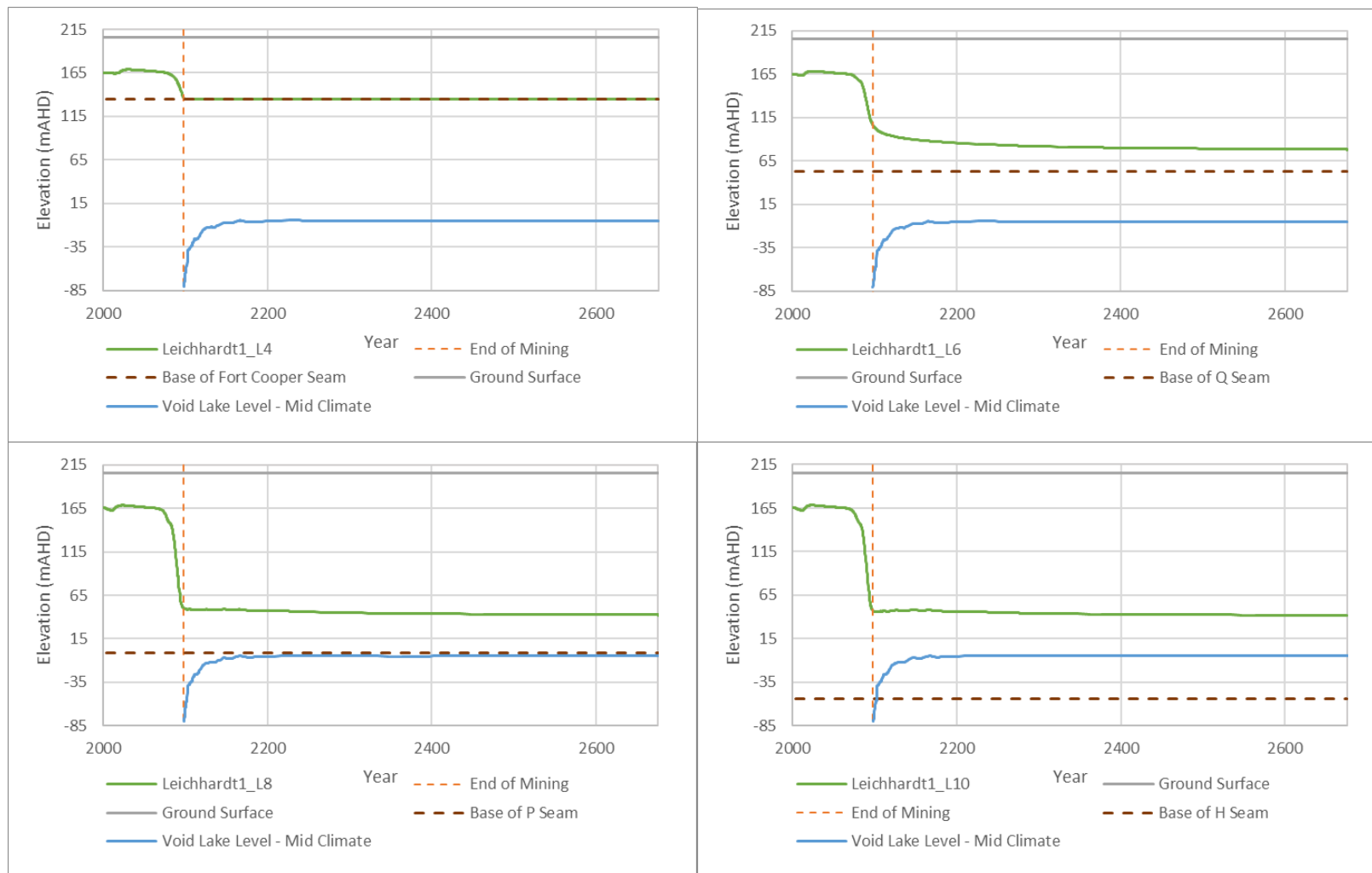


Figure 3-33 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (north)



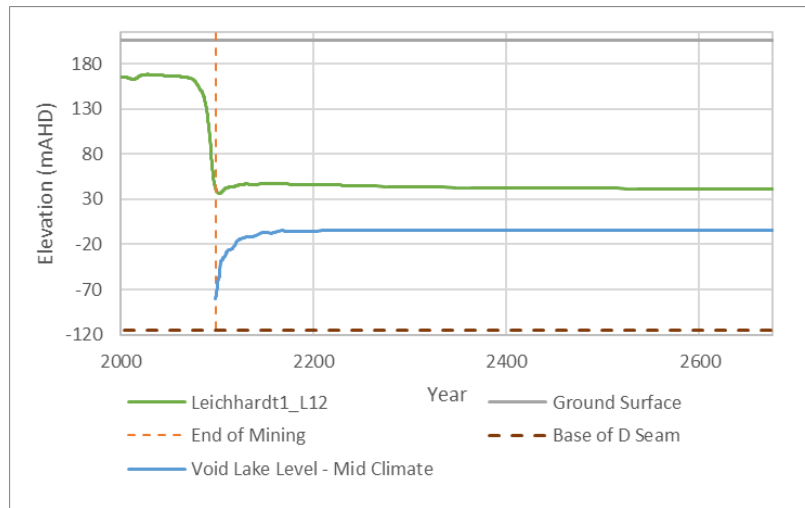


Figure 3-33 Coal Measures Predictive Hydrographs adjacent PriceLeichardt Void (north) (cont.)



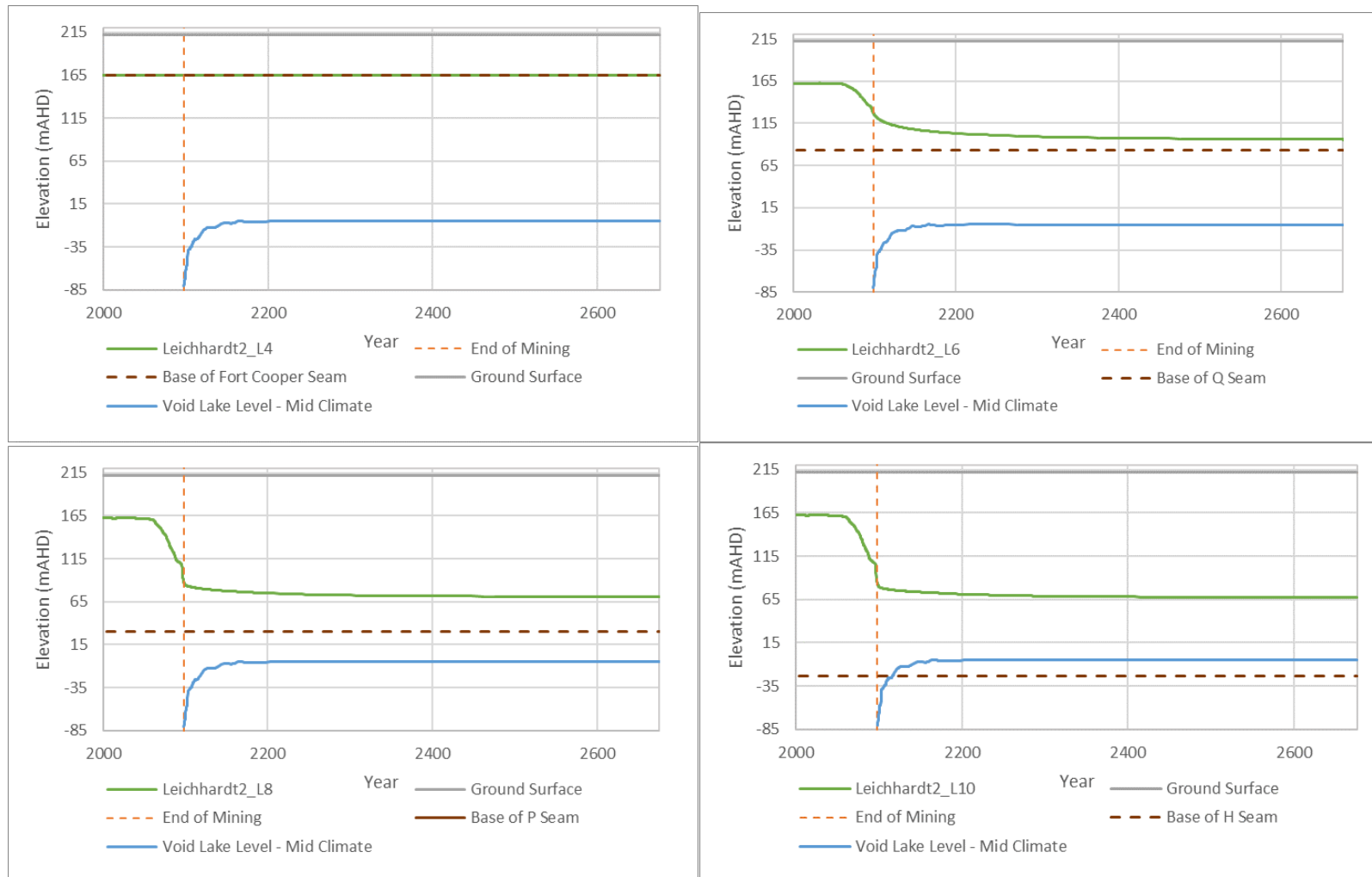


Figure 3-34 Coal Measures Predictive Hydrographs adjacent PriceLeichardt Void (south)



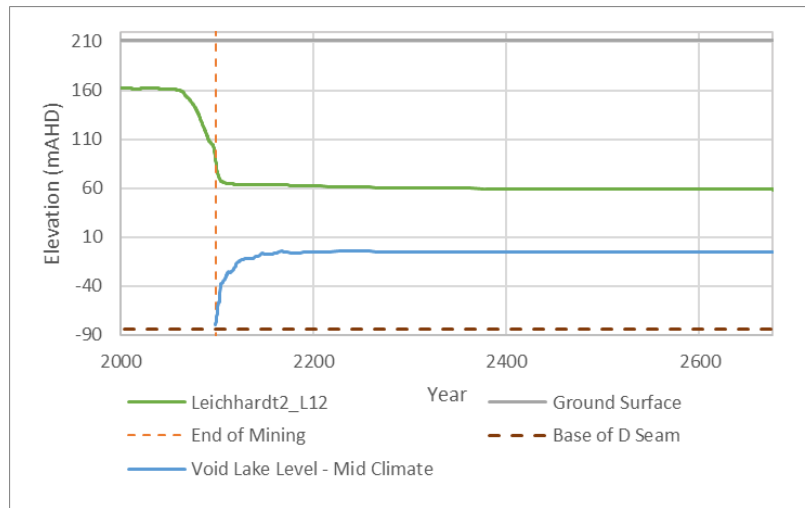


Figure 3-34 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (south) (cont.)



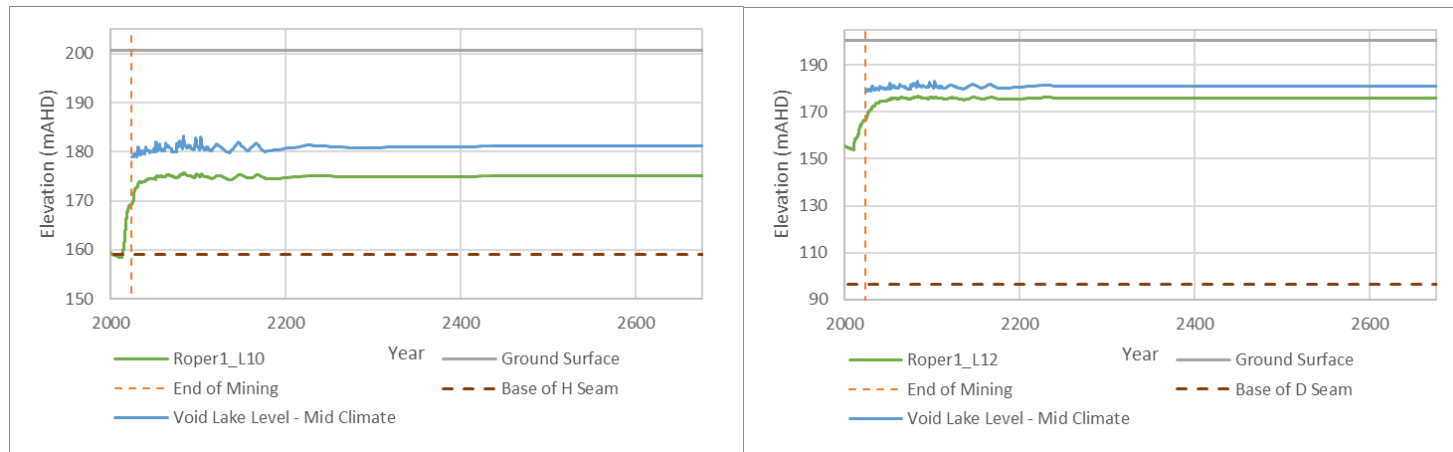


Figure 3-35 Coal Measures Predictive Hydrographs adjacent Roper Voids (north)

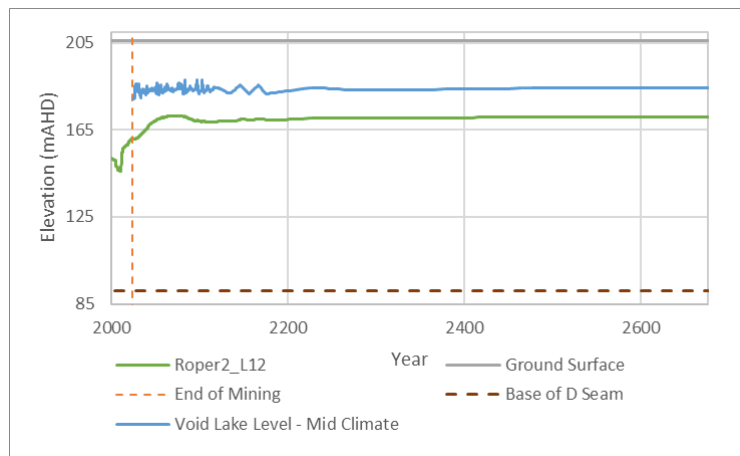


Figure 3-36 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 1)



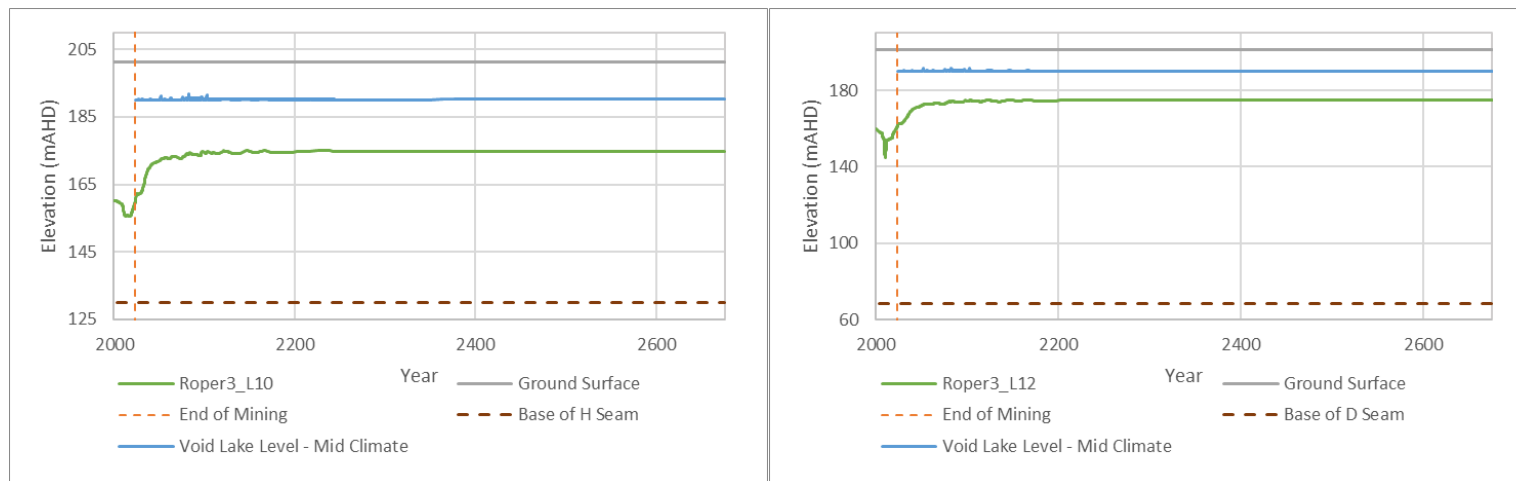


Figure 3-37 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 2)

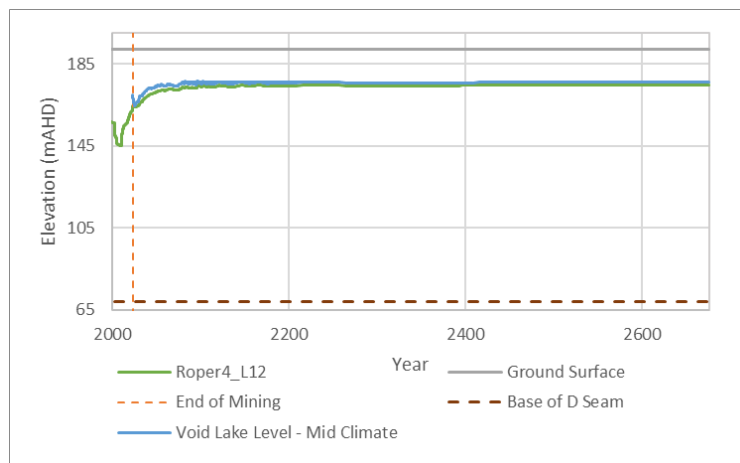


Figure 3-38 Coal Measures Predictive Hydrographs adjacent Roper Voids (south)



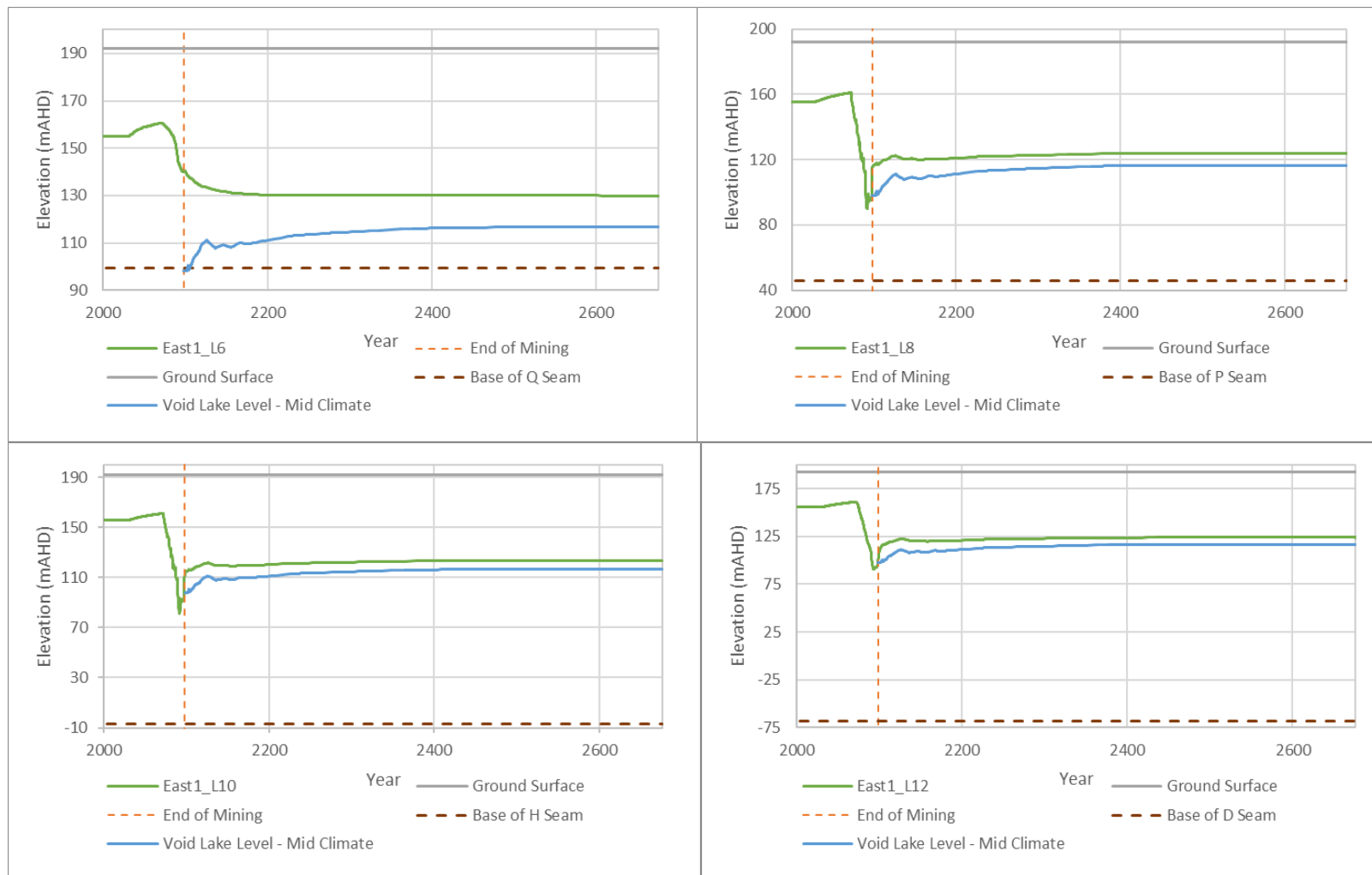


Figure 3-39 Coal Measures Predictive Hydrographs Adjacent East 1 Void



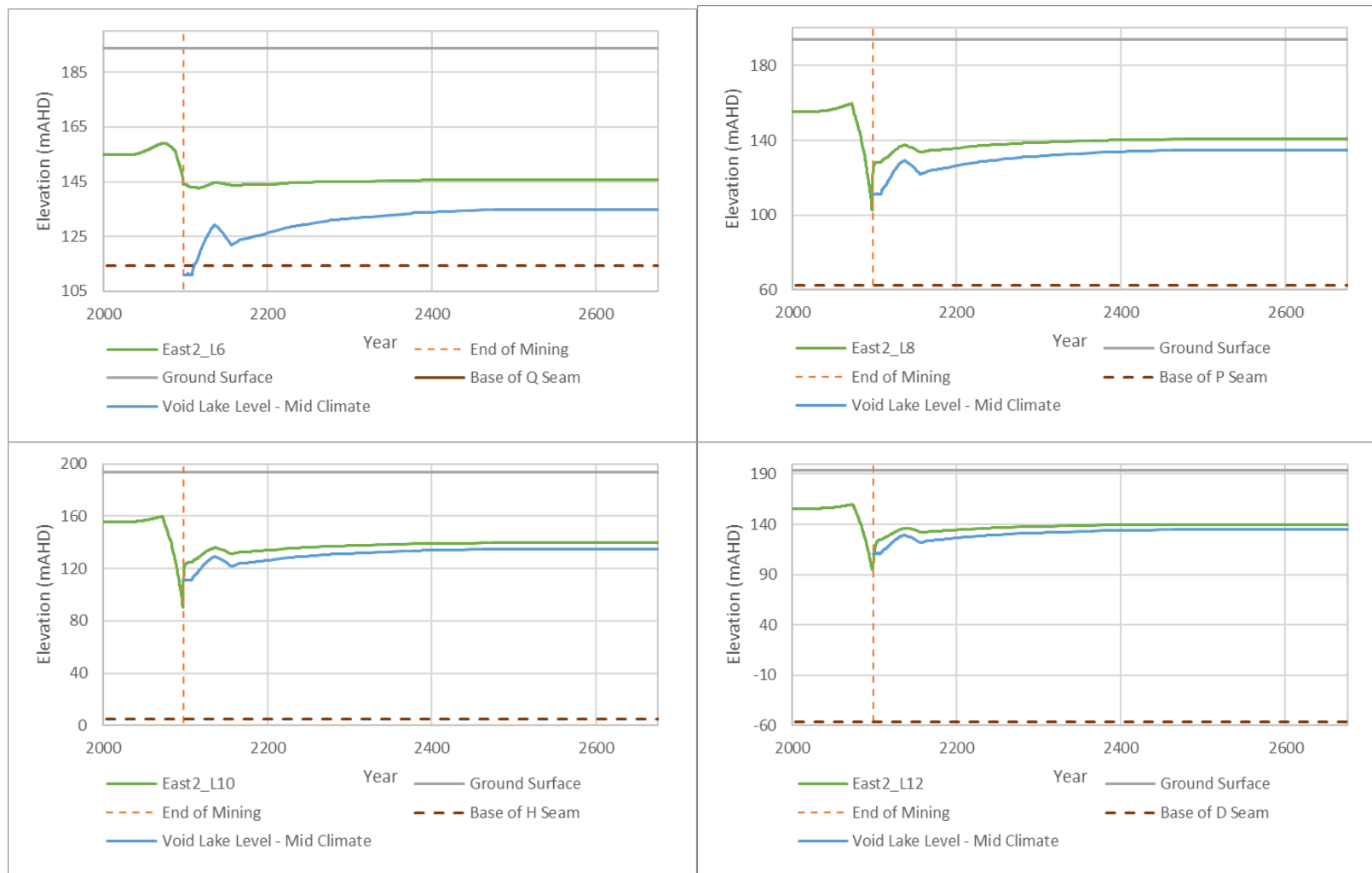


Figure 3-40 Coal Measures Predictive Hydrographs Adjacent East 2 Void

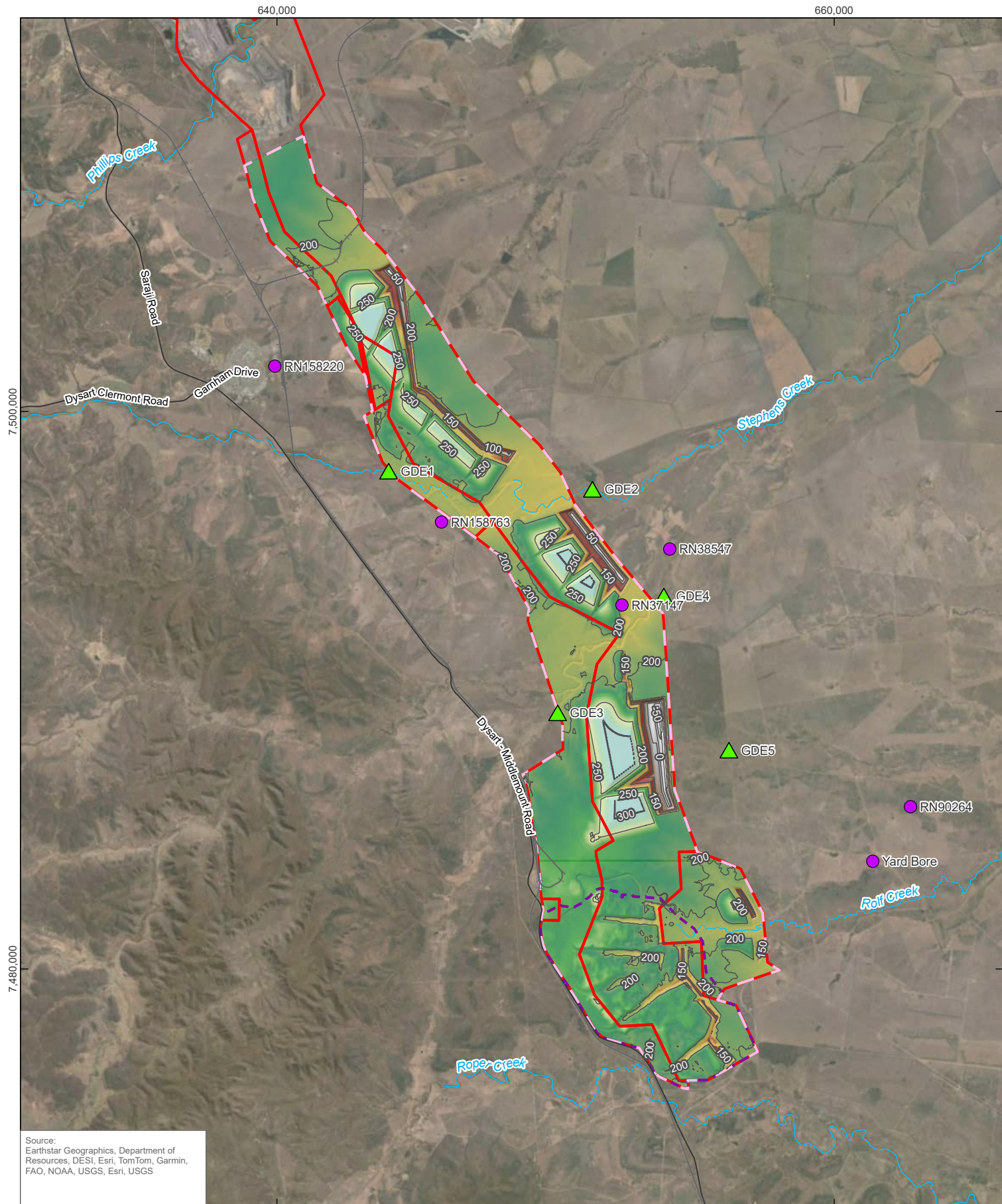


3.5.2 Groundwater Level Impacts to Potential Receptors

Predictive hydrographs have been derived from the groundwater model to understand the nature of likely groundwater level change in the interpreted source aquifer for identified potential natural and anthropogenic groundwater receptors in the vicinity of the SSM Area. The aim of the hydrographs is to assess the potential for additional impacts to these potential receptors in the period post-mining, i.e. identify additional potential impacts beyond those that have occurred during already approved mining operations that may be attributable to the PRC Plan's proposed final landform. **Figure 3-41** provides the hydrograph locations.

Predictive hydrographs for the water table at the potential GDE sites identified in and adjacent to the SSM Area are provided as **Figure 3-42** for the mid climate scenario. The hydrographs also indicate that much of the water table drawdown in the vicinity of the potential GDEs is predicted to occur prior to the end of mining (i.e. associated with approved SSM mining operations), with any additional drawdown occurring over the post-mining period continuing the drawdown trends that commence prior to the end of mining. The shape of the hydrographs suggests that the additional drawdown impacts that occur in the post-mining period are residual impacts from approved previous active mining activities (i.e. a time lag from active mining), rather than new impacts caused by the PRC Plan's landform design; i.e. suggesting that the final landform is not contributing significantly to additional impacts at the potential GDE locations. Note there is no difference in the hydrographs for the drier or wetter climate scenarios.





Source:
Earthstar Geographics, Department of
Resources, DESI, Esri, TomTom, Garmin,
FAO, NOAA, USGS, Esri, USGS

	0 2.5 5 km
Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:180,000 at A4
Project Number:	620.314444.00000
Date Drawn:	21-Aug-2024
Drawn by:	RB

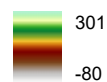
LEGEND

Hydrograph Location

- Bore
- GDE

- Topographic Contour (mAHd)
- Railway
- Major Road
- Watercourse
- SSM Mine Lease
- SSM EA Boundary

Elevation (mAHd)



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POTENTIAL RECEPTOR PREDICTIVE HYDROGRAPH LOCATIONS



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FIGURE 3-41

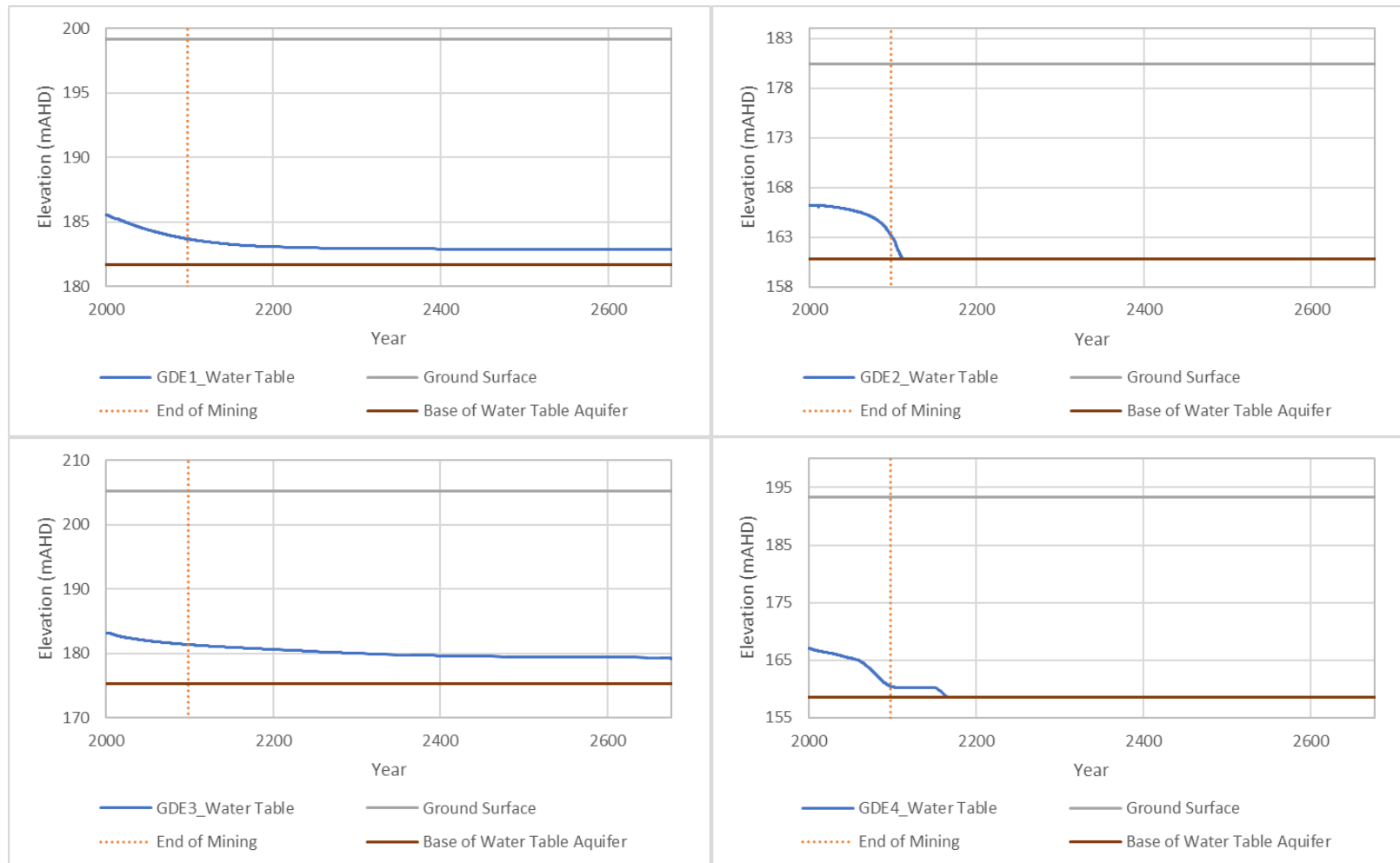


Figure 3-42 Water Table Hydrographs at Potential GDEs



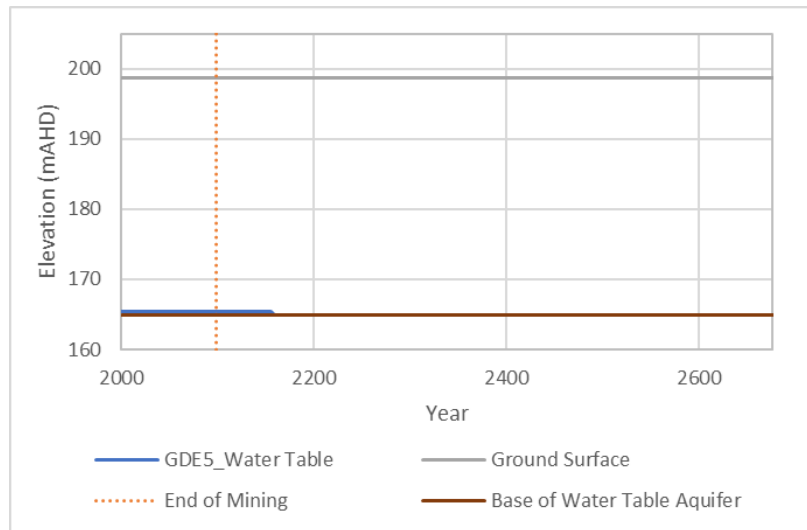


Figure 3-42 Water Table Hydrographs at Potential GDEs (cont.)



Predictive hydrographs for the six identified third party water supply bores with sufficient information to attribute a source aquifer are provided as **Figure 3-43** for the mid climate scenario. Some long-term post mining groundwater drawdown of less than 5 m is predicted at bores RN37147, RN158220, RN158763, unregistered Yard Bore, and RN90264.

A relatively significant amount of drawdown is predicted in the long term post-mining. The maximum drawdown is expected to occur over hundreds of years, well beyond the expected service life of a groundwater bore, at the bore located in the Fort Cooper Coal Measure, RN38547 (~2 km east of the Gilbert void).

This drawdown is considered to be mostly related to a time lag from during-mining impacts, plus also regional scale influences represented in the model (i.e. other mining activities) given the bore accesses groundwater from geological units not present across the vast majority of the SSM Area. The maximum drawdown at this bore (RN38547) is greater than the relevant 5 m drawdown 'bore trigger threshold' for consolidated aquifers (i.e. the Fort Cooper Coal Measures) identified in Chapter 3 of the *Water Act 2000*, i.e. the threshold at which drawdown impacts may need to be further investigated for the purposes of determining any requirement to 'make good' a bore impairment. Note there is no difference in the hydrographs for the drier or wetter climate scenarios.

The bores RN84538, RN136092, and unregistered House Bore are located outside the model boundary, and therefore have not been included in the model assessment.



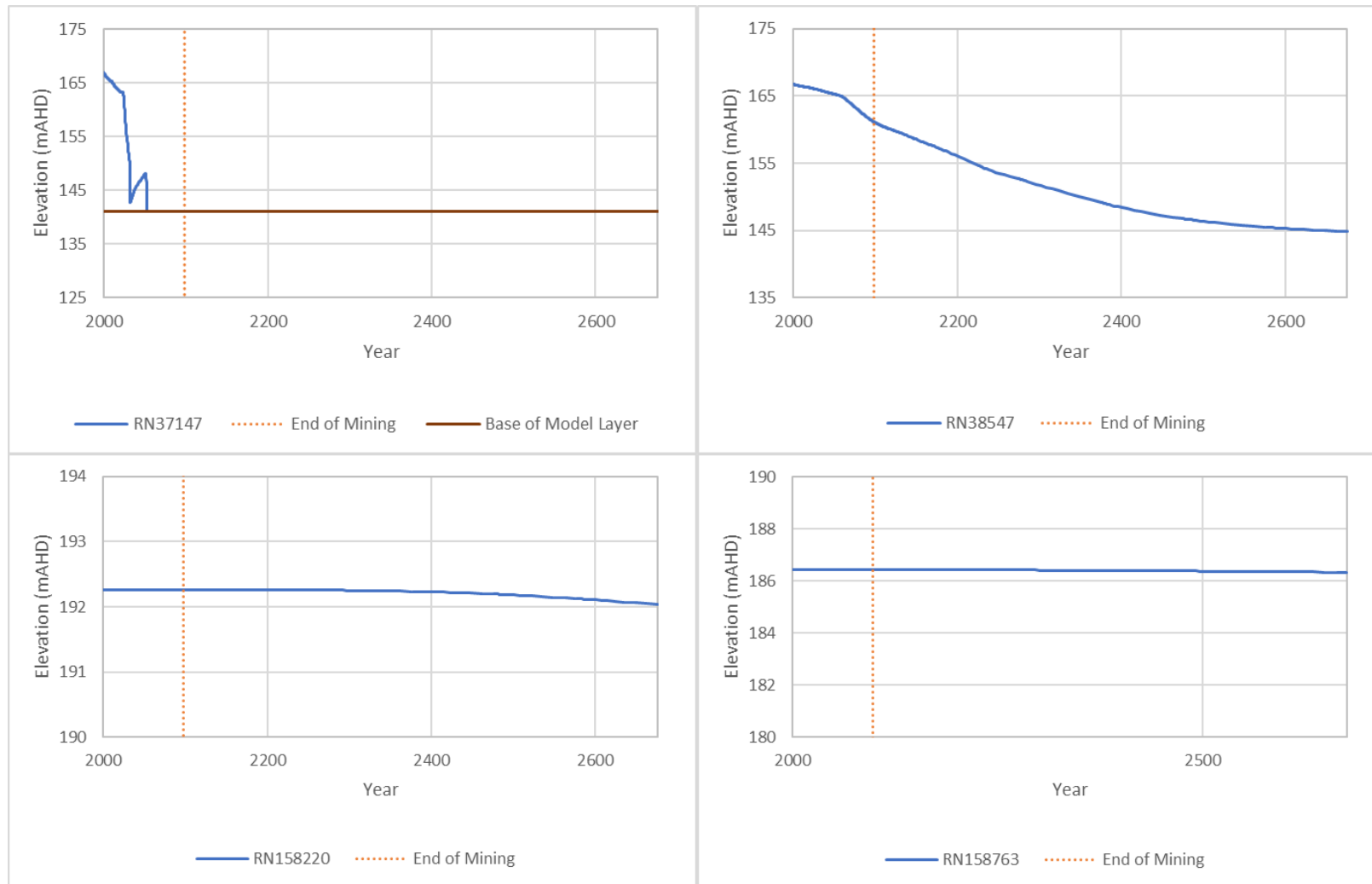


Figure 3-43 Hydrographs for Surveyed Third Party Supply Bores with Attributable Source Aquifer



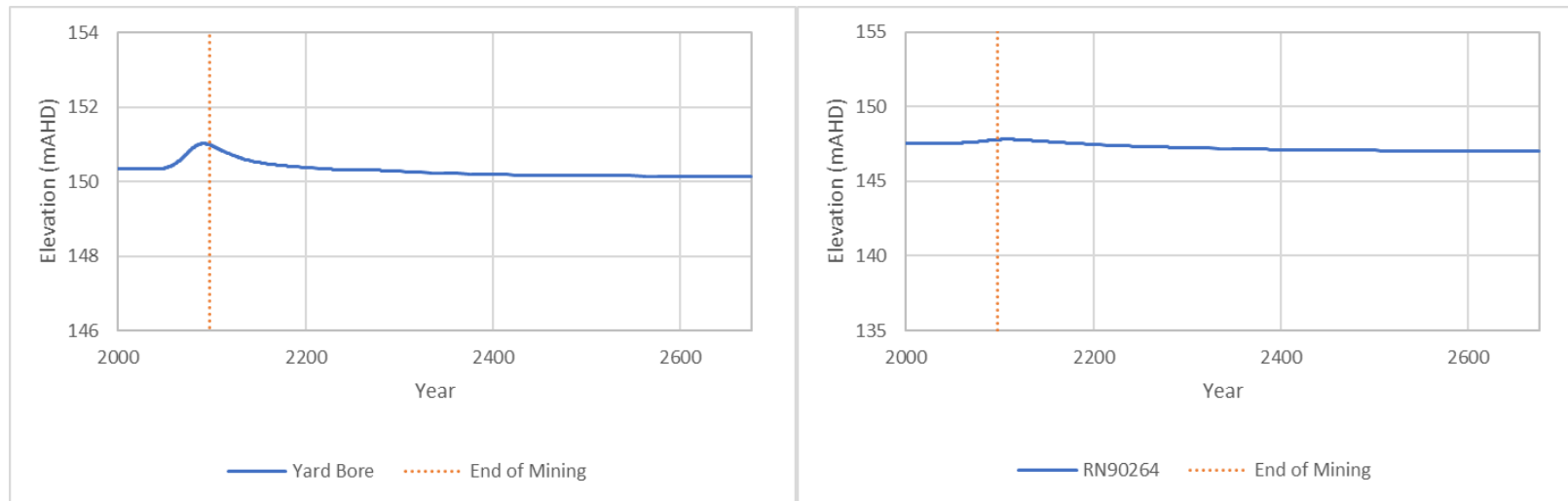


Figure 3-43 Hydrographs for Surveyed Third Party Supply Bores with Attributable Source Aquifer (cont.)



3.6 Flow Path Simulation

3.6.1 Particle Tracking Setup

An analysis of the water movement within the final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post-mining. A number of particles were placed on the final landform and within the residual voids in the recovery groundwater model and the mod-PATH3DU code (S.S. Papadopoulos & Associates, Inc., 2018) was used to simulate particle pathways along the groundwater flow field during recovery (i.e. 578 years). To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flow path lines.

Figure 3-44 shows the initial location of particles on the final landform. The particles were placed at the surface of the model and released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation. It should be noted that the mod-PATH3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation; as shown on **Figure 3-44** for many of the particles, this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the SSM Area at the commencement of the post-mining simulation. Locations where the model predicts saturation in the shallow groundwater system (i.e. Layer 2) at the end of mining.

3.6.2 Predicted Flow Paths - Mid Climate Scenario

Figure 3-45 shows the predicted movement of water particles in the 578-year recovery simulation of the final landform for the Mid Climate scenario. The colours along the predicted particle flow paths provides the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The colour changes along the paths on **Figure 3-45** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures has been mined out) over the post-mining period. The flow path analysis indicates the particles generally move toward the void lakes, with many of the particles captured in the voids. No particles are shown to move significantly away from the SSM Area to the broader receiving environment.

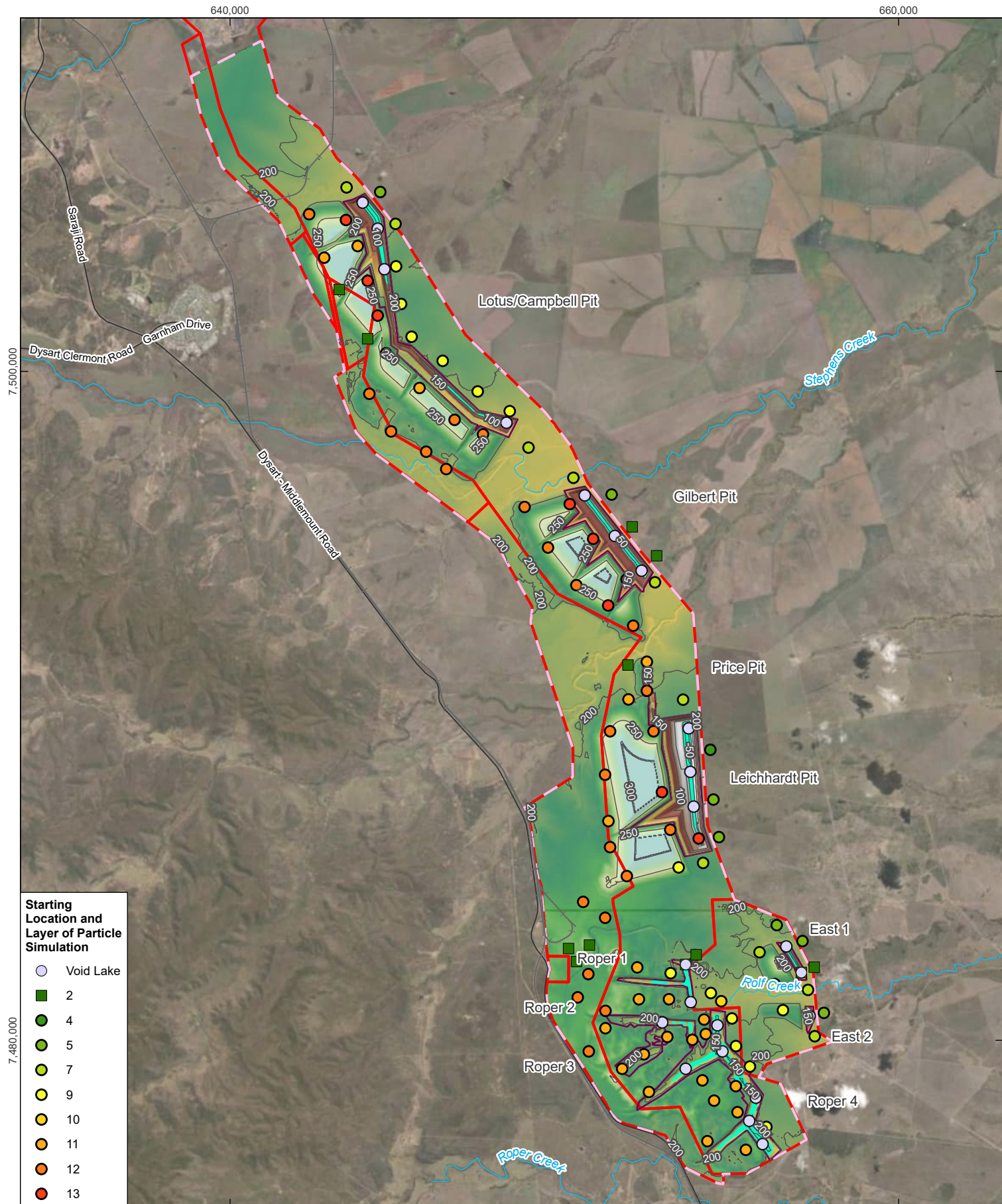
Overall, the particle movement simulation indicates that groundwater on SSM, including that flowing through spoil of the final landform and that beneath the mine area, would remain within the final landform (e.g. backfilled spoil and voids) in the long-term, except for within the Roper Study Area. Except for within the Roper Study Area, no groundwater originating from the SSM is predicted to flow to the receiving environment, i.e. the voids would remain groundwater sinks and groundwater would not flow from the residual voids off-site.

In regards to the particle tracking results for the Roper Study Area, as noted previously additional groundwater data collection and assessment in the Roper Study Area will improve the understanding of groundwater aquifers in the area and improve the modelling calibration and reduce the uncertainty currently present within the model outputs. This will assist to inform the development of an appropriate closure landform for the Roper Study Area that minimises the potential for environmental harm.



Given that the particle pathlines are simulated from the start of recovery, they generally follow predicted head gradients. However, the particle directions at times appear to be contrary to the head contours/gradients shown on **Figure 3-45**. It should be noted that the contours shown on **Figure 3-45** only represents the final head pattern when the aquifer has reached an equilibrium and hence does not necessarily show the transient head changes occurring during the 578 years recovery simulation, given the recovery simulation commences from the first year post-mining. For example, head gradients will change over the 578 years of recovery simulation as void lake levels stabilise and the groundwater system recovers partially from mining.





Starting Location and Layer of Particle Simulation

- Void Lake
- 2
- 4
- 5
- 7
- 9
- 10
- 11
- 12
- 13



0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:150,000 at A4

Project Number: 620.314444.00000

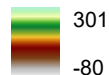
Date Drawn: 30-May-2024

Drawn by: RB

LEGEND

- Topographic Contour (mAHd)
- Railway
- Major Road
- Watercourse
- Void Extent
- Void Lake
- SSM Mine Lease
- SSM EA Boundary

Elevation (mAHd)



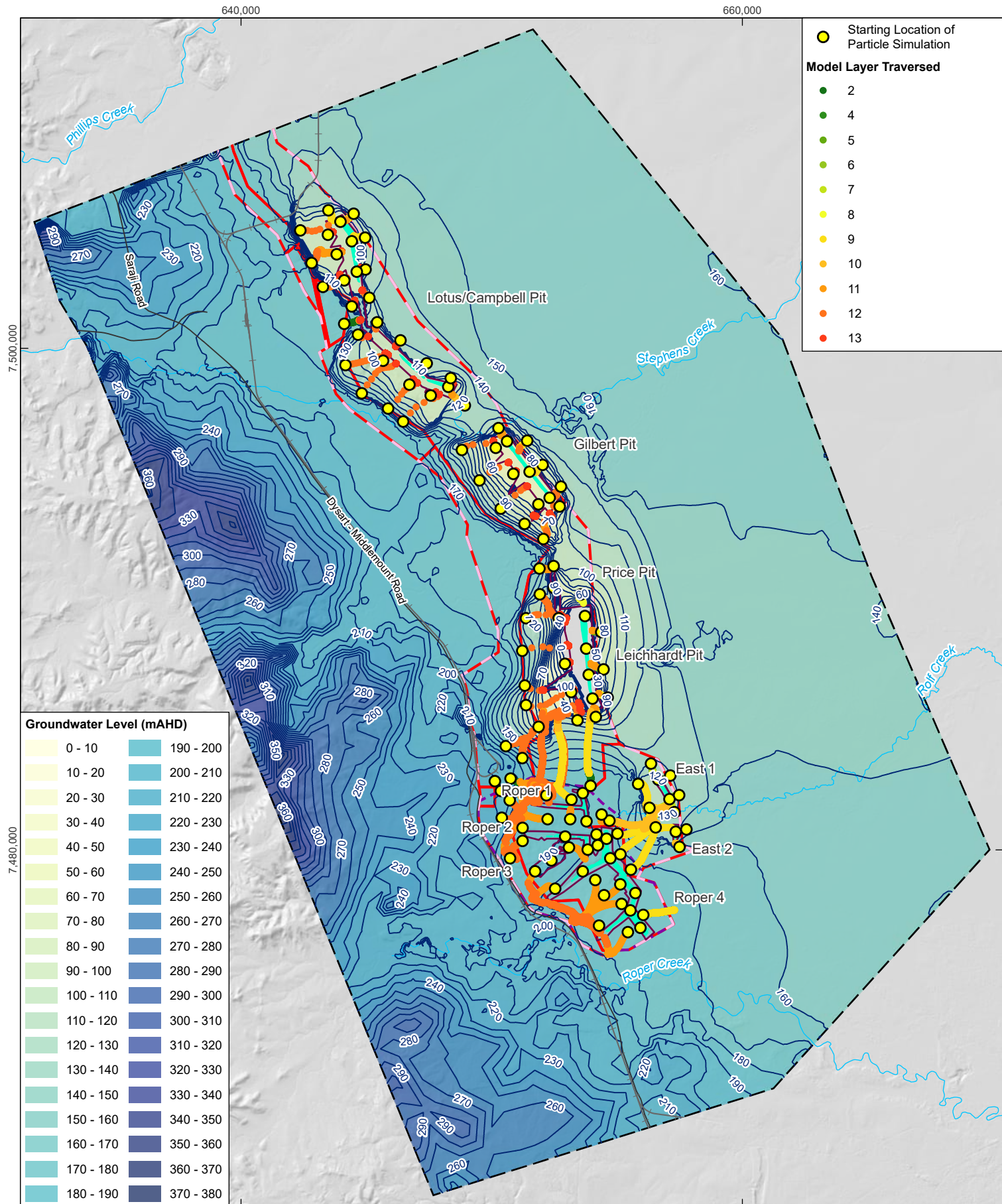
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STARTING LOCATION OF PARTICLES



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FIGURE 3-44



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 16-Jul-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHd)
-  Void Extent
-  Void Lake
-  SSM Mine Lease
-  SSM EA Boundary

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PREDICTED MOVEMENT OF PARTICLES (MID CLIMATE SCENARIO)



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FIGURE 3-45

3.7 Climate Sensitivity

Predicted groundwater levels and flow path simulation results for the Drier Climate scenario and Wetter Climate scenario as shown in **Appendix F** and **Appendix G**, respectively.

Regionally, there is very little difference between the predicted groundwater levels for the Drier Climate scenario, the Wetter Climate scenario and the Mid Climate scenario. This is discussed in more detail in **Section 3.5**. Similarly, particle movements are comparable regionally across all three climate scenarios. All particles remain within the landform regardless of climate scenario with no groundwater predicted to flow to the receiving environment, again with the exception of the Roper Study Area.



4.0 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

The first step in Monte Carlo analysis is to define the parameter distribution and range. For this project, the software PESTPP-IES (White, 2018) was used to generate parameter ensembles based on a provided range of plausible values. Parameters distributions showing the range of parameters tested during the uncertainty analysis, for all the parameters included, are shown in **Appendix H**.

PESTPP-IES uses an “ensemble smoother” method that enables the optimisation of each realisation, in order to obtain an ensemble (suite of realisations) that:

- Covers the range of the plausible distribution for each parameter; and
- Is calibrated to historical water level data.

As discussed in **Section 2.7**, a total of 120 realisations were successfully optimised.

The uncertainty analysis included the predicted net inflow of groundwater to each of the residual voids for the 500-year period following the cessation of mining activity at each void location.

4.1 Uncertainty of Residual Void Groundwater Inflows

The uncertainty associated with the predicted groundwater inflow to the residual voids from the beginning of recovery to 500-years post-mining, is presented in **Figure 4-1** through to **Figure 4-9**.

The figures show the predicted inflows for the Base Model and different percentile prediction ranges. These represent:

- 5th – 33rd indicates it is likely that the outcome is larger than this range.
- Median (p50) indicate it is as likely as not that the outcome is larger or smaller than this value.
- 33rd - 67th indicates it is likely that the outcome is within that range.
- 67th – 95th indicates it is unlikely that the outcome is larger than this range.
- 95th percentile indicates it is very unlikely the outcome is larger than this value.

The predicted uncertainty in residual void inflows shows that the Base Model generally fits within the 5th to the 33rd percentile range for the northern voids (Lotus/Campbell, Gilbert and Price\Leichhardt voids) and the East Voids.

For the Roper voids, the Base Model sits within the 67th – 95th percentile range for the Roper 1 and 4, and within the 5th to the 33rd percentile range for the Roper 3. The Roper 2 sits within the 33rd - 67th percentile range.



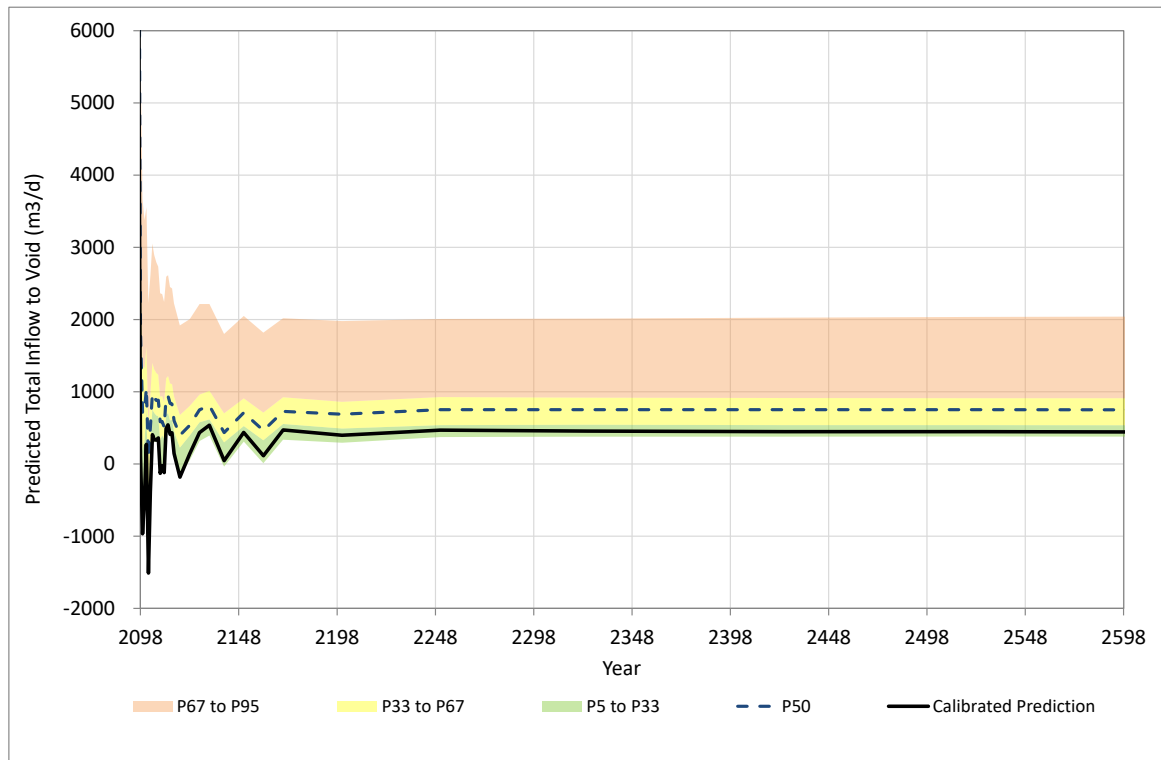


Figure 4-1 Uncertainty in Predicted Void Groundwater Inflows – Lotus\Campbell Void

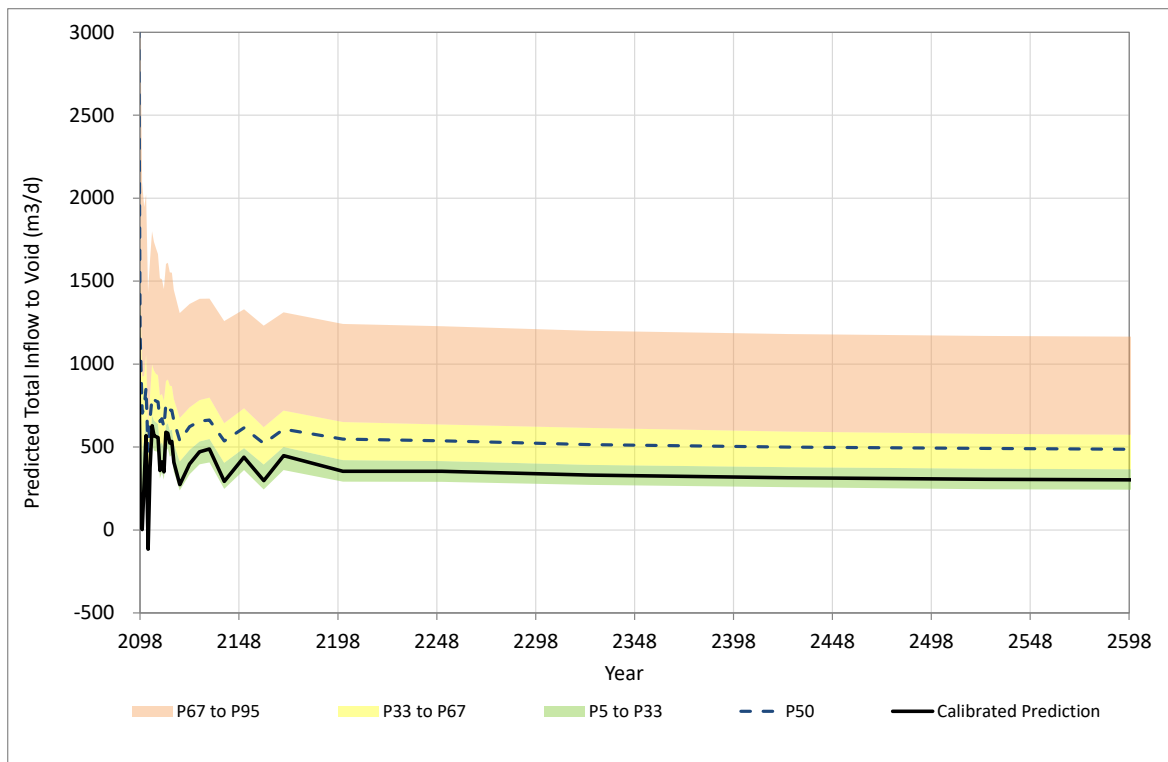


Figure 4-2 Uncertainty in Predicted Void Groundwater Inflows – Gilbert Void



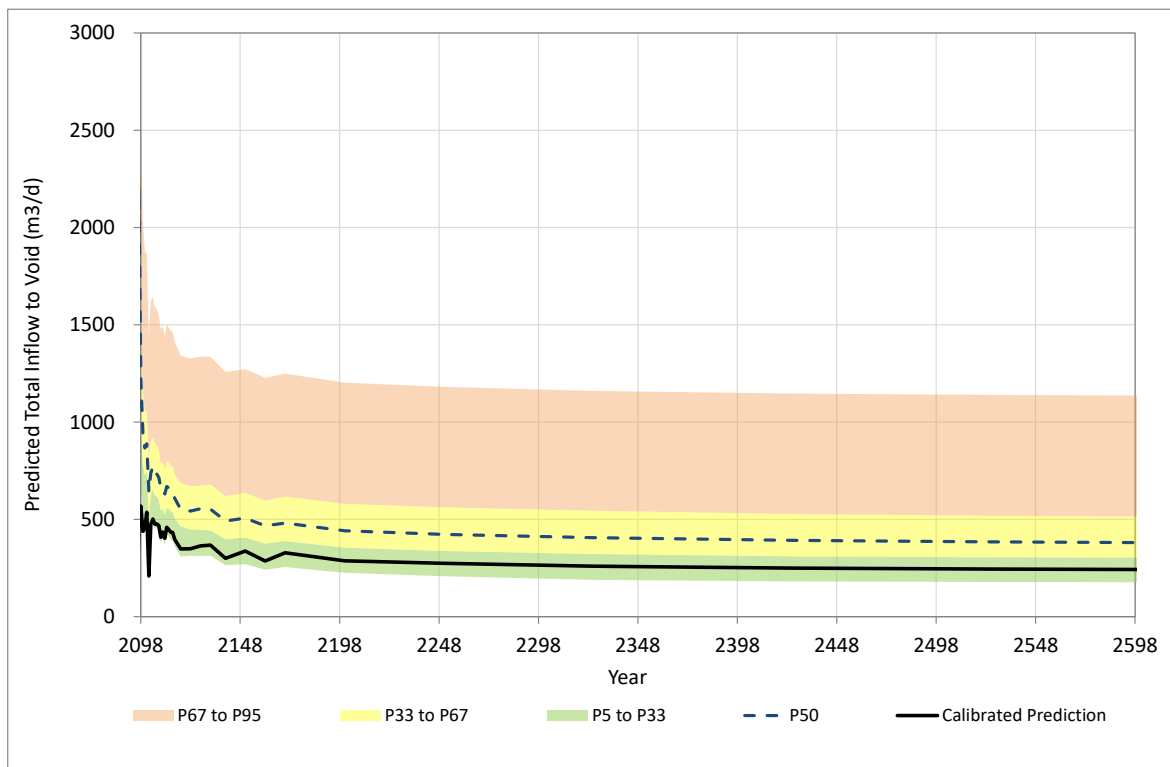


Figure 4-3 Uncertainty in Predicted Void Groundwater Inflows – Price\Leichhardt Void

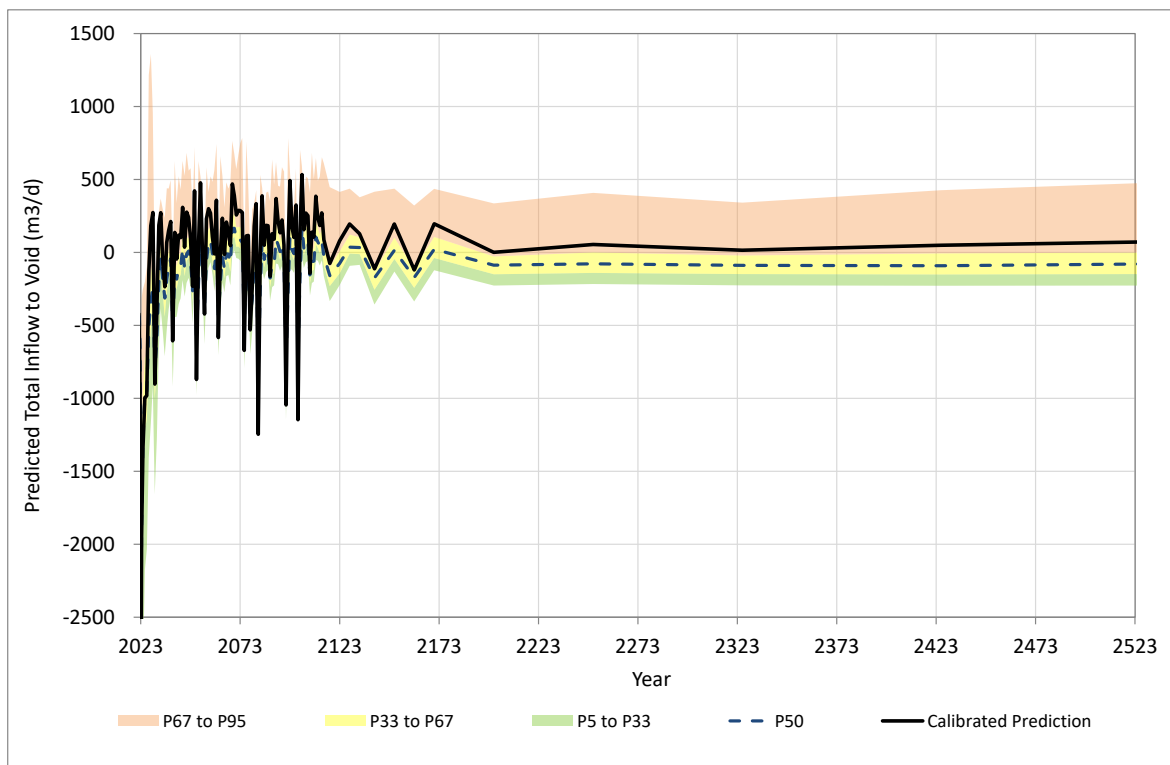


Figure 4-4 Uncertainty in Predicted Void Groundwater Inflows – Roper 1 Void



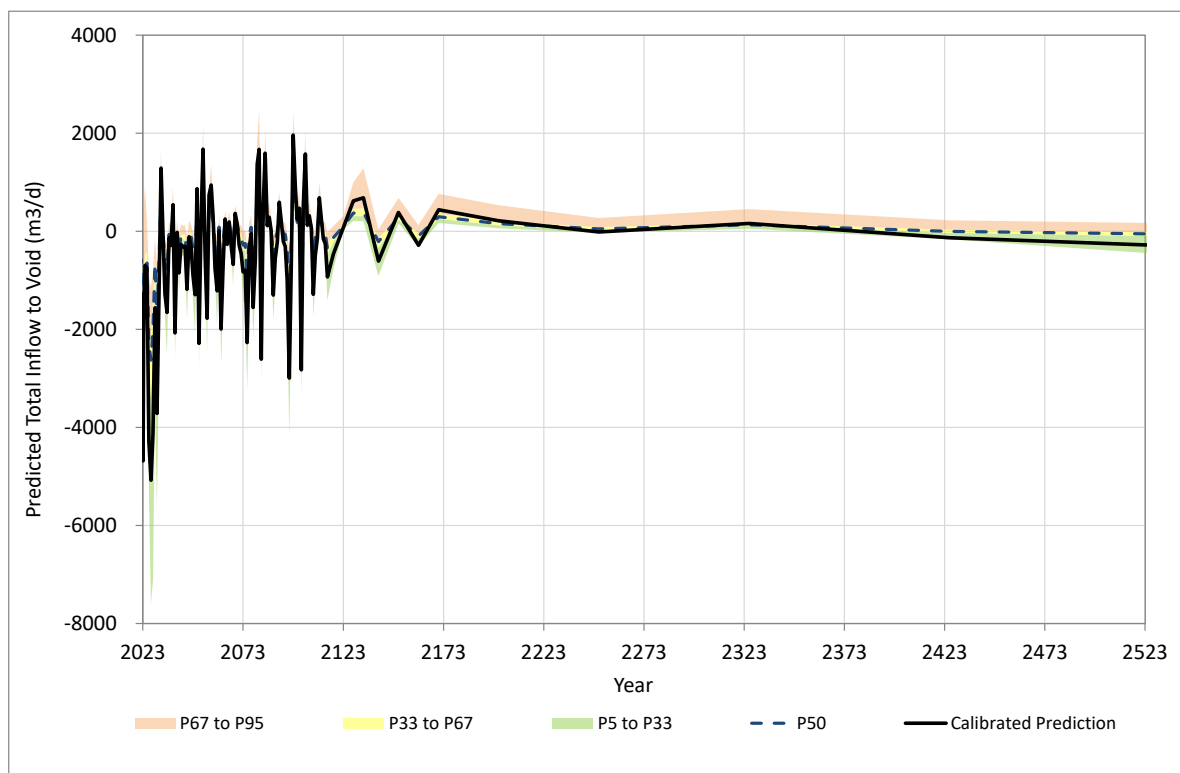


Figure 4-5 Uncertainty in Predicted Void Groundwater Inflows – Roper 2 Void

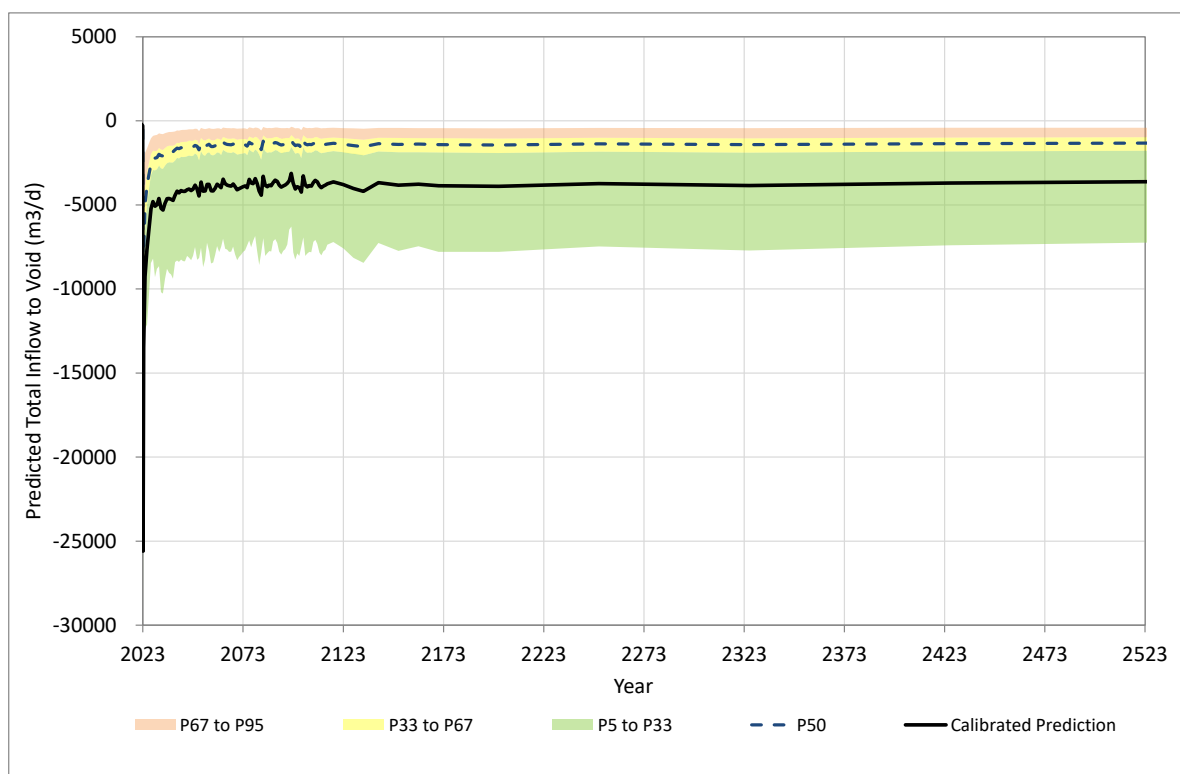


Figure 4-6 Uncertainty in Predicted Void Groundwater Inflows – Roper 3 Void



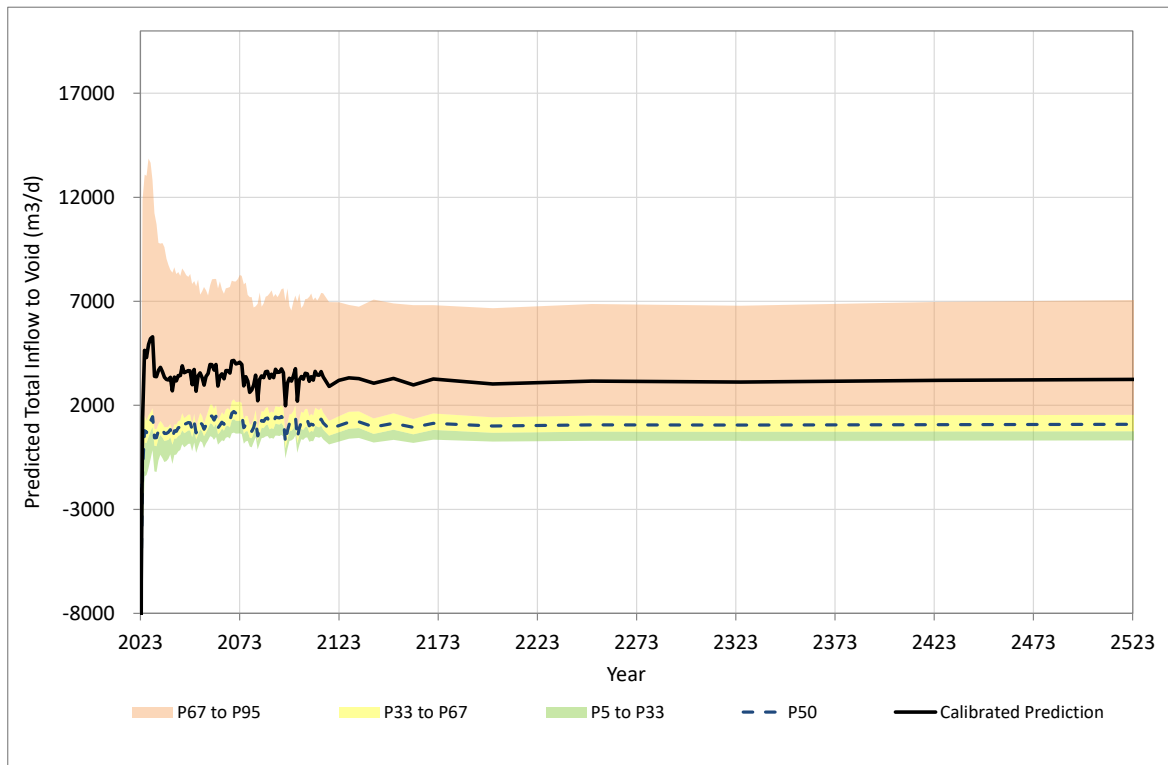


Figure 4-7 Uncertainty in Predicted Void Groundwater Inflows – Roper 4 Void

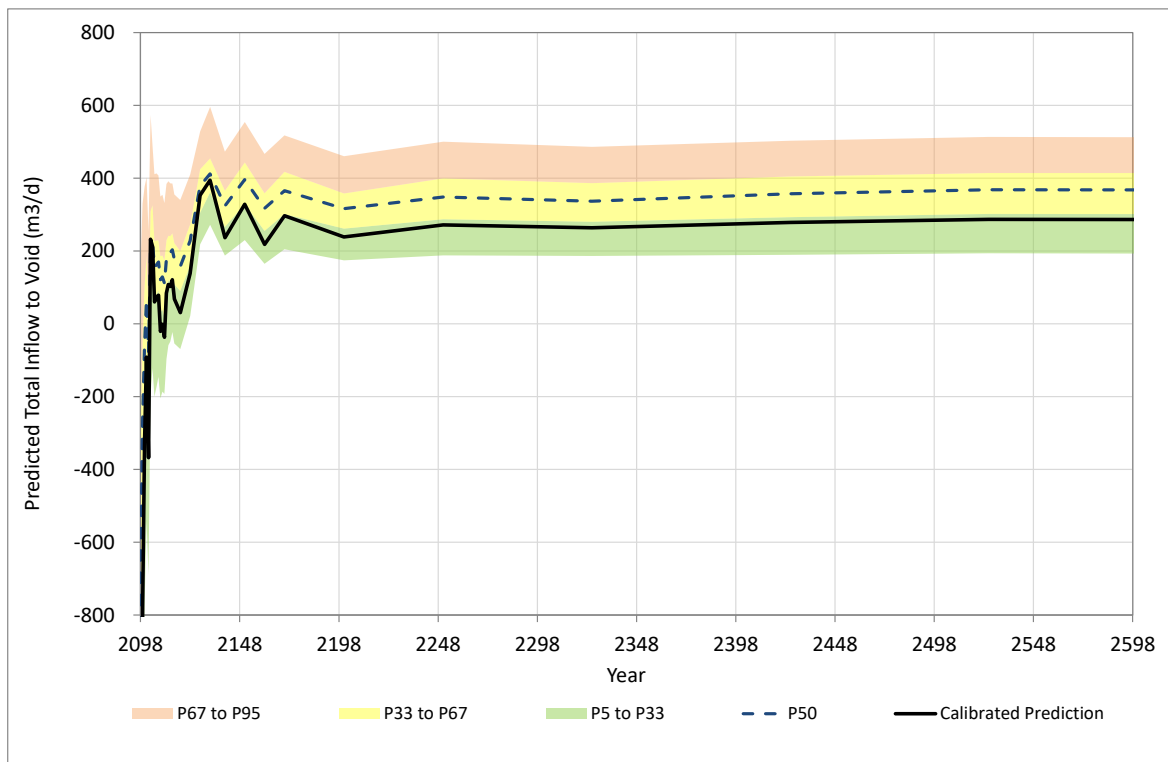


Figure 4-8 Uncertainty in Predicted Void Groundwater Inflows – East 1 Void



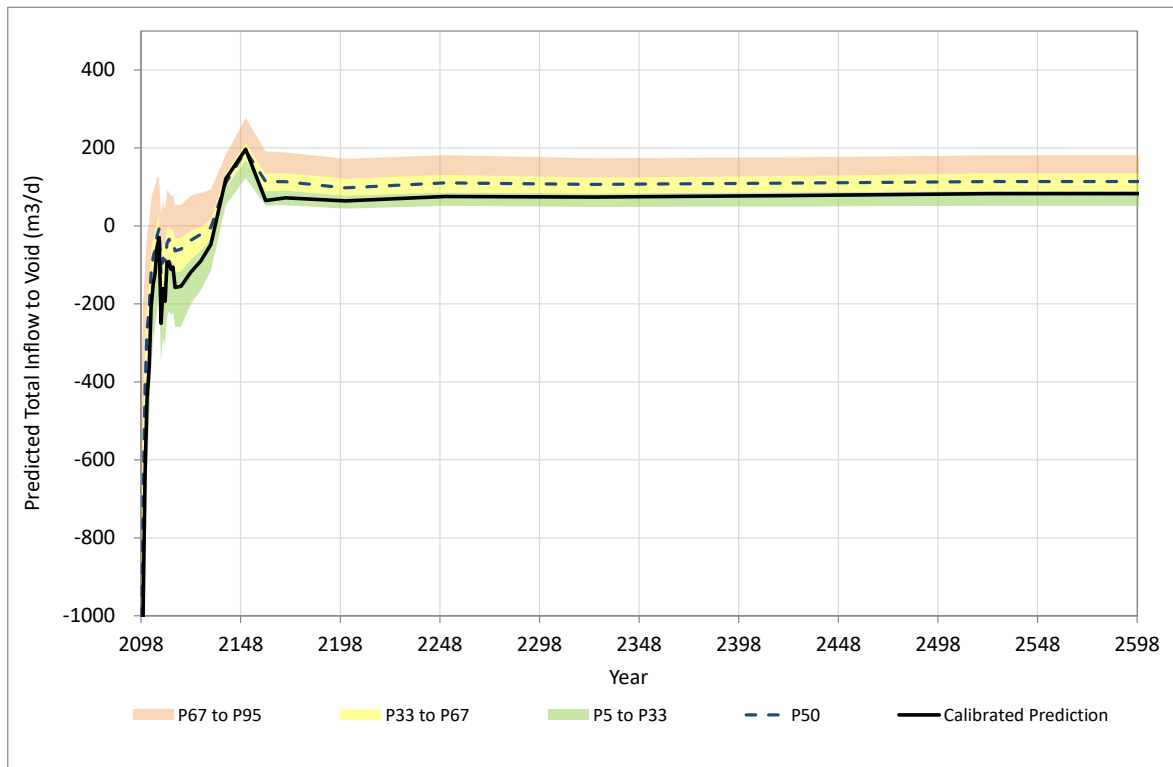


Figure 4-9 Uncertainty in Predicted Void Groundwater Inflows – East 2 Void



5.0 Model Limitations

The Australian Government's Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) *Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling* (Peeters and Middlemis, 2023) identifies four key sources of scientific uncertainty affecting groundwater model simulations:

- Structural/conceptual.
- Parameterisation.
- Measurement error.
- Scenario uncertainties.

Peeters and Middlemis (2023) state that simulation models are developed as simplified representations of 'real world' systems that are usually history-matched to measured data, albeit affected to some degree by the various sources of uncertainty outlined above. Peeters and Middlemis (2023) further describe that models are continuously refined with new data, conceptualisations and processes, to investigate the effects of management options on future eventualities.

The four sources of scientific uncertainty identified by Peeters and Middlemis (2023) have been qualitatively assessed with regards to key aspects of the SSM numerical model adopted for this groundwater assessment, as presented in **Table 5-1**.

Overall, the model captures depressurisation due to active mining. The model is numerically stable with no mass balance error. The model shows a reasonable fit between observed and modelled groundwater levels. A depth dependence function was used for hydraulic conductivity, with the calibrated values showing a good fit to observed data. Overall, the model is considered fit for purpose based on the data provided and the project timeframe.

In case of future use of the model, updates could be conducted to further refine the model if it was deemed that an increase in model confidence level was required, but the applicability of this would be dependent on the purpose of the future modelling and availability of data to inform future changes. As it stands, the current model is deemed fit for purpose for assessment.



Table 5-1 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around the SSM site, major modelled faults and along drainage features.
	Layers	Fit for purpose	Representation of alluvium and other geologic units based on CSIRO depth to regolith surface (Wilford et, al., 2016) and SSM-derived information from the study area including drilling data.
	Conceptualisation – Geological Structure	Fit for purpose	The local structure of the geology is based on detailed data at SSM where available, including a SSM developed site geology model. Geological mapping has identified several large faults throughout the model domain. Faults have been included as separate (i.e. individual for each fault) hydraulic parameter zones and calibrated to fit measured water level data across the model domain.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The Moranbah Coal Measures outcrop within the numerical model domain and as such they receive direct recharge like the Alluvium and Tertiary in the model. A specific recharge zone was attributed to the drainage lines, to represent infiltration recharge via the creek bed during flooding events. Mine pits that were flooded in 2011 are represented using a constant head boundary based on site measurements.
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose improvements possible	For the extent and thickness of alluvium and regolith within the model domain, a combination of site geological model (SSM geological model - base of weathering), regional geological mapping and the CSIRO depth to regolith surface (Wilford et, al., 2016) was used. Any additional data or study on alluvium extent and thickness in the SSM area should be reviewed and captured (where relevant) in future updates of the model.
Parameterisation	Hydraulic Conductivity – Depth Dependence	Fit for purpose, future improvements possible	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the SSM and the neighbouring Saraji East Mine area. Hydraulic conductivity test results from the wider Bowen Basin were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model. Further hydraulic conductivity tests and measurements of storage properties can improve model calibration and refine model predictions but are not deemed required for the current impact assessment.



Type	Part	Status	Comment
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil parameter calibration ranges were estimated based on previous studies at other sites.
	Rivers	Fit for purpose, future improvements possible	All watercourses within the model domain are minor ephemeral creeks. They are represented in the model via specific recharge zone, to reproduce infiltration recharge via the creek bed during flooding events. A refinement along the riverbeds was also performed to capture the variation in the evapotranspiration surface along the watercourses).
	Recharge	Fit for purpose, future improvements possible	Recharge zonation is based on mapped surface geology and calibrated recharge rates. Calibration ranges were based on site data analysis and literature values.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units. 261 target heads were established for 53 bores from the SSM area.
	Temporal spread	Fit for purpose	Timeseries water level data from the site used for calibration contains at least one observation in every modelled aquifer, except for the Q Seam and the Fort Cooper overburden. Data is available from 1990, although most of the data covers the period 2010 – 2023.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	A steady state calibration to initial heads at each bore was performed followed by a transient calibration to observed drawdowns up to 2023.
	Predictive	Fit for purpose	Model prediction period covers all 2023 onwards SSM approved mining activity and accounts for post mining rehabilitation (i.e. Final landform)
	Sensitivity and uncertainty	Fit for purpose	Postmining simulation of surface water lakes in all the final voids was conducted via an iterative process whereby groundwater fluxes to and from the lakes were estimated using the MODFLOW groundwater model and surface water fluxes were simulated using a GoldSim rainfall/runoff model. Final lake levels were obtained after the two models converged and the results of this final set of lake levels were used to estimate postmining groundwater impacts in the groundwater assessment component of the SSM PRCP.



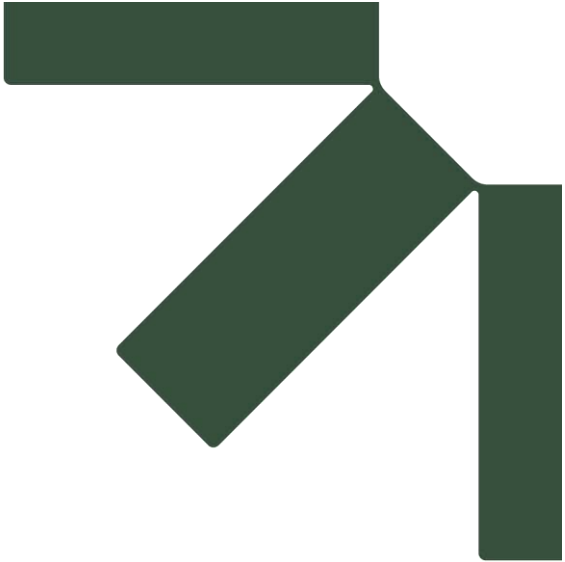
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<https://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/current-projects/winchester-south-project/winchester-south-project-draft-eis-documents>
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<https://doi.org/10.1016/j.geoderma.2015.11.033>
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Appendix A Stress Periods and Simulated Active Mine Timings

Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

22 August 2024

Calibration Period	Interval	Stress Period	Date	Date	Lotus Pit	Campbell Pit	Gilbert Pit	Price Pit	Leichhardt Pit	Roper Pit	East Pit
			(from)	(to)							
Steady-state		1	Steady-state								
Warm-up	10 Years	2	Transient Warm up							x	
Calibration	10 Years	3	1990-01-02	2000-01-03			x			x	
		4	2000-01-03	2001-01-02		x				x	
		5	2001-01-02	2002-01-02		x				x	
		6	2002-01-02	2003-01-02		x		x		x	
		7	2003-01-02	2004-01-03		x		x		x	
		8	2004-01-03	2004-04-03		x		x		x	
		9	2004-04-03	2004-07-03		x		x		x	
		10	2004-07-03	2004-10-02		x		x		x	
		11	2004-10-02	2005-01-02		x		x		x	
		12	2005-01-02	2005-04-03		x		x	x	x	
		13	2005-04-03	2005-07-03		x		x	x	x	
		14	2005-07-03	2005-10-03		x		x	x	x	
		15	2005-10-03	2006-01-02		x		x	x	x	
		16	2006-01-02	2006-04-03		x		x	x	x	
		17	2006-04-03	2006-07-04		x		x	x	x	
		18	2006-07-04	2006-10-03		x		x	x	x	
		19	2006-10-03	2007-01-02		x		x	x	x	
		20	2007-01-02	2007-04-04		x		x	x	x	
		21	2007-04-04	2007-07-04		x		x	x	x	
		22	2007-07-04	2007-10-03		x		x	x	x	
		23	2007-10-03	2008-01-03		x		x	x	x	
		24	2008-01-03	2008-04-03		x		x	x	x	
		25	2008-04-03	2008-07-03		x		x	x	x	
		26	2008-07-03	2008-10-02		x		x	x	x	
		27	2008-10-02	2009-01-02		x		x	x	x	
		28	2009-01-02	2009-04-03		x		x	x	x	
		29	2009-04-03	2009-07-03		x		x	x	x	
		30	2009-07-03	2009-10-03		x		x	x	x	
		31	2009-10-03	2010-01-02		x		x	x	x	
		32	2010-01-02	2010-04-03	x				x	x	
		33	2010-04-03	2010-07-04	x						
		34	2010-07-04	2010-10-03							



Calibration Period	Interval	Stress Period	Date	Date	Lotus Pit	Campbell Pit	Gilbert Pit	Price Pit	Leichhardt Pit	Roper Pit	East Pit
			(from)	(to)							
		35	2010-10-03	2011-01-02							
		36	2011-01-02	2011-04-04							
		37	2011-04-04	2011-07-04							
		38	2011-07-04	2011-10-03							
		39	2011-10-03	2012-01-03							
		40	2012-01-03	2012-04-03							
		41	2012-04-03	2012-07-03							
		42	2012-07-03	2012-10-02							
		43	2012-10-02	2013-01-02							
		44	2013-01-02	2013-04-03							
		45	2013-04-03	2013-07-03							
		46	2013-07-03	2013-10-03							
		47	2013-10-03	2014-01-02							
		48	2014-01-02	2014-04-03							
		49	2014-04-03	2014-07-04							
		50	2014-07-04	2014-10-03							
		51	2014-10-03	2015-01-02							
		52	2015-01-02	2015-04-04							
		53	2015-04-04	2015-07-04							
		54	2015-07-04	2015-10-03							
		55	2015-10-03	2016-01-03							
		56	2016-01-03	2016-04-03							
		57	2016-04-03	2016-07-03							
		58	2016-07-03	2016-10-02							
		59	2016-10-02	2017-01-02							
		60	2017-01-02	2017-04-03							
		61	2017-04-03	2017-07-03							
		62	2017-07-03	2017-10-03							
		63	2017-10-03	2018-01-02							
		64	2018-01-02	2018-04-03							
		65	2018-04-03	2018-07-04							
		66	2018-07-04	2018-10-03							
		67	2018-10-03	2019-01-02							
		68	2019-01-02	2019-04-04							
		69	2019-04-04	2019-07-04							



Calibration Period	Interval	Stress Period	Date	Date	Lotus Pit	Campbell Pit	Gilbert Pit	Price Pit	Leichhardt Pit	Roper Pit	East Pit
			(from)	(to)							
		70	2019-07-04	2019-10-03							
		71	2019-10-03	2020-01-03							
		72	2020-01-03	2020-04-03							
		73	2020-04-03	2020-07-03							
		74	2020-07-03	2020-10-02							
		75	2020-10-02	2021-01-02							
		76	2021-01-02	2021-04-03							
		77	2021-04-03	2021-07-03							
		78	2021-07-03	2021-10-03							
		79	2021-10-03	2022-01-02							
		80	2022-01-02	2022-04-03							
		81	2022-04-03	2022-07-04							
		82	2022-07-04	2022-10-03							
		83	2022-10-03	2023-01-02							
		84	2023-01-02	2023-04-04							
		85	2023-04-04	2023-07-04							
		86	2023-07-04	2023-10-03	x	x	x		x		
Prediction		87	2023-10-03	2024-01-03	x	x	x		x		
		88	2024-01-03	2025-01-02	x	x	x		x		
		89	2025-01-02	2026-01-02	x	x	x		x		
		90	2026-01-02	2027-01-02	x	x	x		x		
		91	2027-01-02	2028-01-03	x	x	x		x		
		92	2028-01-03	2029-01-02	x	x	x		x		
		93	2029-01-02	2030-01-02	x	x	x		x		
		94	2030-01-02	2031-01-02	x	x	x		x		
		95	2031-01-02	2032-01-03	x	x	x		x		
		96	2032-01-03	2033-01-02	x	x	x		x		
		97	2033-01-02	2034-01-02	x	x	x		x		
		98	2034-01-02	2035-01-02	x	x	x		x		
		99	2035-01-02	2036-01-03	x	x	x		x		
		100	2036-01-03	2037-01-02	x	x	x		x		
		101	2037-01-02	2038-01-02	x	x	x		x		
		102	2038-01-02	2039-01-02	x	x	x		x		
		103	2039-01-02	2040-01-03	x	x	x		x		
		104	2040-01-03	2041-01-02	x	x	x		x		

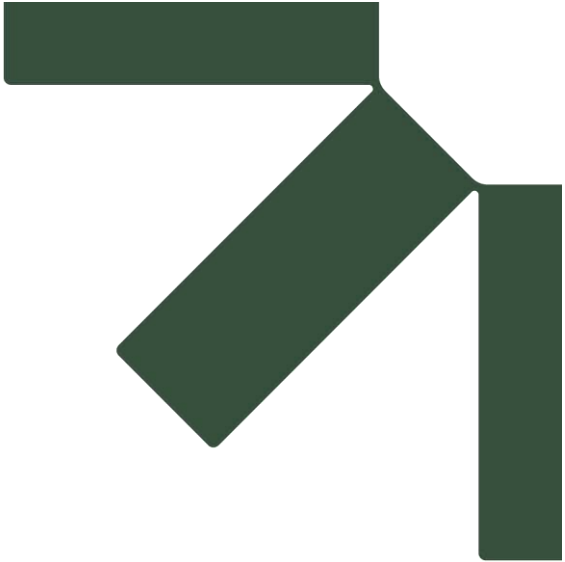


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			(from)	(to)							
		105	2041-01-02	2042-01-02	x	x	x		x		
		106	2042-01-02	2043-01-02	x	x	x		x		
		107	2043-01-02	2044-01-03	x	x	x		x		
		108	2044-01-03	2045-01-02	x	x	x		x		
		109	2045-01-02	2046-01-02	x	x	x		x		
		110	2046-01-02	2047-01-02	x	x	x		x		
		111	2047-01-02	2048-01-03	x	x	x		x		
		112	2048-01-03	2049-01-02	x	x	x		x		
		113	2049-01-02	2050-01-02	x	x	x		x		
		114	2050-01-02	2051-01-02	x	x	x		x		
		115	2051-01-02	2052-01-03	x	x	x		x		
		116	2052-01-03	2053-01-02	x	x	x		x		
		117	2053-01-02	2054-01-02	x	x	x		x		
		118	2054-01-02	2055-01-02	x	x	x		x		
		119	2055-01-02	2056-01-03	x	x	x		x		
		120	2056-01-03	2057-01-02	x	x	x		x		
		121	2057-01-02	2058-01-02	x	x	x		x		
		122	2058-01-02	2059-01-02	x	x	x		x		
		123	2059-01-02	2060-01-03	x	x	x		x		
		124	2060-01-03	2061-01-02	x	x	x		x		
		125	2061-01-02	2062-01-02	x	x	x		x		
		126	2062-01-02	2063-01-02	x	x	x		x		
		127	2063-01-02	2064-01-03	x	x	x		x		
		128	2064-01-03	2065-01-02	x	x	x		x		
		129	2065-01-02	2066-01-02	x	x	x		x		
		130	2066-01-02	2067-01-02	x	x	x		x		
		131	2067-01-02	2068-01-03	x	x	x		x		
		132	2068-01-03	2069-01-02	x	x	x		x		
		133	2069-01-02	2070-01-02	x	x	x		x		
		134	2070-01-02	2071-01-02	x	x	x		x		
		135	2071-01-02	2072-01-03	x	x	x		x		
		136	2072-01-03	2073-01-02	x	x	x		x		x
		137	2073-01-02	2074-01-02	x	x	x		x		x
		138	2074-01-02	2075-01-02	x	x	x		x		x
		139	2075-01-02	2076-01-03	x	x	x		x		x



Calibration Period	Interval	Stress Period	Date	Date	Lotus Pit	Campbell Pit	Gilbert Pit	Price Pit	Leichhardt Pit	Roper Pit	East Pit
			(from)	(to)							
		140	2076-01-03	2077-01-02	x	x	x		x		x
		141	2077-01-02	2078-01-02	x	x	x		x		x
		142	2078-01-02	2079-01-02	x	x	x		x		x
		143	2079-01-02	2080-01-03	x	x	x		x		x
		144	2080-01-03	2081-01-02	x	x	x		x		x
		145	2081-01-02	2082-01-02	x	x	x		x		x
		146	2082-01-02	2083-01-02	x	x	x		x		x
		147	2083-01-02	2084-01-03	x	x	x		x		x
		148	2084-01-03	2085-01-02	x	x	x		x		x
		149	2085-01-02	2086-01-02	x	x	x		x		x
		150	2086-01-02	2087-01-02	x	x	x		x		x
		151	2087-01-02	2088-01-03	x	x	x		x		x
		152	2088-01-03	2089-01-02	x	x	x		x		x
		153	2089-01-02	2090-01-02	x	x	x		x		x
		154	2090-01-02	2091-01-02	x	x	x		x		x
		155	2091-01-02	2092-01-03	x	x	x		x		x
		156	2092-01-03	2093-01-02	x	x	x		x		x
		157	2093-01-02	2094-01-02	x		x		x		x
		158	2094-01-02	2095-01-02	x		x		x		x
		159	2095-01-02	2096-01-03	x		x		x		x
		160	2096-01-03	2097-01-02	x		x		x		x
		161	2097-01-02	2098-01-02	x		x		x		x
		162	2098-01-02	2099-01-02	x		x		x		x





Appendix B Calibration Residuals

Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

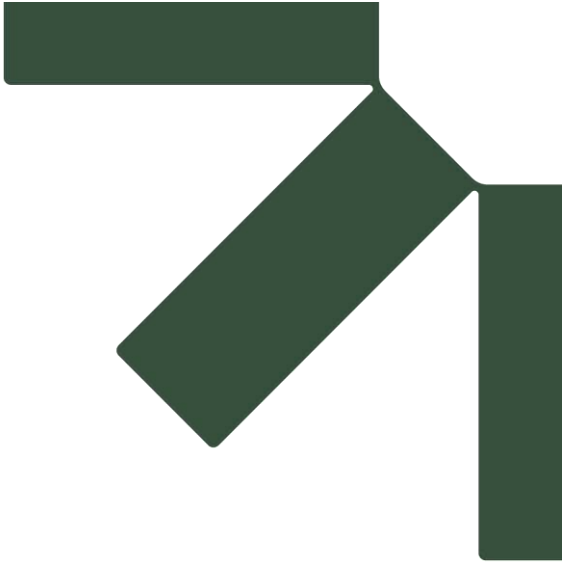
22 August 2024

Bore ID	Easting	Northing	Model Layer	Average Residual
MB20NPM02P	643391.2	7505498	10	1.6
NPMMB01_01	643395.2	7505495	8	2.3
NPMMB06_03	653438	7487481	8	-2.7
P2A	651026.4	7483343	2	4.0
P3	649872	7489937	2	-0.4
P6	650330.4	7496846	1	-0.1
P6R	650356.1	7496833	10	-1.2
B43060	663900	7482826	2	-1.4
B43062	659415	7488033	4	0.1
B38547	654098	7495068	4	-0.5
MBL01A	652545.1	7488003	12	-1.9
MBL01B	652541.1	7488007	2	-0.4
MBR01A	655738.1	7479095	12	-5.3
MBR02A	656144.1	7478203	12	-5.1
MBP001A	652782	7491808	5	2.7
MBP001B	652778	7491810	7	3.9
MBP002A	652810	7491432	2	-2.5
MBP002B	652808	7491427	2	-2.0
MBP003A	652157	7491547	2	-5.8
MBP003B	652158	7491552	11	-8.3
MBP004A	652380	7491536	2	-3.6
MBP004B	652381	7491542	2	-1.7
MBP005A	652525	7491909	2	-2.1
MBP005B	652523	7491904	9	0.5
SSM_MB205	650894	7483058	12	-0.7
SSM_MB207	650150	7483088	2	-1.2
SSM_MB208	650333	7483393	2	-14.8
SSM_MB209	650275	7483087	2	-4.0
SSM_MB210	650411	7483255	2	-11.0
SSM_MB211	650239	7482867	2	3.7
SSM_MB212	650118	7482643	2	12.2
SSM_MB213	650410	7482413	2	5.0
SSM_MB214	650331	7482553	2	17.2



Bore ID	Easting	Northing	Model Layer	Average Residual
SSM_MB216	650430	7482467	2	4.9
SSM_MB217	650375	7482476	2	5.1
SSM_MB218	650227	7482538	2	3.4
SSM_MB219	650412	7482137	2	5.9
SSM_MB220	650340	7482246	2	5.7
SSM_MB221	650337	7482138	2	6.9
SSM_MB222	650482	7482204	2	12.5
SSM_MB223	650526	7482395	11	7.3
SSM_MB224	649811	7482413	2	0.2
SSM_MB225	649829	7482335	2	0.3
MB20NPM07A	656939.1	7479625	7	1.7
MB20NPM06T	653469.3	7493063	2	5.0
MB20NPM05A	653471.1	7493056	2	4.9
MB20NPM04P	650338.1	7496838	10	1.8
MB20NPM08P	656952.1	7479625	8	2.1
NPMMB02_01	649880.1	7489940	13	0.4
NPMMB03_01	650328.9	7496838	5	-1.0
NPMMB08_01	650987.1	7483198	2	0.3
P2AR	651026.4	7483343	2	3.6
NPMMB06_01	653440.2	7487474	2	-4.7





Appendix C Calibration Hydrographs

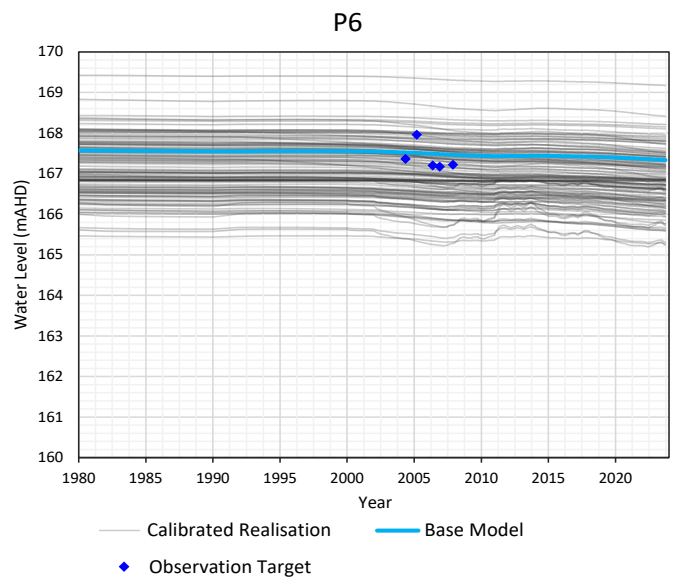
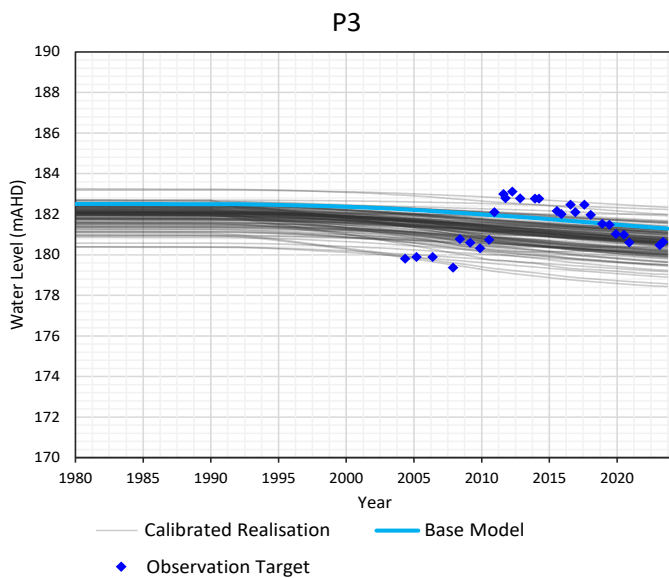
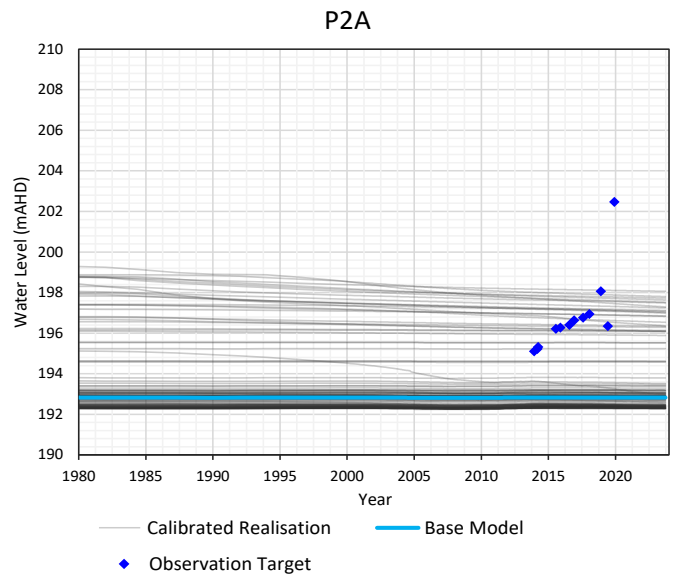
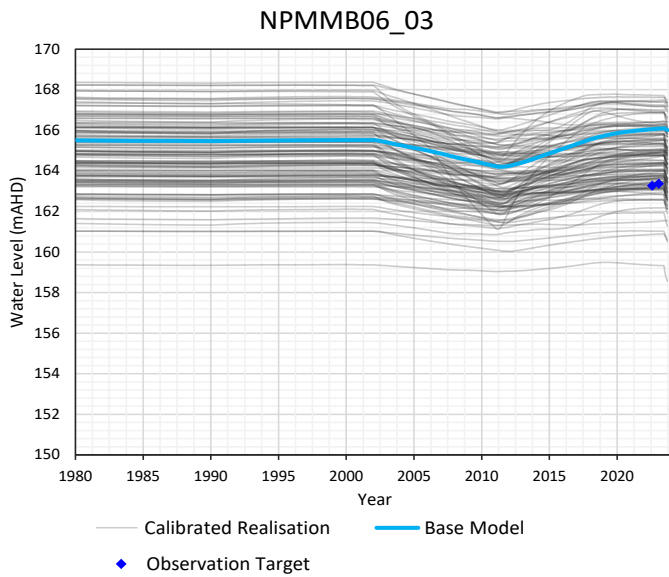
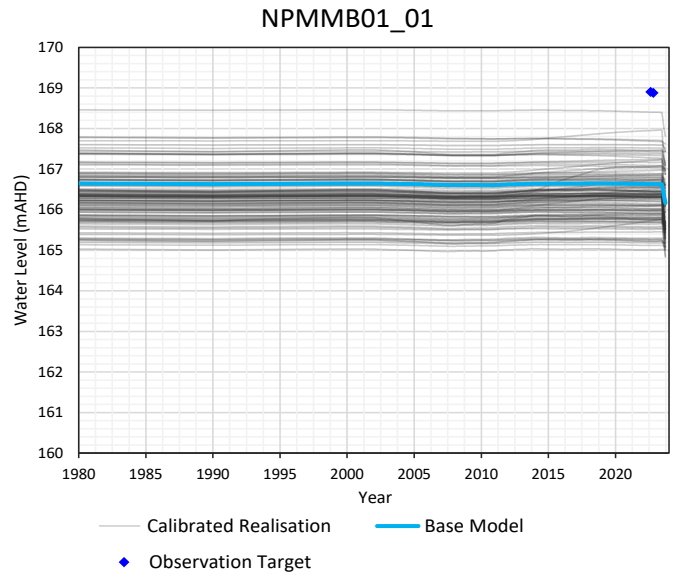
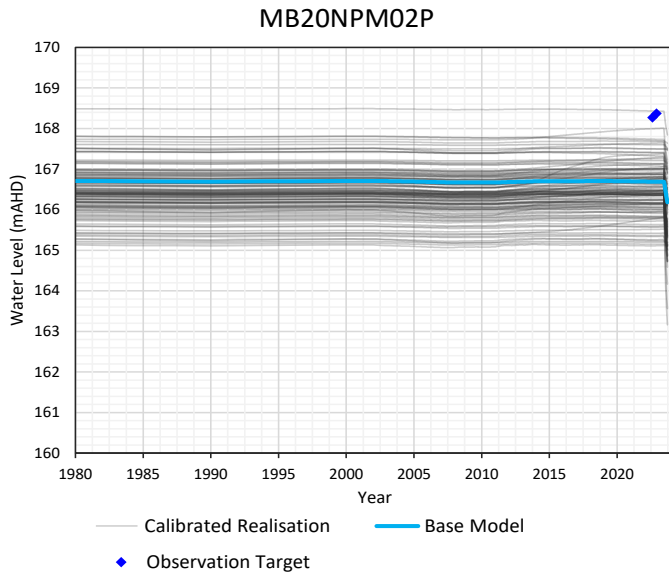
Saraji South Mine

Groundwater Modelling Technical Report

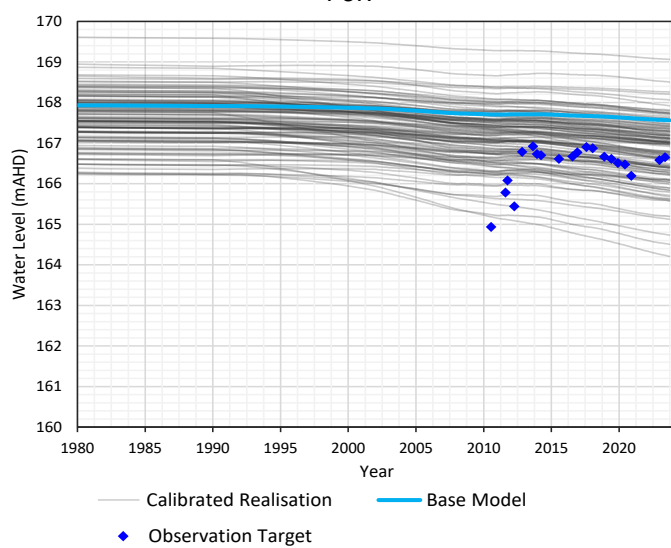
BMA

SLR Project No.: 620.31444.00000

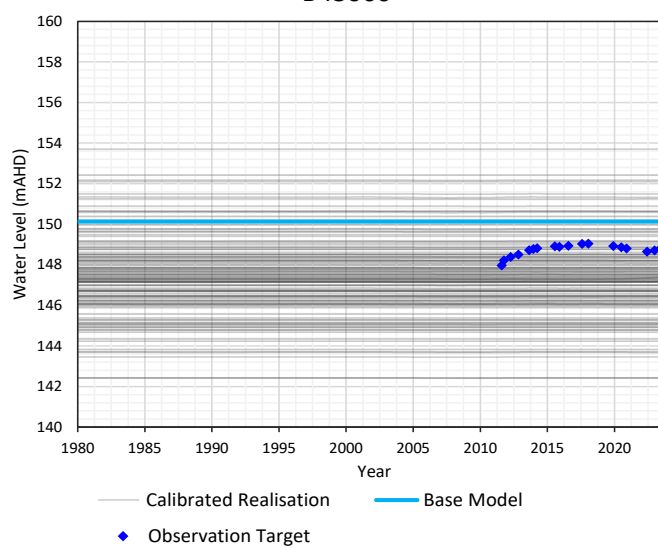
22 August 2024



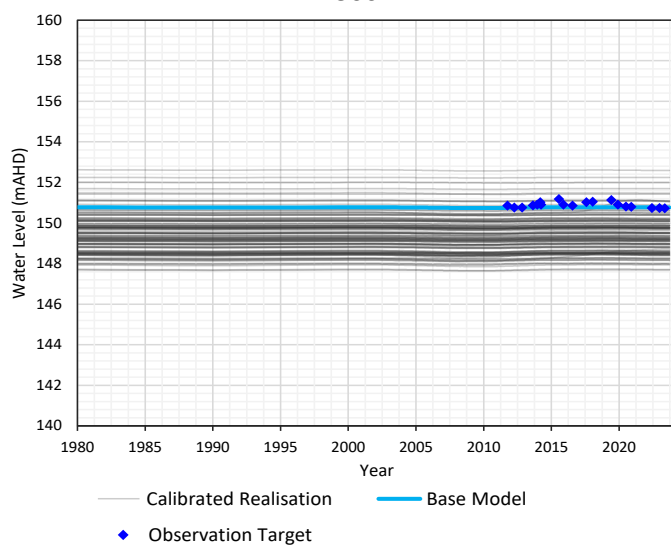
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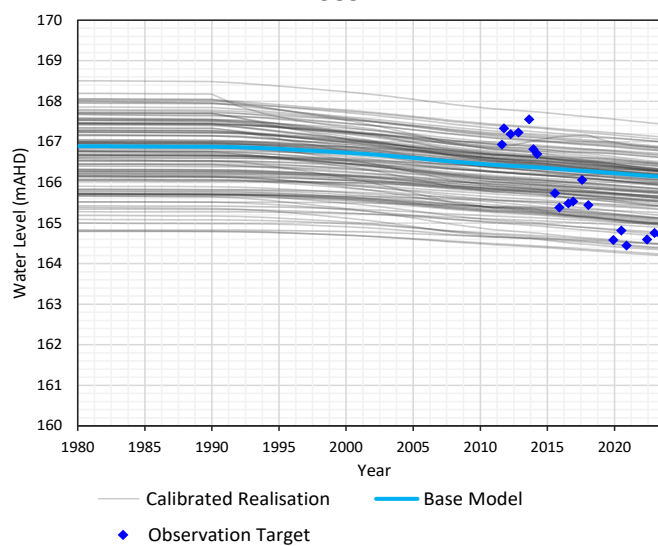
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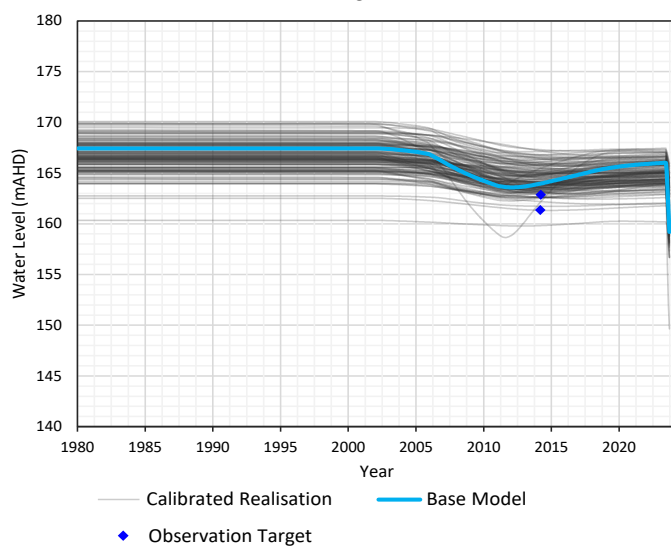
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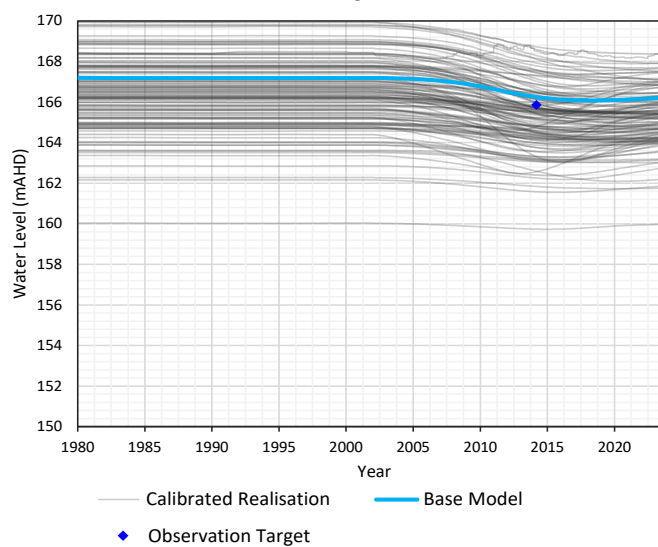
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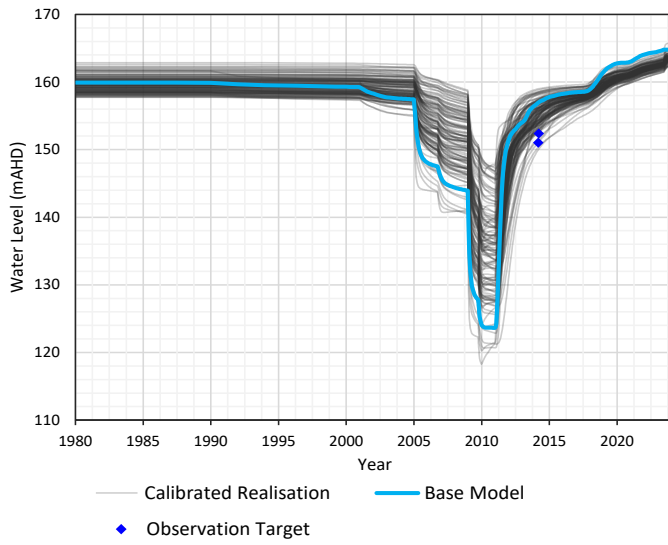
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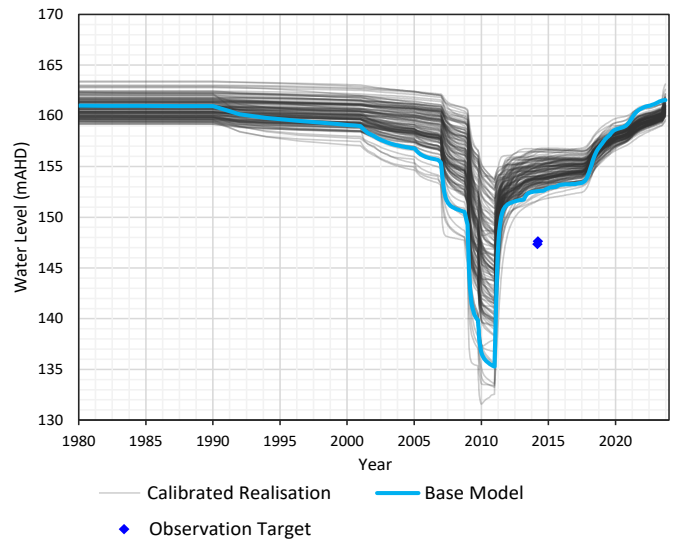
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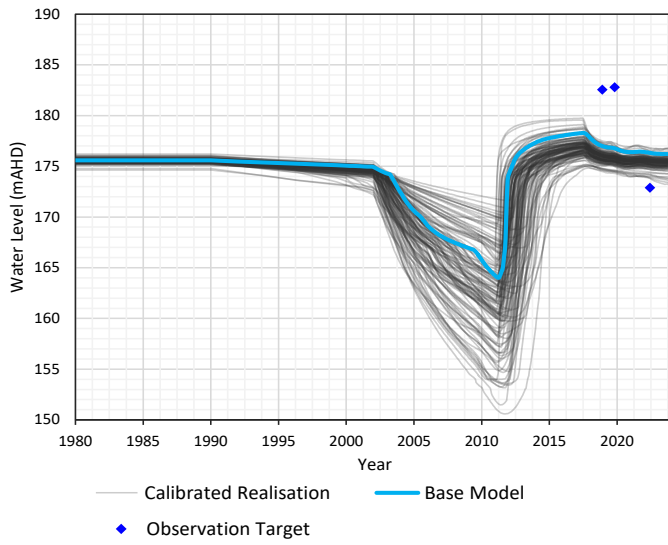
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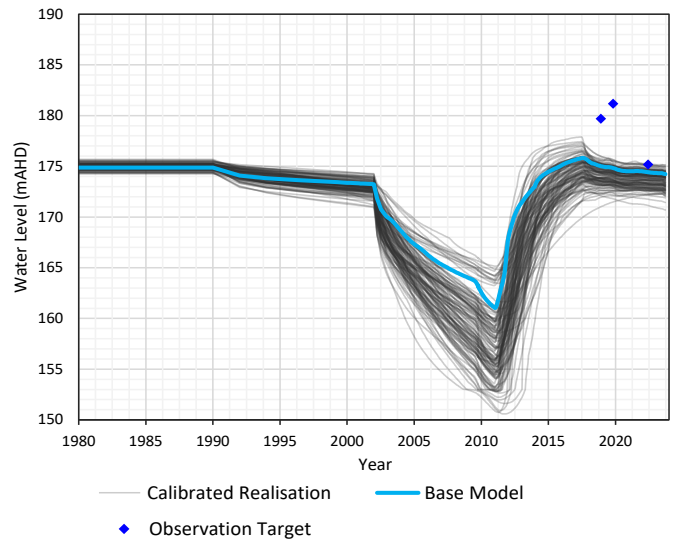
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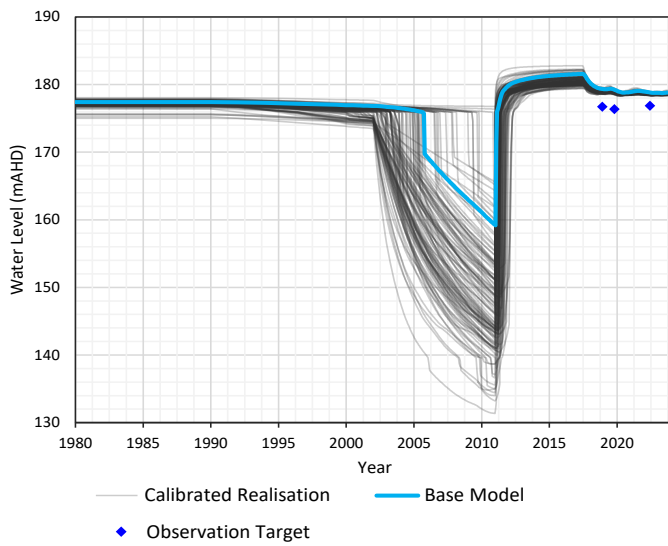
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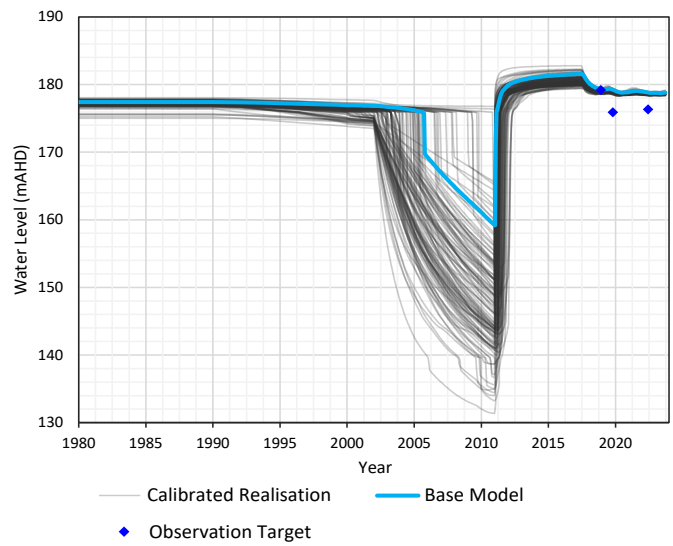
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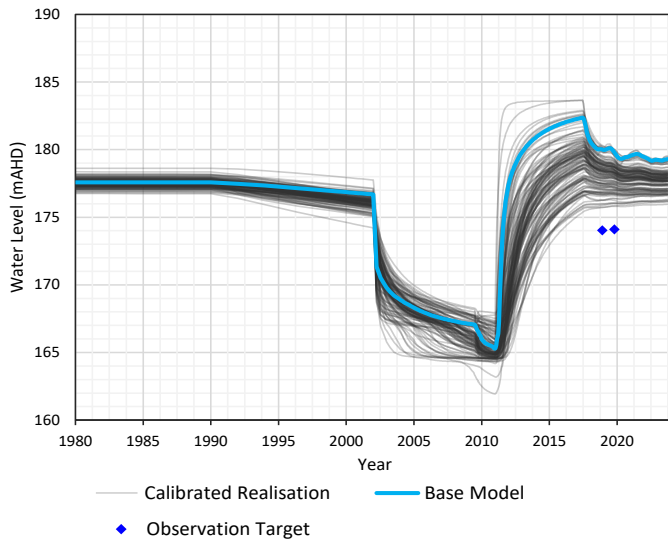
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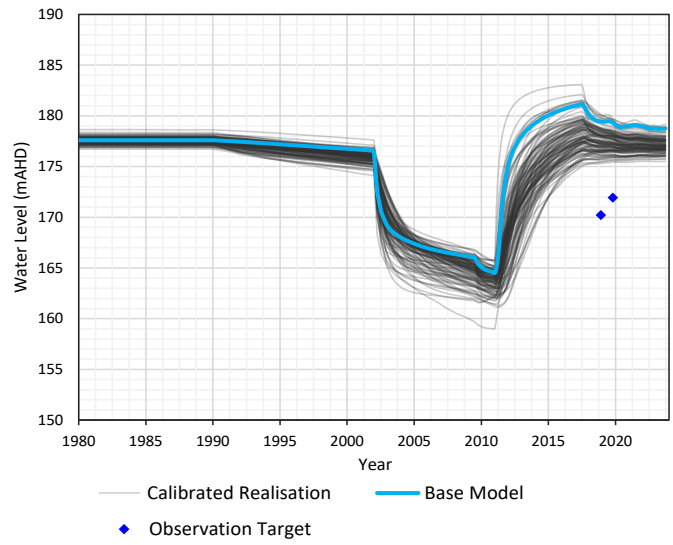
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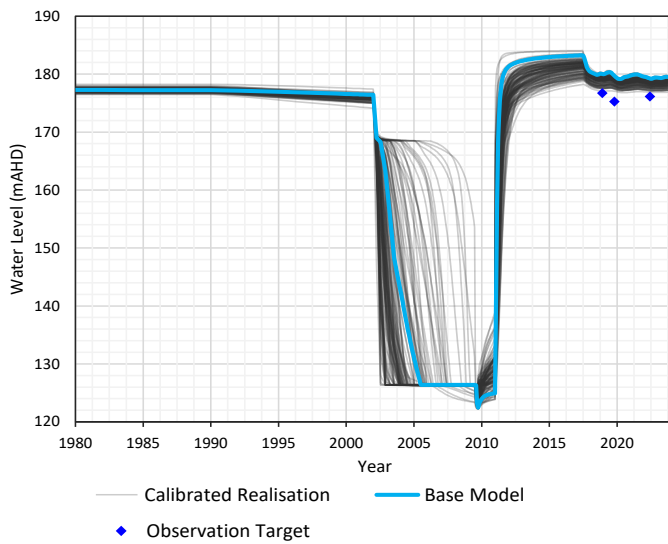
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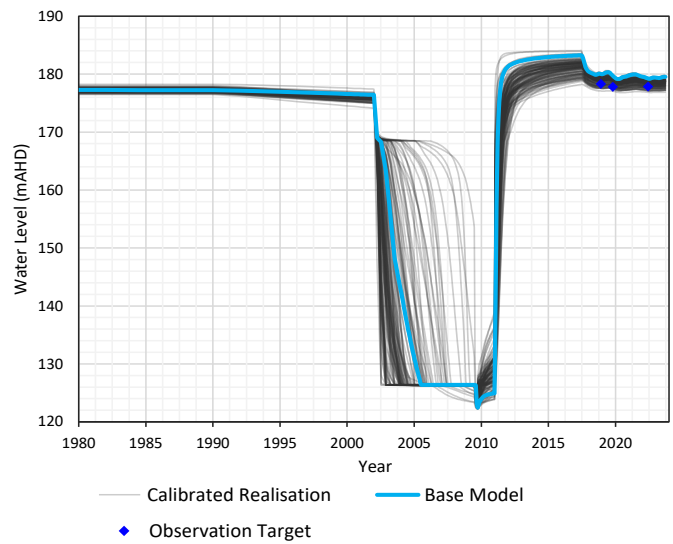
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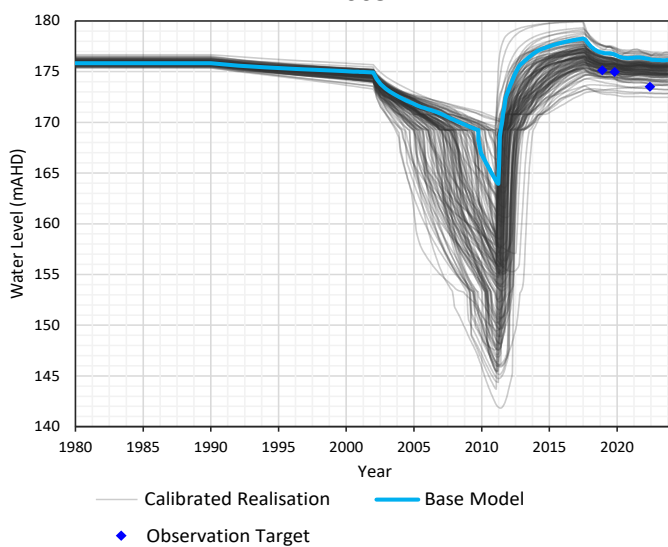
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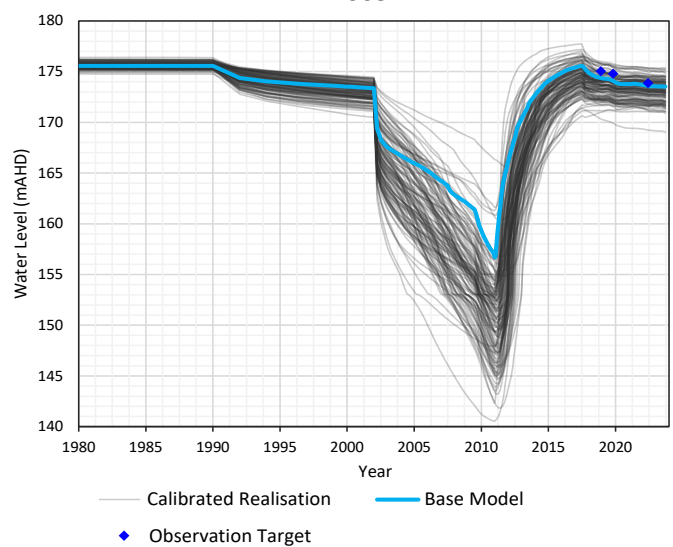
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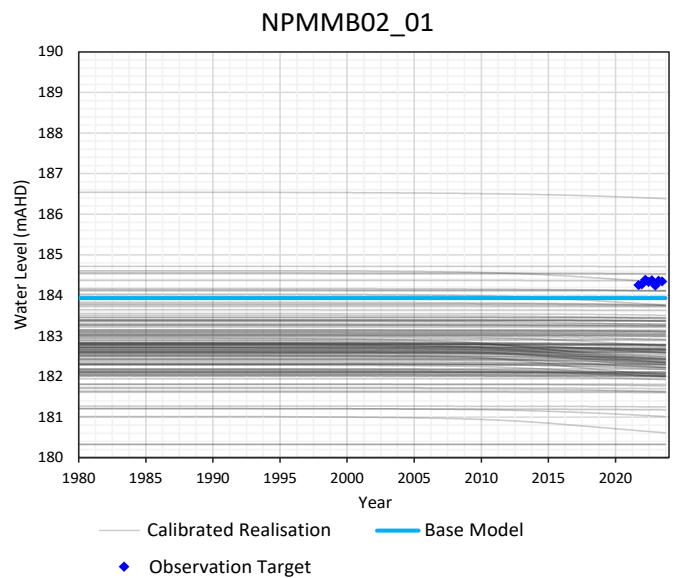
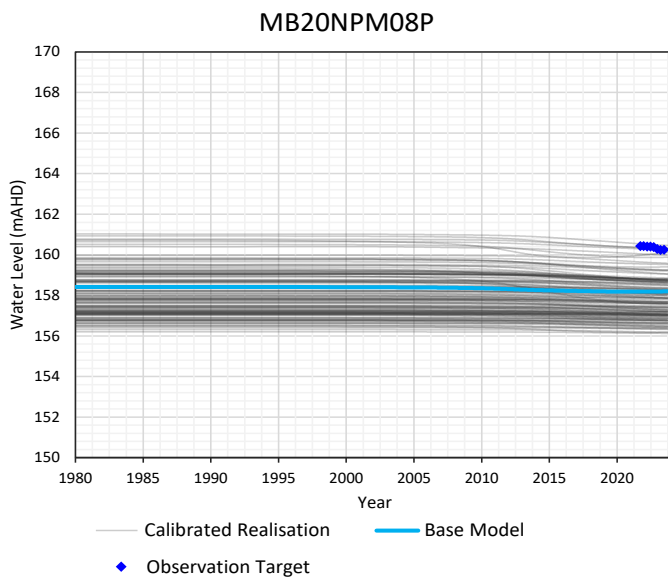
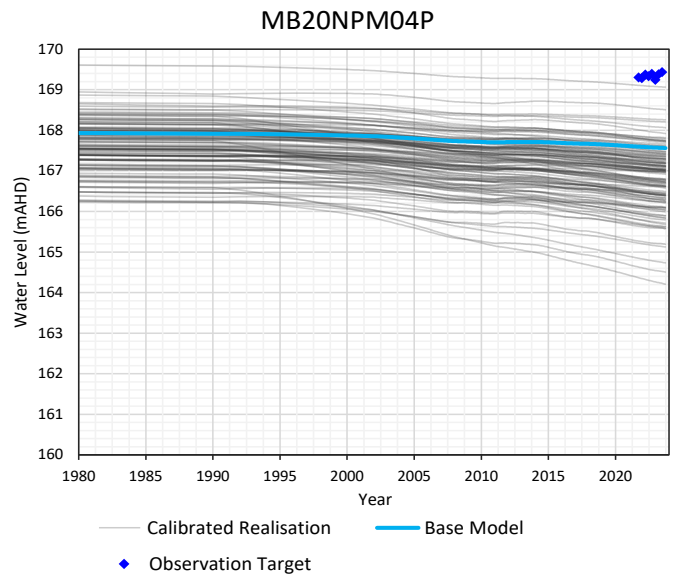
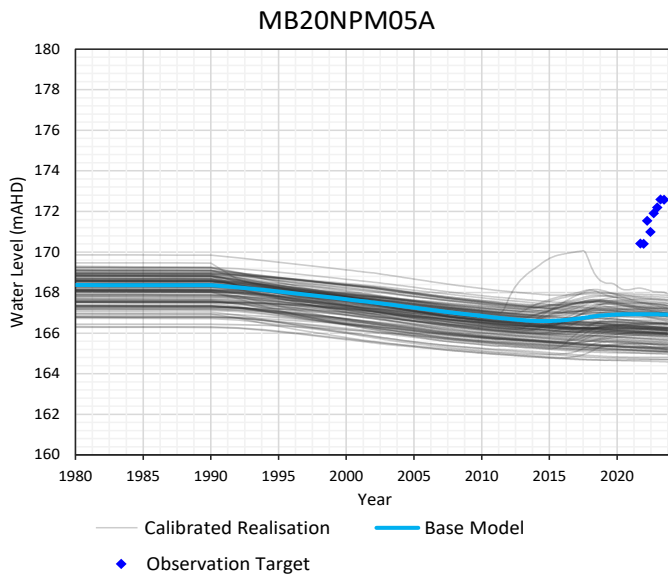
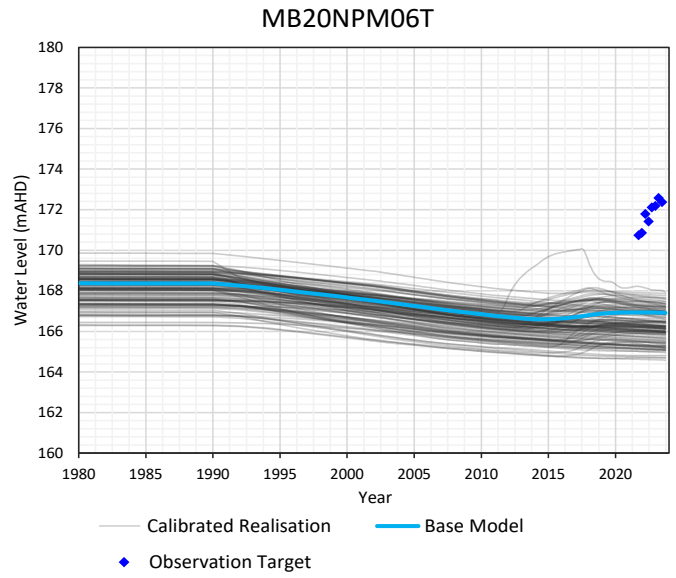
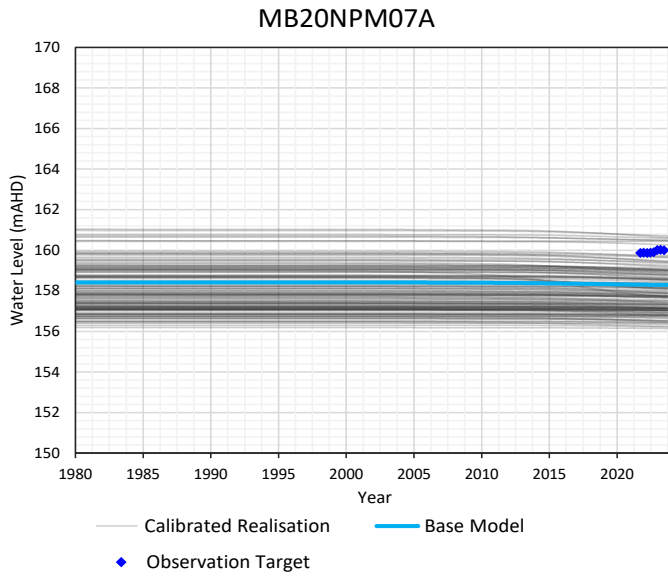


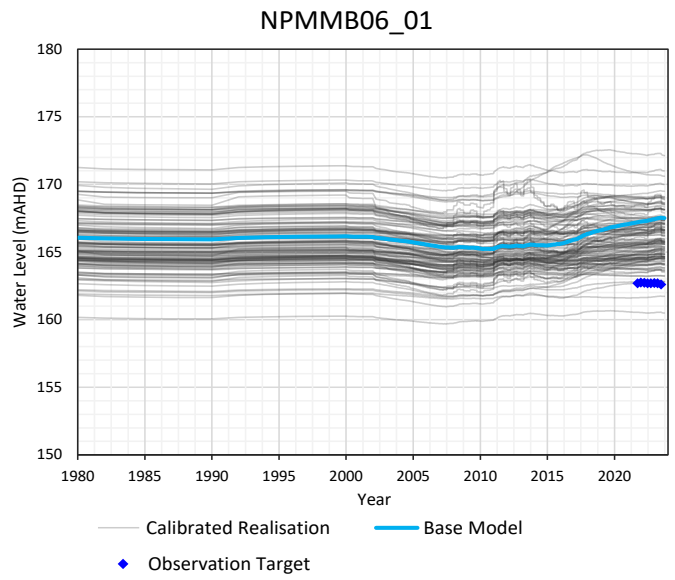
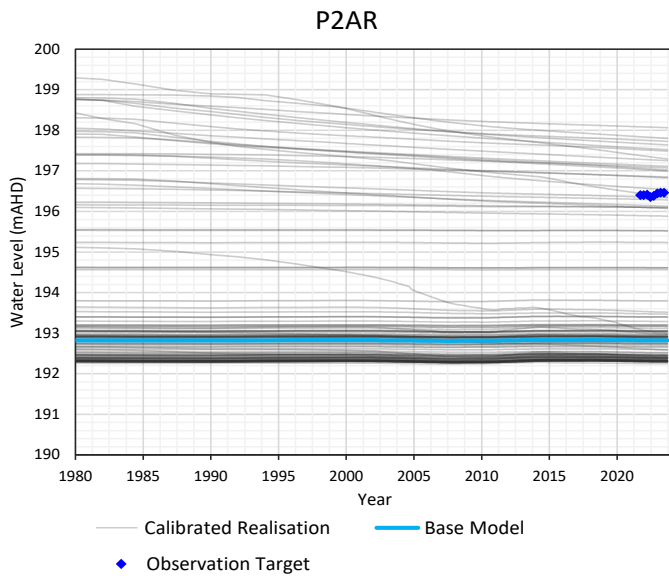
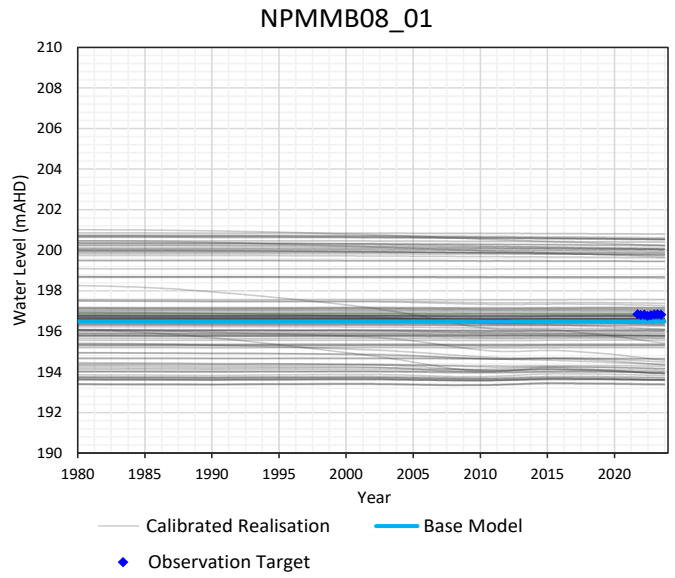
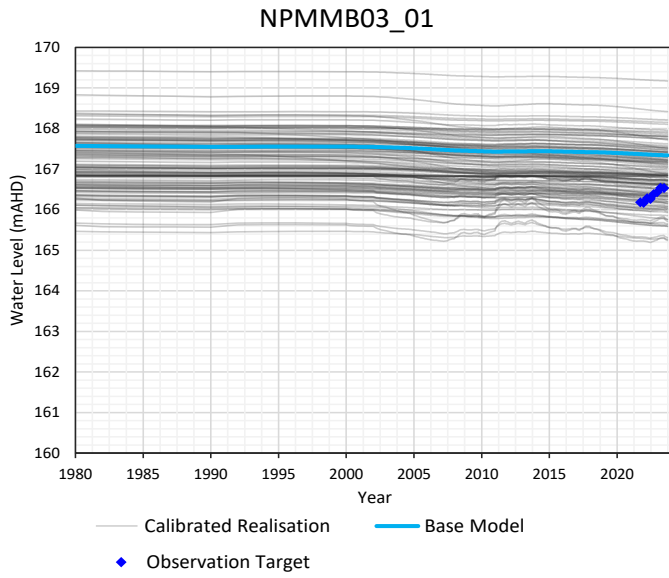
MBP005A

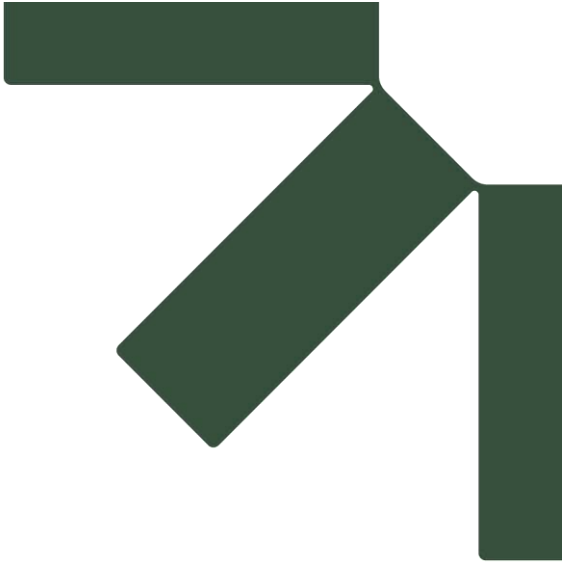


MBP005B









Appendix D Hydraulic Parameters and Recharge Zone Distribution

Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

22 August 2024



Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

-  Alluvium Qa
-  Regolith

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 1



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FIGURE D-1



Source:
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Environment and Science, Esri, TomTom,
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and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

-  Regolith

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 2



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FIGURE D-2

640,000

660,000

7,500,000

7,480,000

Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS



Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 09-May-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Parameter Zone

- | | |
|-----------------|--------------|
| FCCM-Overburden | Fault Zone 5 |
| Fault Zone 1 | Fault Zone 6 |
| Fault Zone 2 | Fault Zone 7 |
| Fault Zone 3 | Fault Zone 8 |
| Fault Zone 4 | |

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 3



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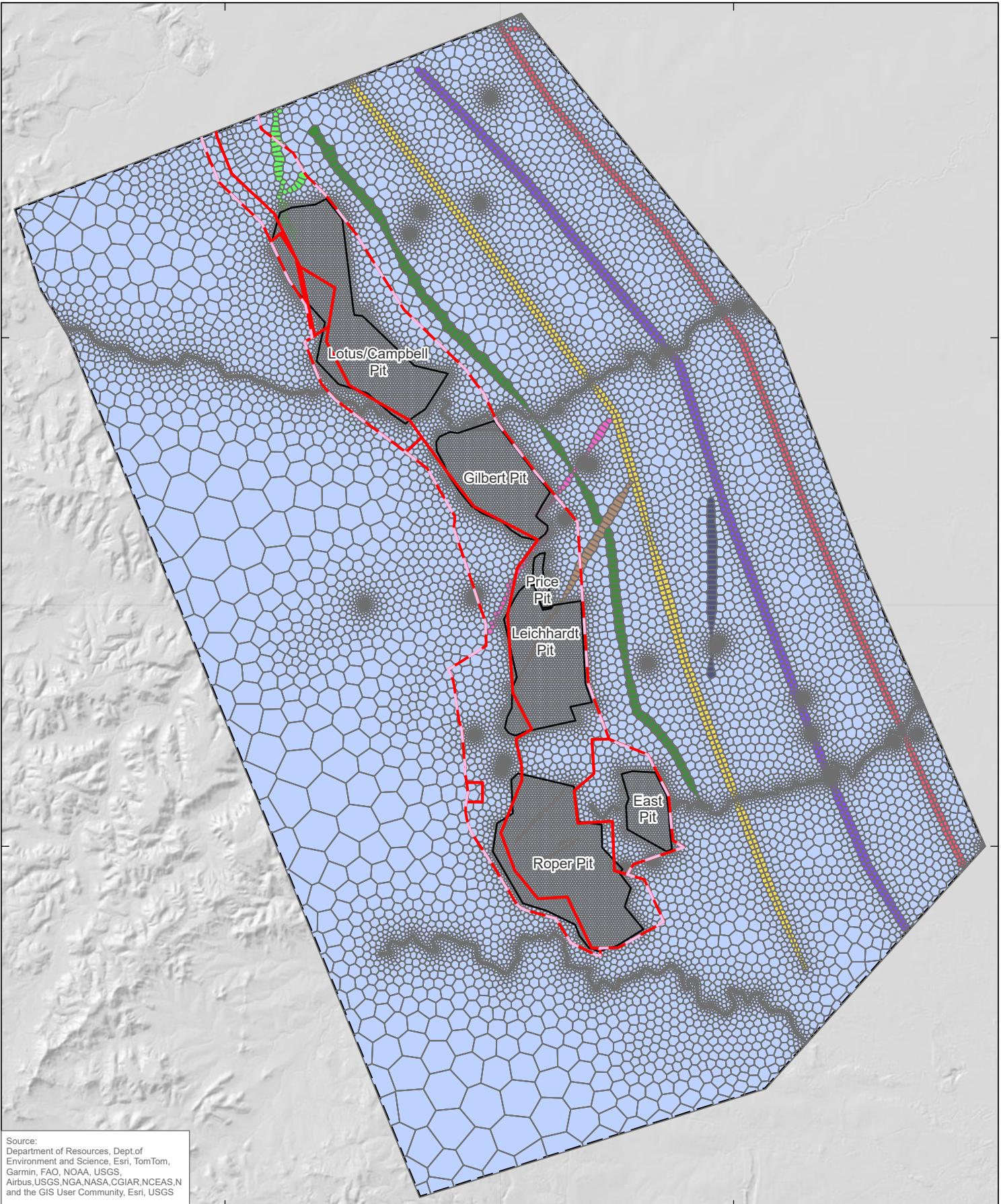
FIGURE D-3

640,000

660,000

7,500,000

7,480,000



Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS



0 2.5 5
km

Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 09-May-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Parameter Zone

- FCCM Seam
- Fault Zone 1
- Fault Zone 2
- Fault Zone 3
- Fault Zone 4
- Fault Zone 5
- Fault Zone 6
- Fault Zone 7
- Fault Zone 8

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 4



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FIGURE D-4

640,000

660,000

7,500,000

7,480,000

Source:
Department of Resources, Dept. of
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Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS



Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 09-May-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Parameter Zone

- | | |
|------------------|--------------|
| FCCM-Underburden | Fault Zone 5 |
| Fault Zone 1 | Fault Zone 6 |
| Fault Zone 2 | Fault Zone 7 |
| Fault Zone 3 | Fault Zone 8 |
| Fault Zone 4 | |

**SARAJI SOUTH MINE
GROUNDWATER MODELLING
TECHNICAL REPORT**

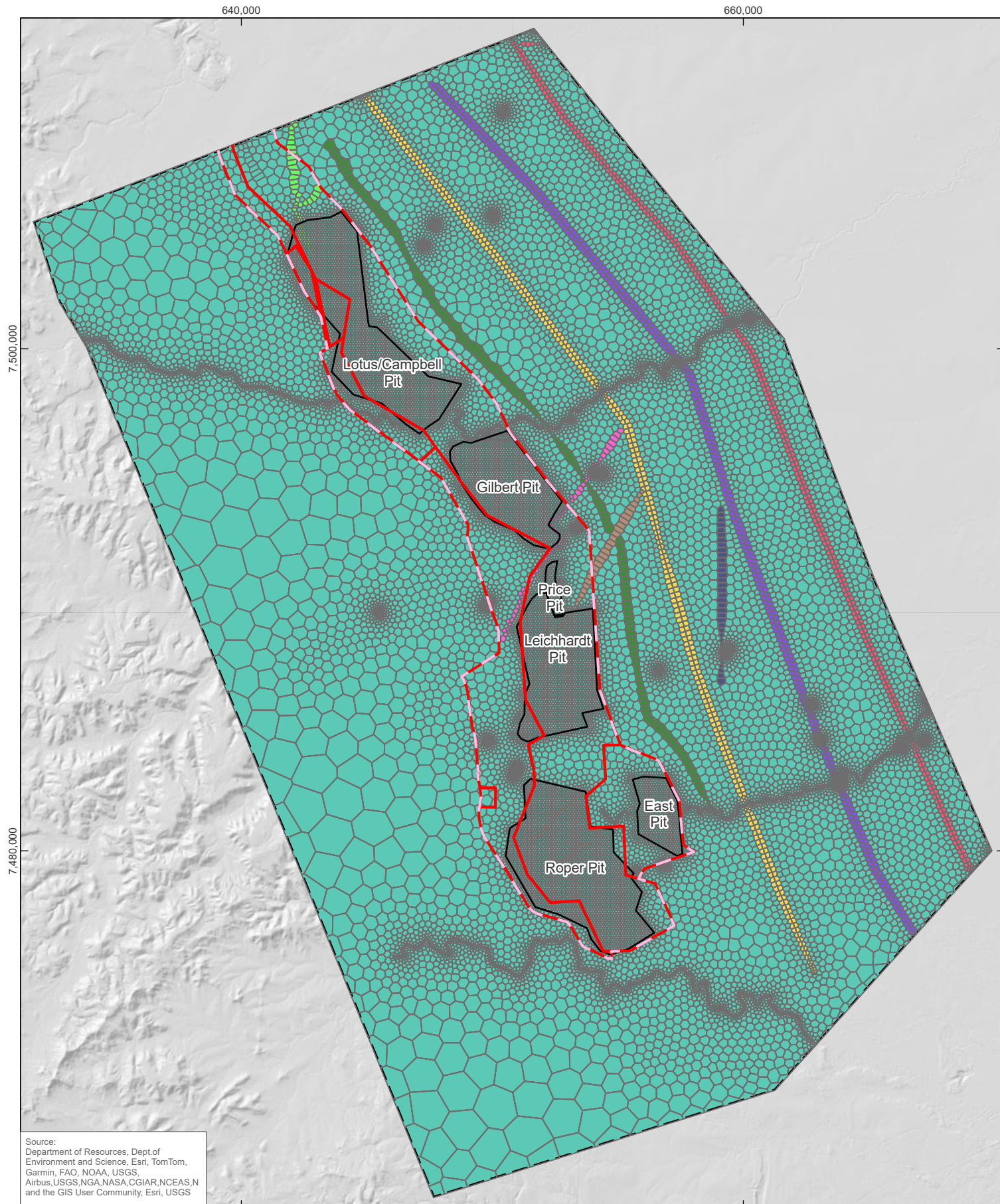
**HYDRAULIC PARAMETER
ZONE DISTRIBUTION –
LAYER 5**



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FIGURE D-5

Path: H:\Projects-SLR\620-BNE\620-BNE\620.31444.00000 PDM & SSM PRCPs GW\03 SLR Data\01 CAD\GIS\SSM Report Figures\SSM Report Figures.aprx\620314444_MOD_APP_D_5_Hydraulic Parameter Zone Distribution – Layer 5



Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
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and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|--|--|
|  Q Seam |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 6



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FIGURE D-6

640,000

660,000

7,500,000

7,480,000

Source:
Department of Resources, Dept. of
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Airbus, USGS, NASA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS



Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 09-May-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Parameter Zone

- MCM-Interburden
- Fault Zone 1
- Fault Zone 2
- Fault Zone 3
- Fault Zone 4
- Fault Zone 5
- Fault Zone 6
- Fault Zone 7
- Fault Zone 8

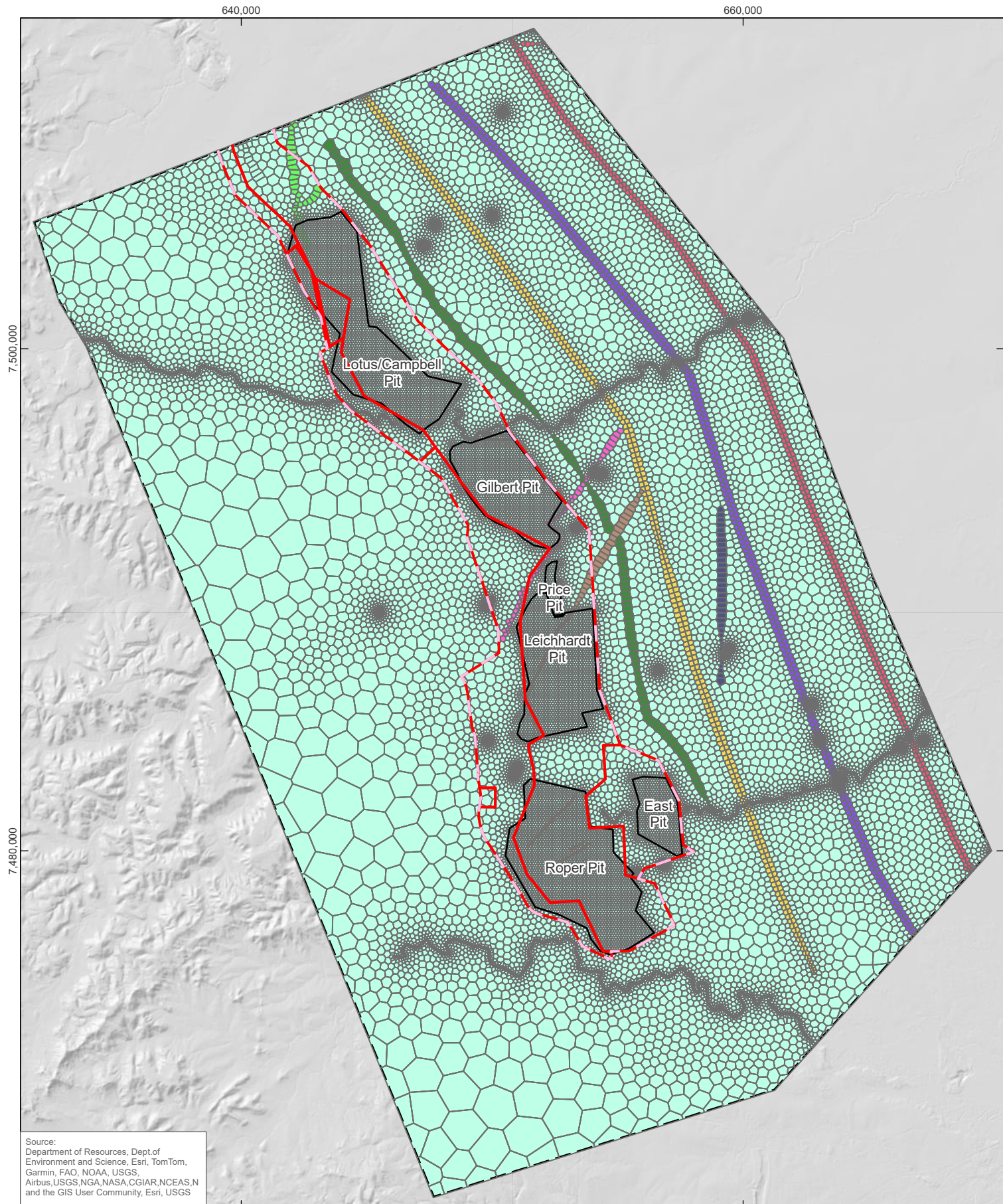
**SARAJI SOUTH MINE
GROUNDWATER MODELLING
TECHNICAL REPORT**

**HYDRAULIC PARAMETER
ZONE DISTRIBUTION –
LAYER 7**



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FIGURE D-7



Source:
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and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|--|--|
|  P Seam |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

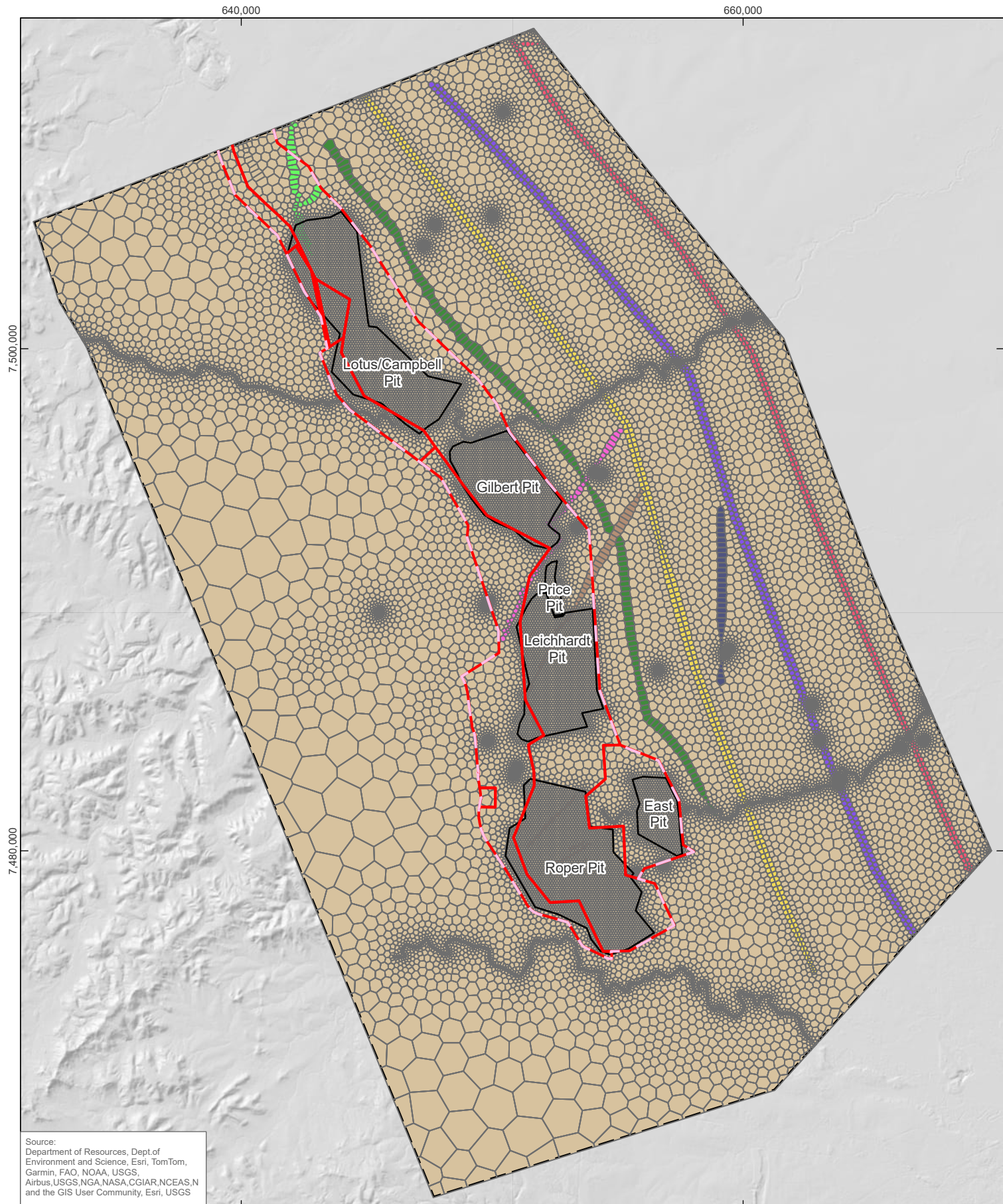
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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 8



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FIGURE D-8



Source:
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 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|---|--|
|  MCM-Interburden |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 9



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FIGURE D-9

640,000

660,000

7,500,000

7,480,000

Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
Airbus, USGS, NGA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS



Coordinate System: GDA 1994 MGA Zone 55

Scale: 1:200,000 at A4

Project Number: 620.314444.00000

Date Drawn: 09-May-2024

Drawn by: RB

LEGEND

- Model Boundary
- Model Grid
- SSM Pit Extent
- SSM Mine Lease
- SSM EA Boundary

Parameter Zone

- | | |
|--|--|
| H Seam | Fault Zone 5 |
| Fault Zone 1 | Fault Zone 6 |
| Fault Zone 2 | Fault Zone 7 |
| Fault Zone 3 | Fault Zone 8 |
| Fault Zone 4 | |

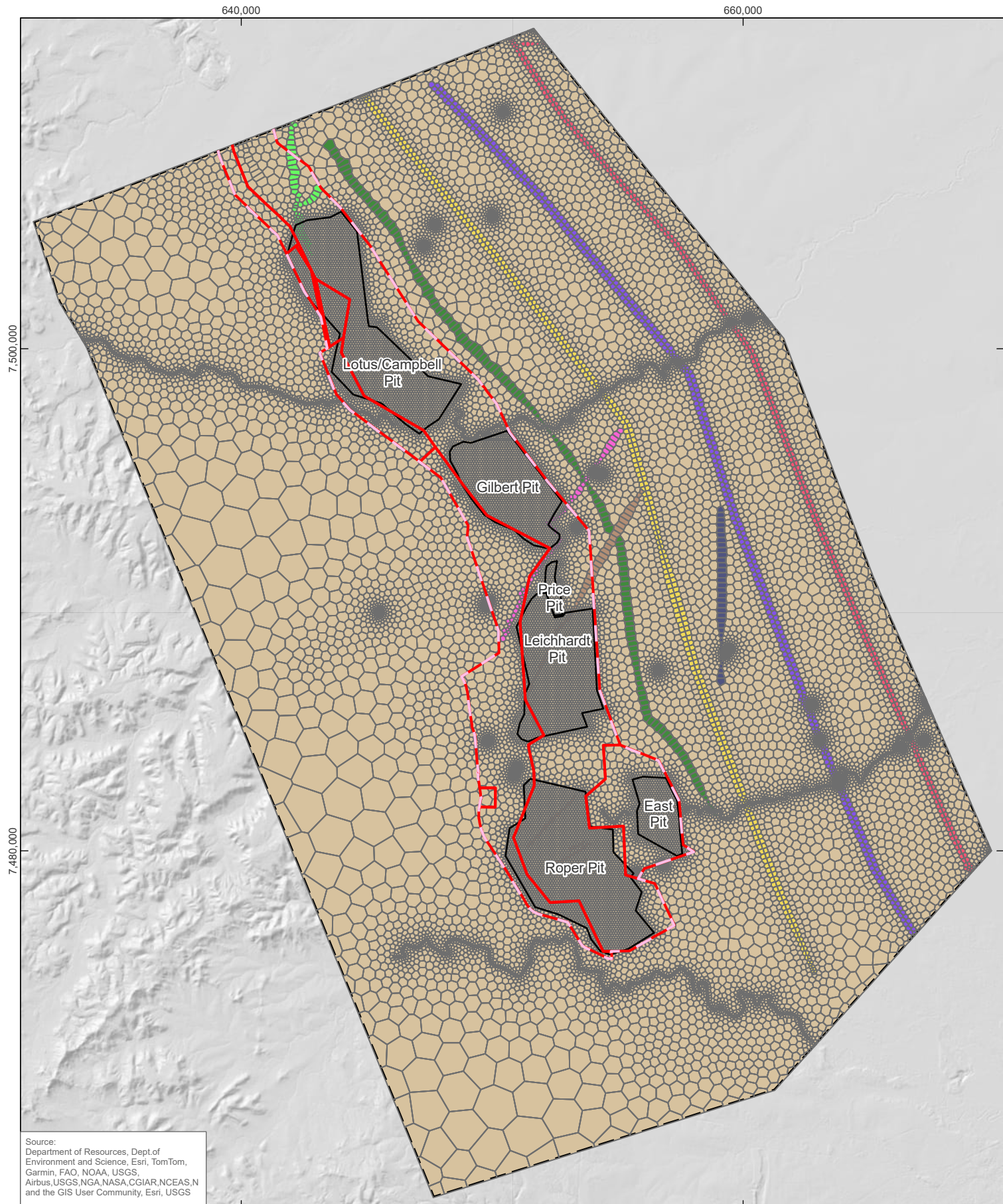
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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 10



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FIGURE D-10



Source:
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Environment and Science, Esri, TomTom,
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Airbus, USGS, NASA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|---|--|
|  MCM-Interburden |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

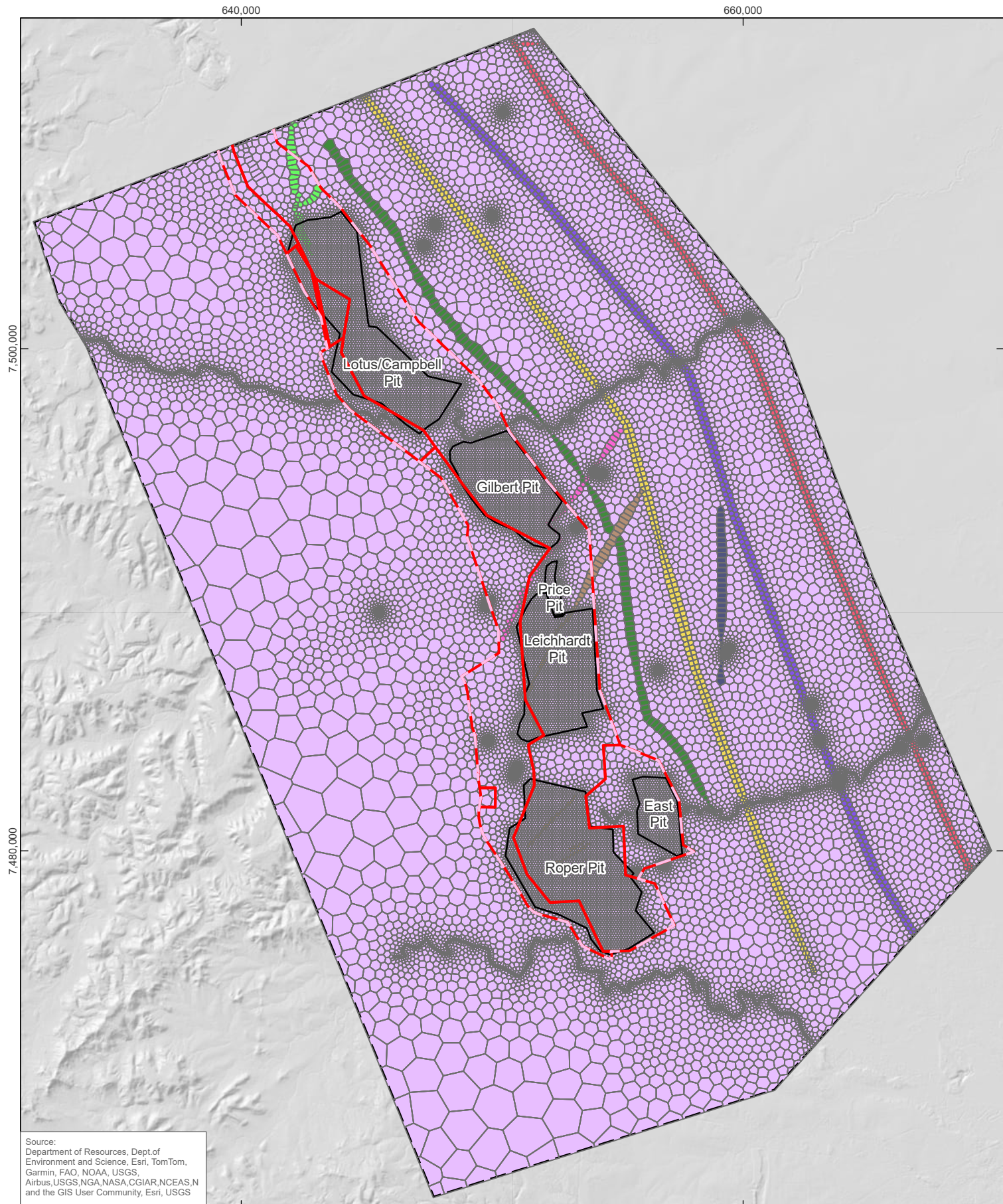
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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 11



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FIGURE D-11



Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
Garmin, FAO, NOAA, USGS,
Airbus, USGS, NGA, NASA, CIGAR, NCEAS, N
and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|--|--|
|  D Seam |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

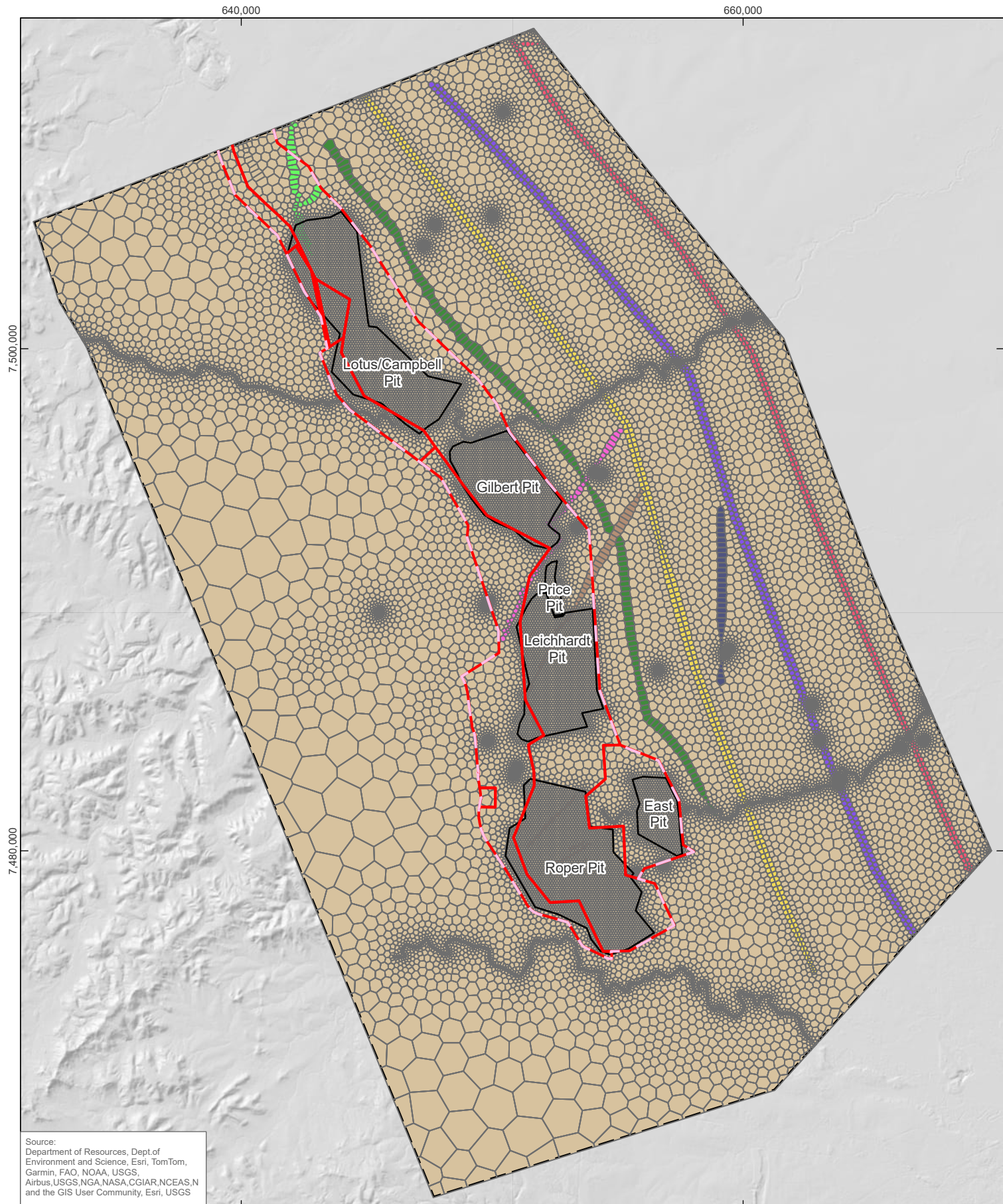
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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 12



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FIGURE D-12



Source:
Department of Resources, Dept. of
Environment and Science, Esri, TomTom,
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Airbus, USGS, NASA, NASA, CGIAR, NCEAS, N
and the GIS User Community, Esri, USGS

 0 2.5 5 km
Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 09-May-2024
Drawn by: RB

LEGEND

-  Model Boundary
-  Model Grid
-  SSM Pit Extent
-  SSM Mine Lease
-  SSM EA Boundary

Parameter Zone

- | | |
|---|--|
|  MCM-Interburden |  Fault Zone 5 |
|  Fault Zone 1 |  Fault Zone 6 |
|  Fault Zone 2 |  Fault Zone 7 |
|  Fault Zone 3 |  Fault Zone 8 |
|  Fault Zone 4 | |

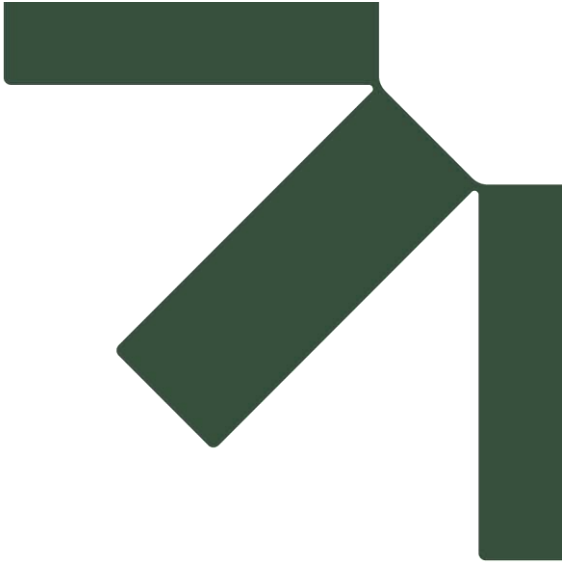
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HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 13



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FIGURE D-13



Appendix E Recovery Model Starting Heads

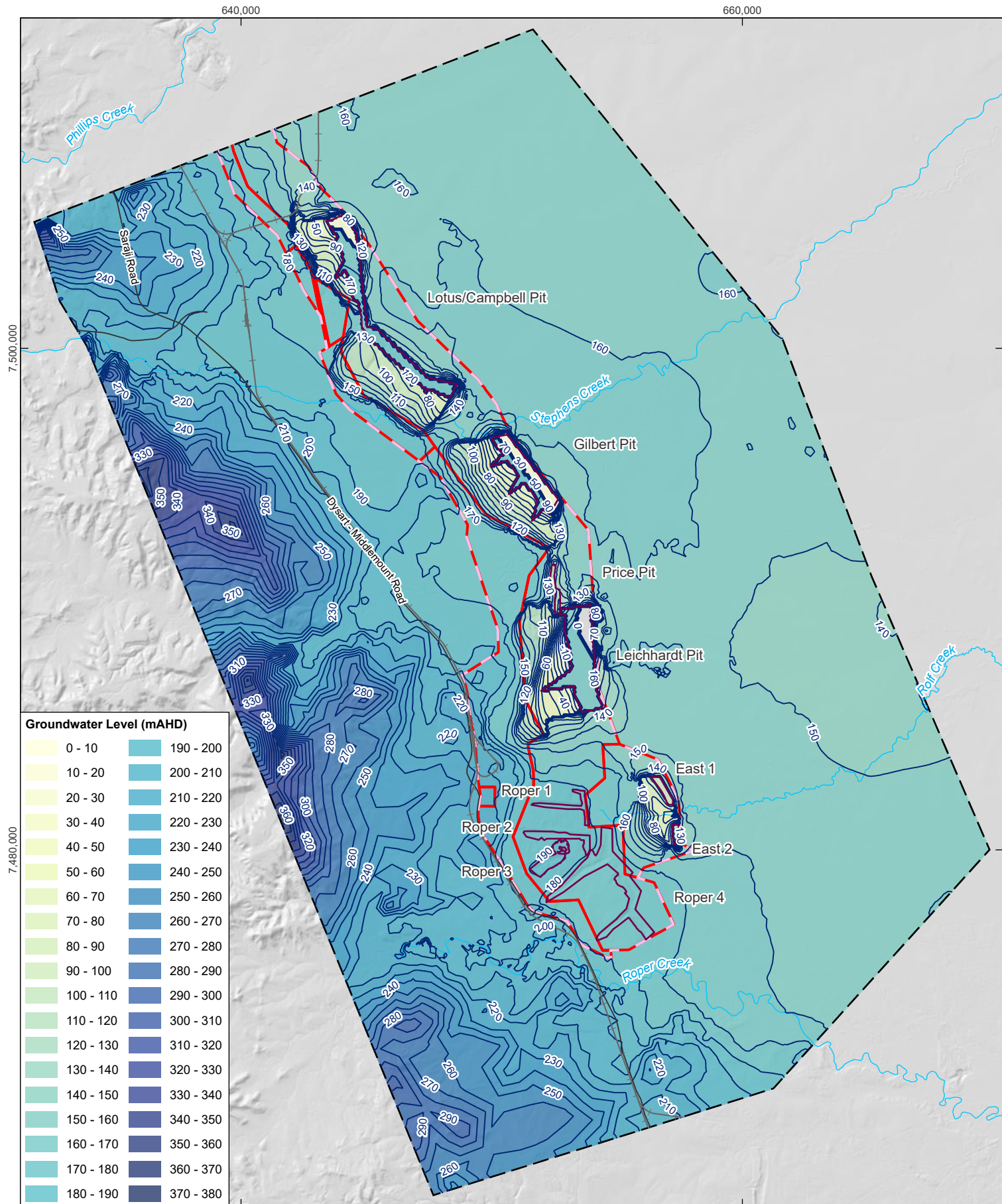
Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

22 August 2024



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 29-May-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHd)
-  Void Extent
-  SSM Mine Lease
-  SSM EA Boundary

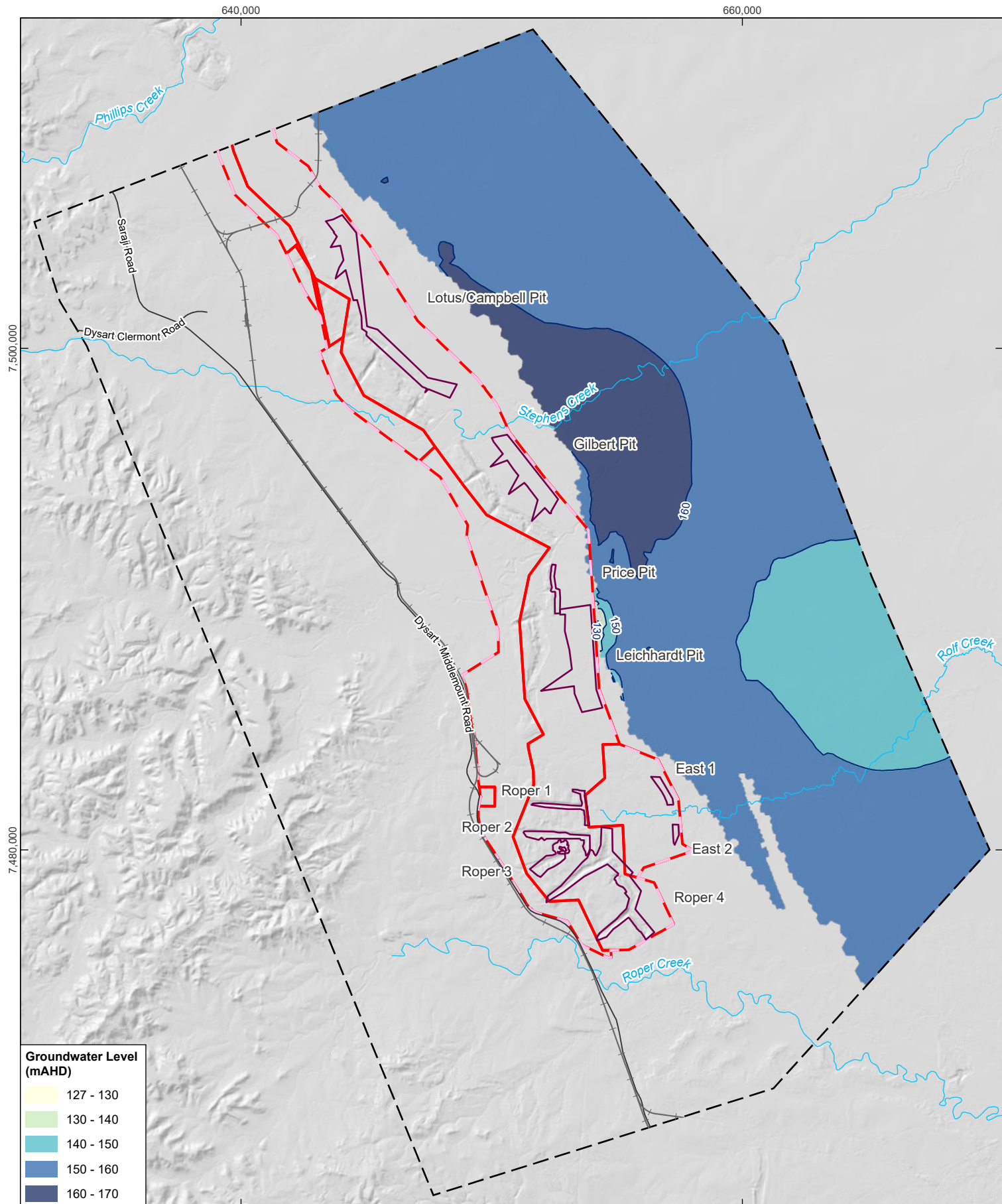
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END OF MINING GROUNDWATER LEVELS – WATER TABLE



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FIGURE E-1



Groundwater Level (mAHd)

	127 - 130
	130 - 140
	140 - 150
	150 - 160
	160 - 170

	0 2.5 5 km
Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:200,000 at A4
Project Number:	620.314444.00000
Date Drawn:	31-May-2024
Drawn by:	RB

LEGEND

	Railway		Groundwater Contour (mAHd)
	Major Road		Void Extent
	Watercourse		SSM Mine Lease
	Model Boundary		SSM EA Boundary

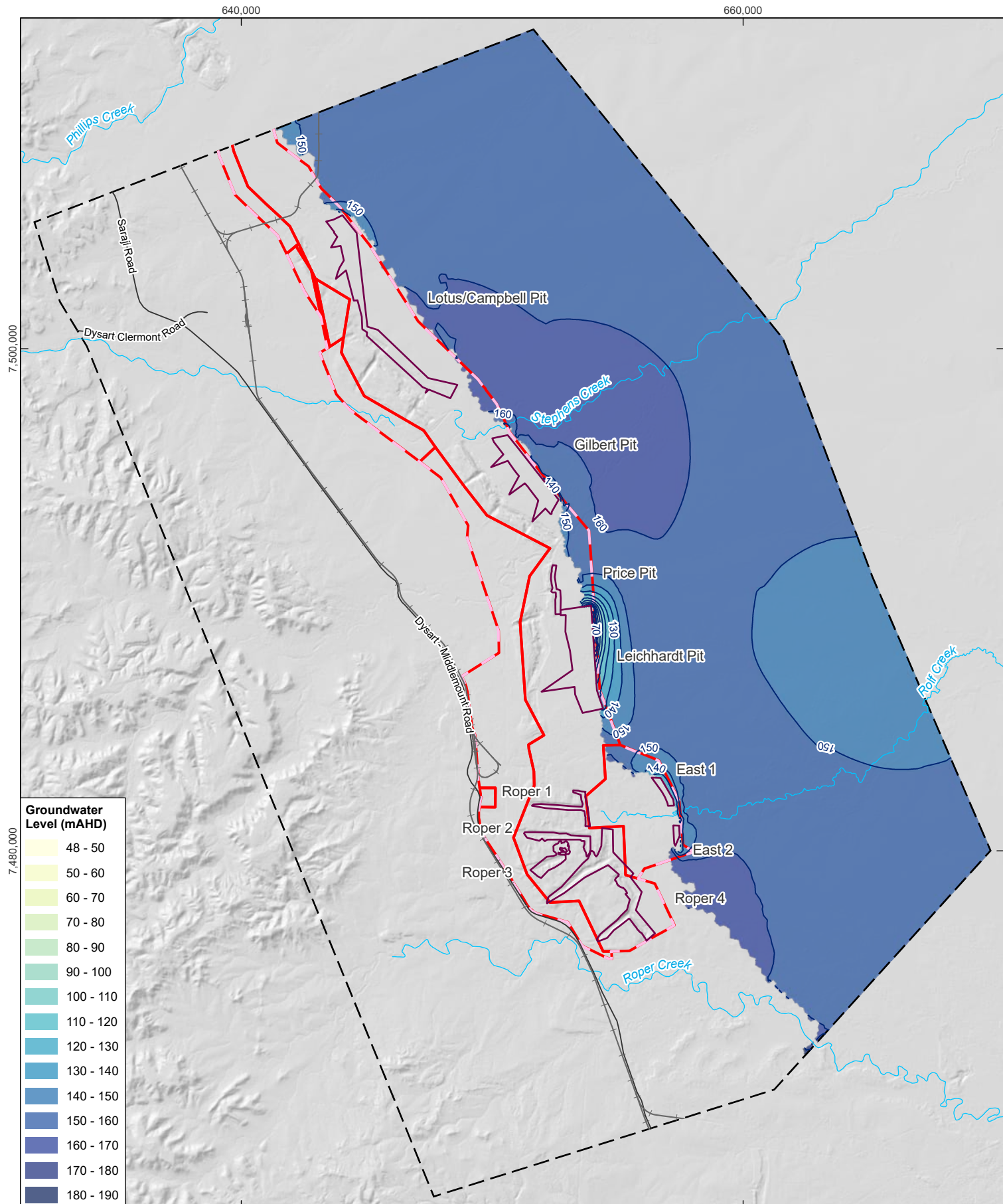
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

END OF MINING GROUNDWATER LEVELS – FORT COOPER SEAMS



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FIGURE E-2



Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- | | |
|----------------|----------------------------|
| Railway | Groundwater Contour (mAHD) |
| Major Road | Void Extent |
| Watercourse | SSM Mine Lease |
| Model Boundary | SSM EA Boundary |

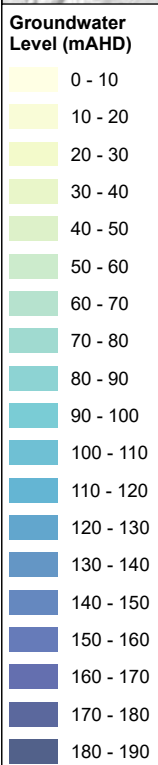
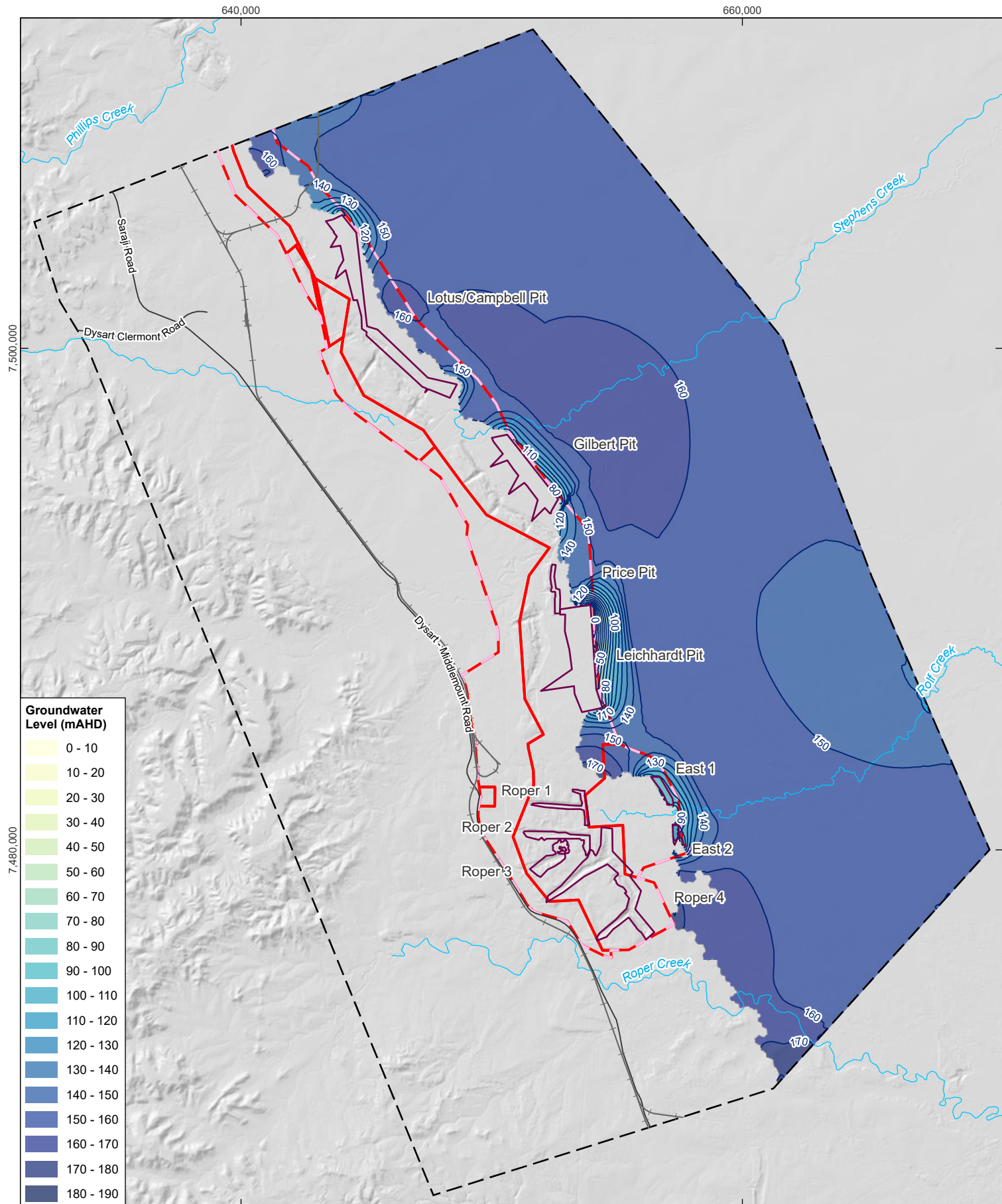
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END OF MINING GROUNDWATER LEVELS – Q SEAM



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FIGURE E-3



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- | | |
|--|--|
|  Railway |  Groundwater Contour (mAHd) |
|  Major Road |  Void Extent |
|  Watercourse |  SSM Mine Lease |
|  Model Boundary |  SSM EA Boundary |

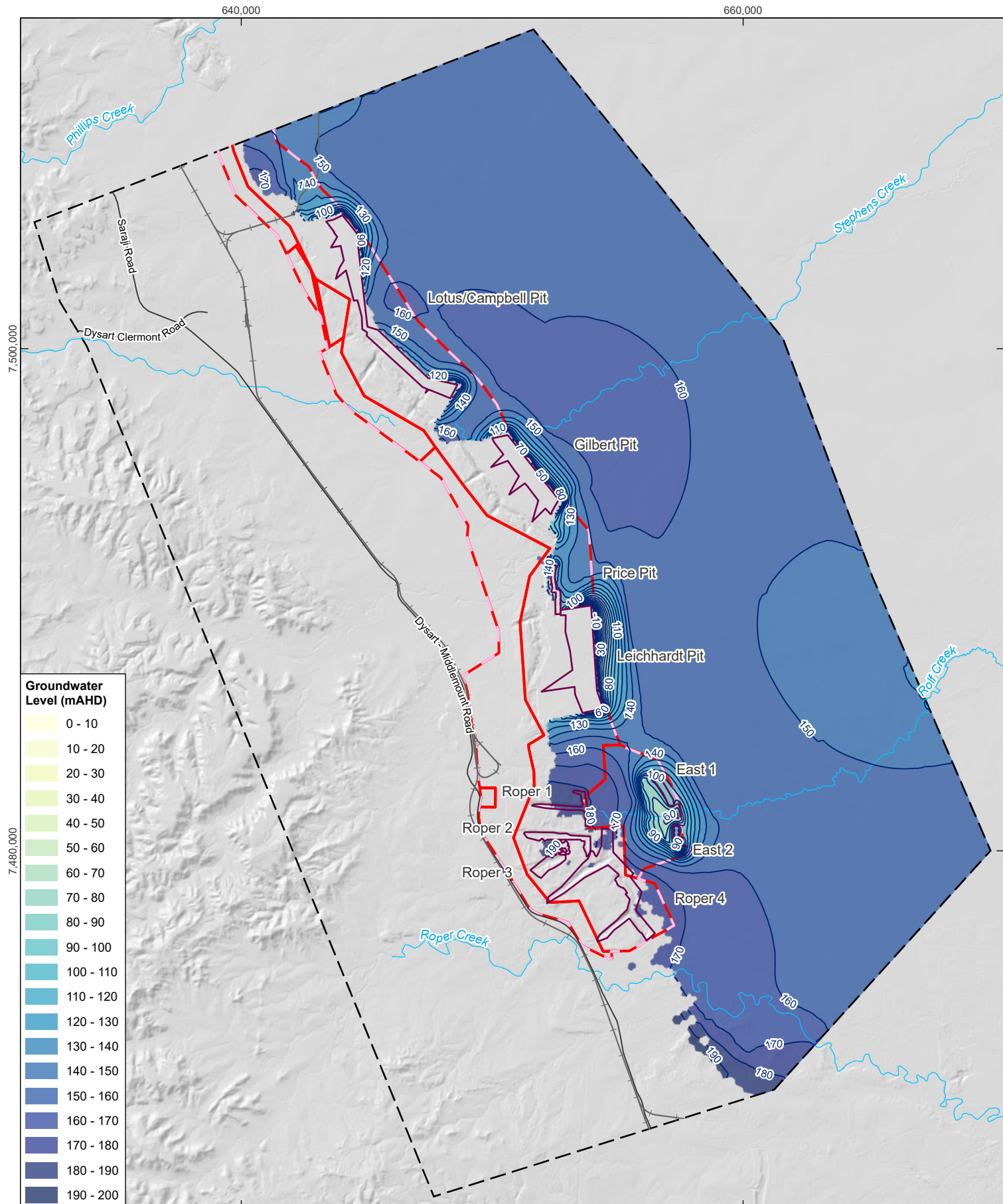
**SARAJI SOUTH MINE
GROUNDWATER MODELLING
TECHNICAL REPORT**

**END OF MINING
GROUNDWATER LEVELS –
P SEAM**



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FIGURE E-4



Groundwater Level (mAHd)
 0 - 10
 10 - 20
 20 - 30
 30 - 40
 40 - 50
 50 - 60
 60 - 70
 70 - 80
 80 - 90
 90 - 100
 100 - 110
 110 - 120
 120 - 130
 130 - 140
 140 - 150
 150 - 160
 160 - 170
 170 - 180
 180 - 190
 190 - 200

Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- Railway
- Major Road
- Watercourse
- Model Boundary
- Groundwater Contour (mAHd)
- Void Extent
- SSM Mine Lease
- SSM EA Boundary

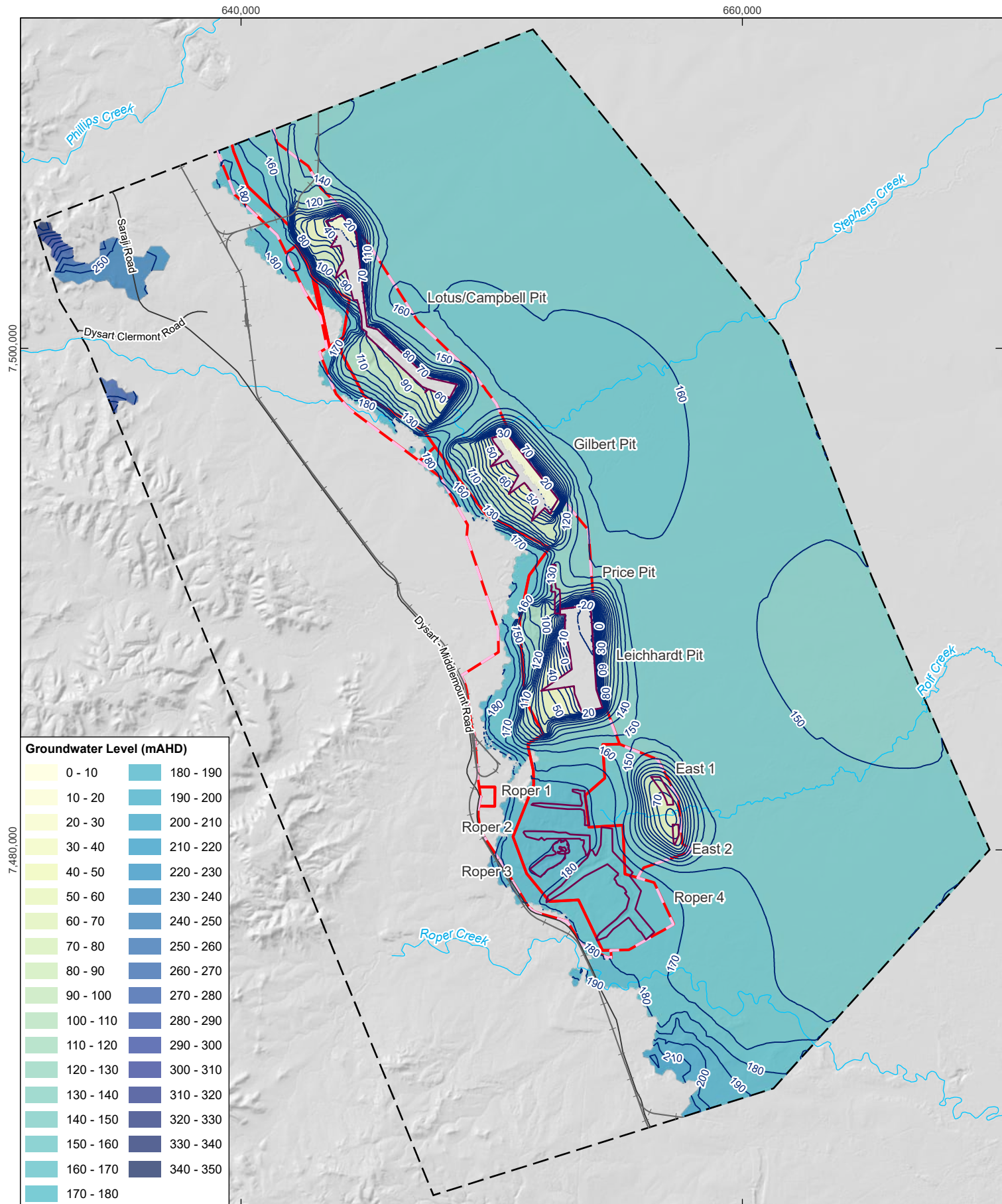
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

END OF MINING GROUNDWATER LEVELS – H SEAM



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FIGURE E-5



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHd)
-  Void Extent
-  SSM Mine Lease
-  SSM EA Boundary

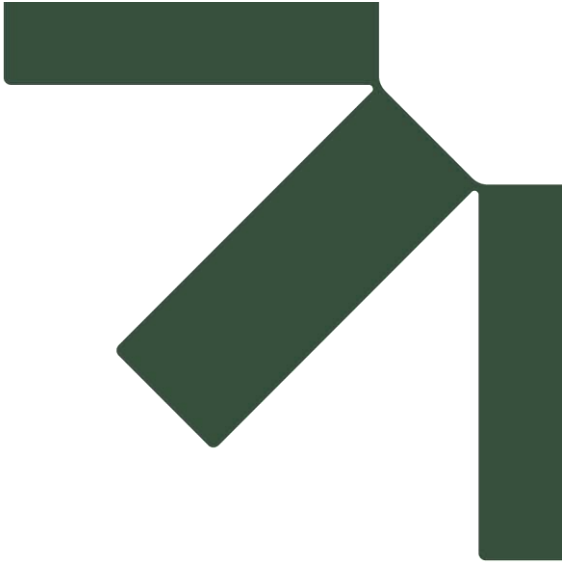
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END OF MINING GROUNDWATER LEVELS – D SEAM



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FIGURE E-6



Appendix F Drier Climate Scenario Model Predictions

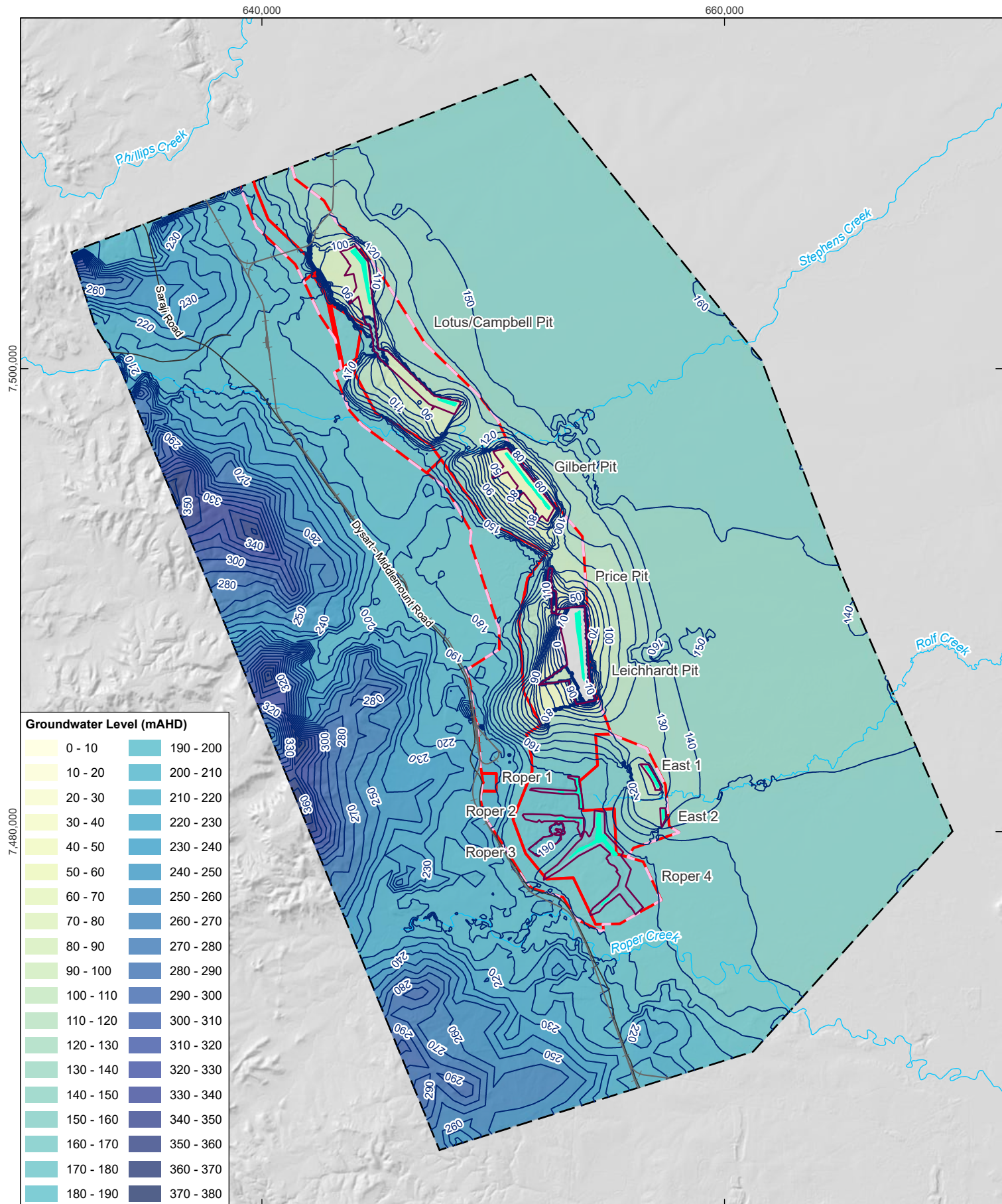
Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

22 August 2024



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:216,761 at A4
 Project Number: 620.314444.00000
 Date Drawn: 29-May-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHd)
-  Void Extent
-  Void Lake
-  SSM Mine Lease
-  SSM EA Boundary

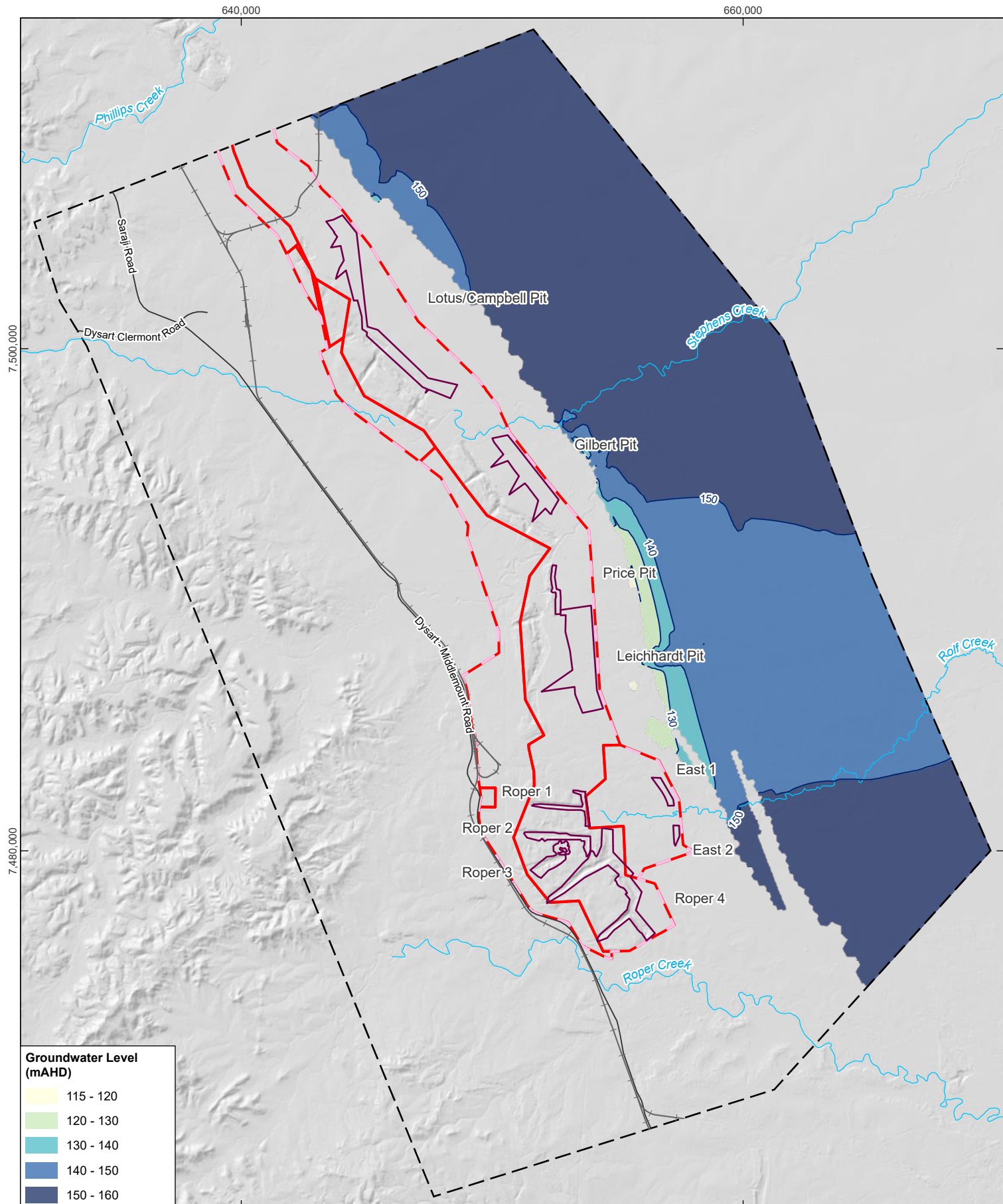
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE ELEVATION – POST-MINING EQUILIBRIUM (DRIER CLIMATE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE F-1



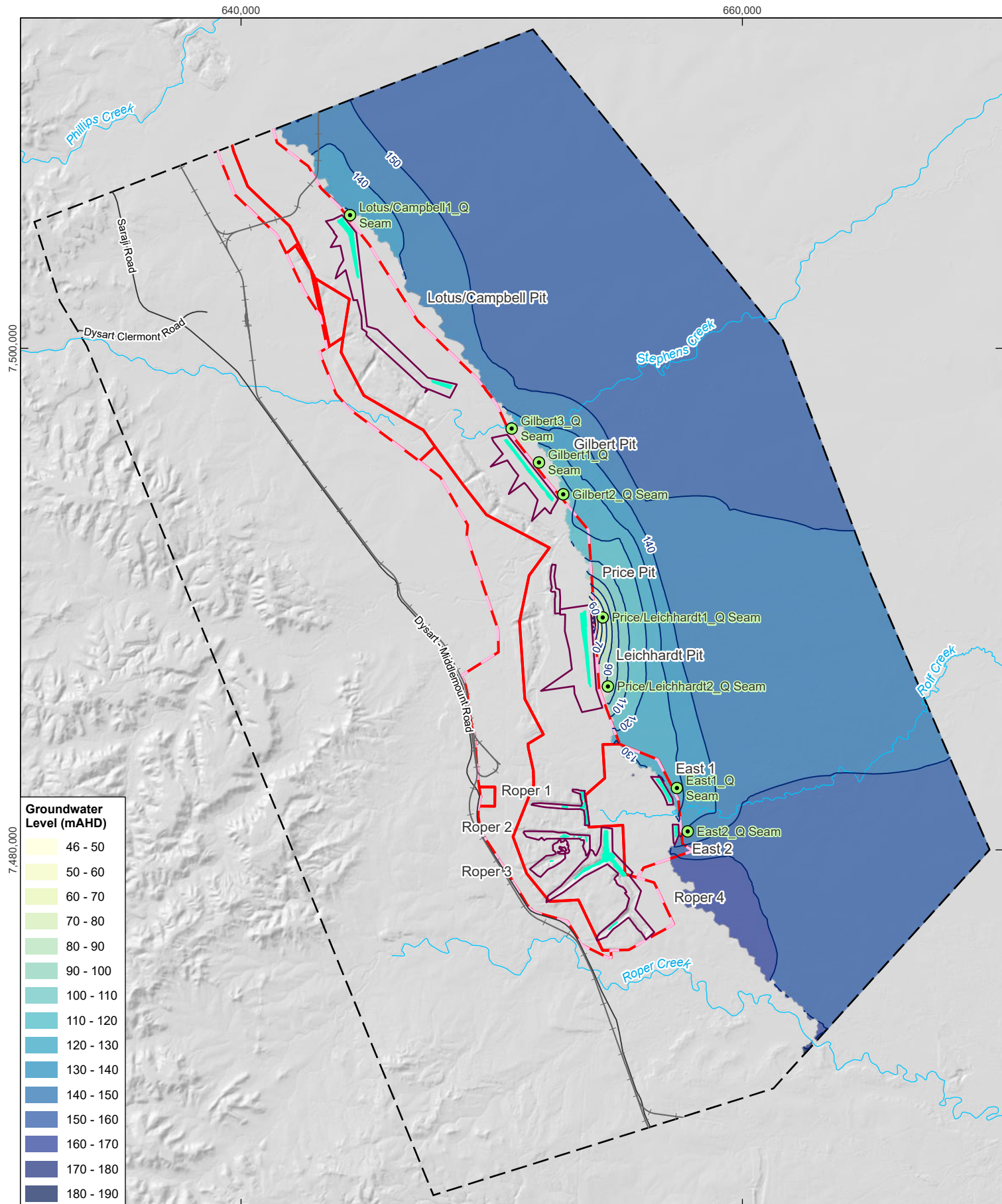
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE FORT COOPER SEAMS (LAYER 4) – POST-MINING EQUILIBRIUM (DRIER CLIMATE SCENARIO)



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FIGURE F-2



Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB

LEGEND

- Hydrograph Location
- Groundwater Contour (mAHd)
- Railway
- Void Extent
- Major Road
- Void Lake
- Watercourse
- SSM Mine Lease
- Model Boundary
- SSM EA Boundary

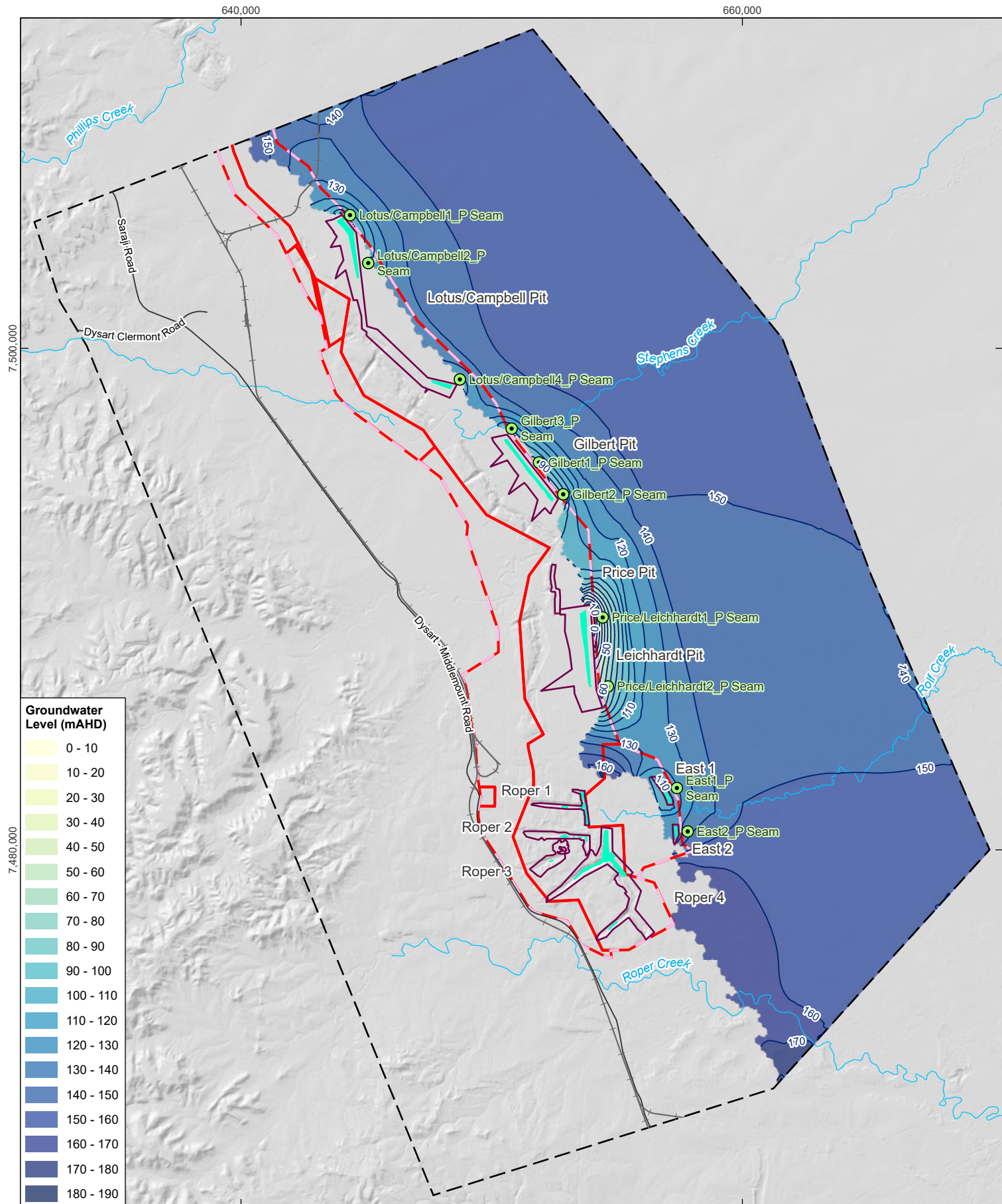
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE Q SEAM (LAYER 6) – POST-MINING EQUILIBRIUM (DRIER CLIMATE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE F-3

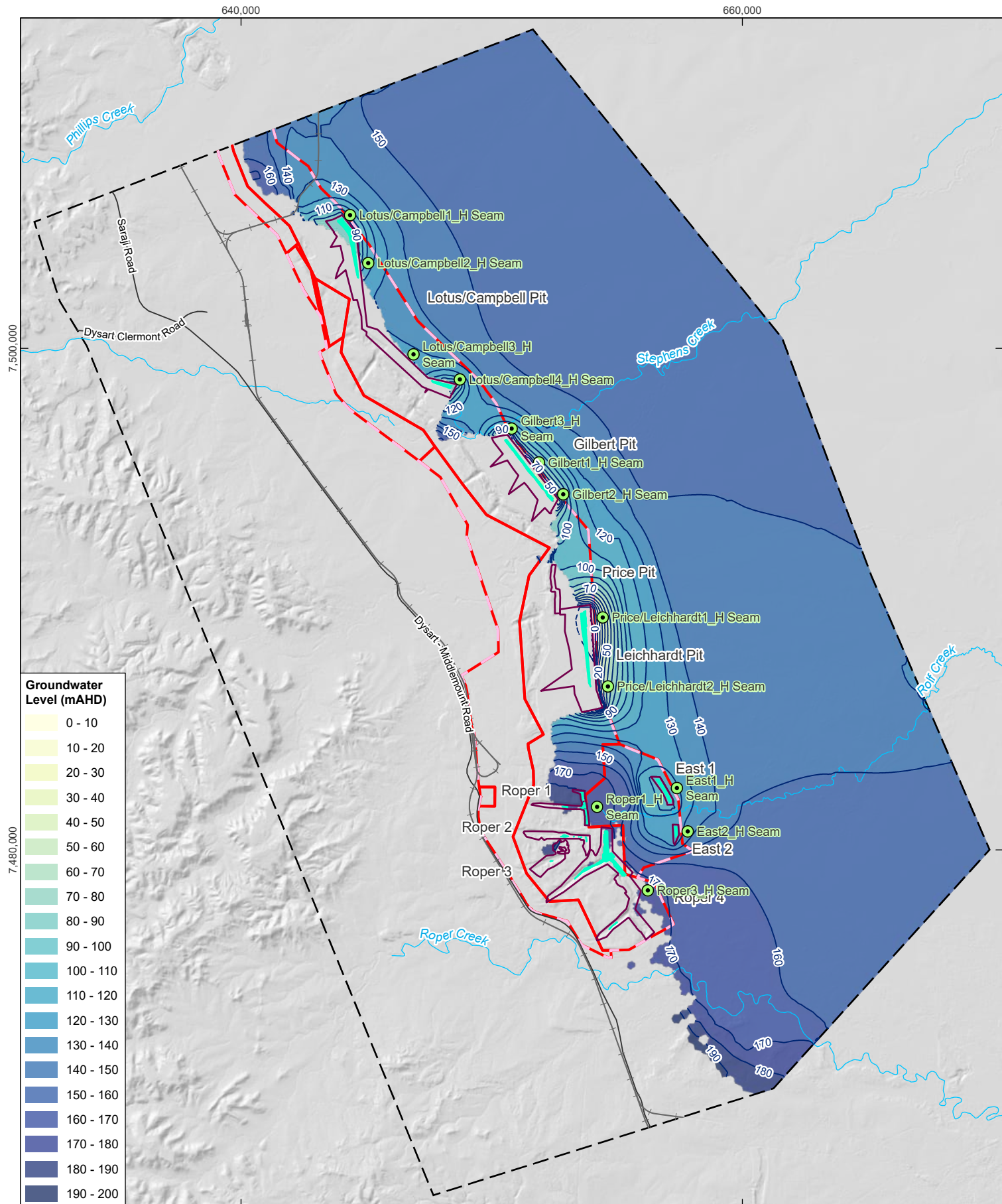


Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE F-4



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB

LEGEND

- | | |
|---|--|
|  Hydrograph Location |  Groundwater Contour (mAHD) |
|  Railway |  Void Extent |
|  Major Road |  Void Lake |
|  Watercourse |  SSM Mine Lease |
|  Model Boundary |  SSM EA Boundary |

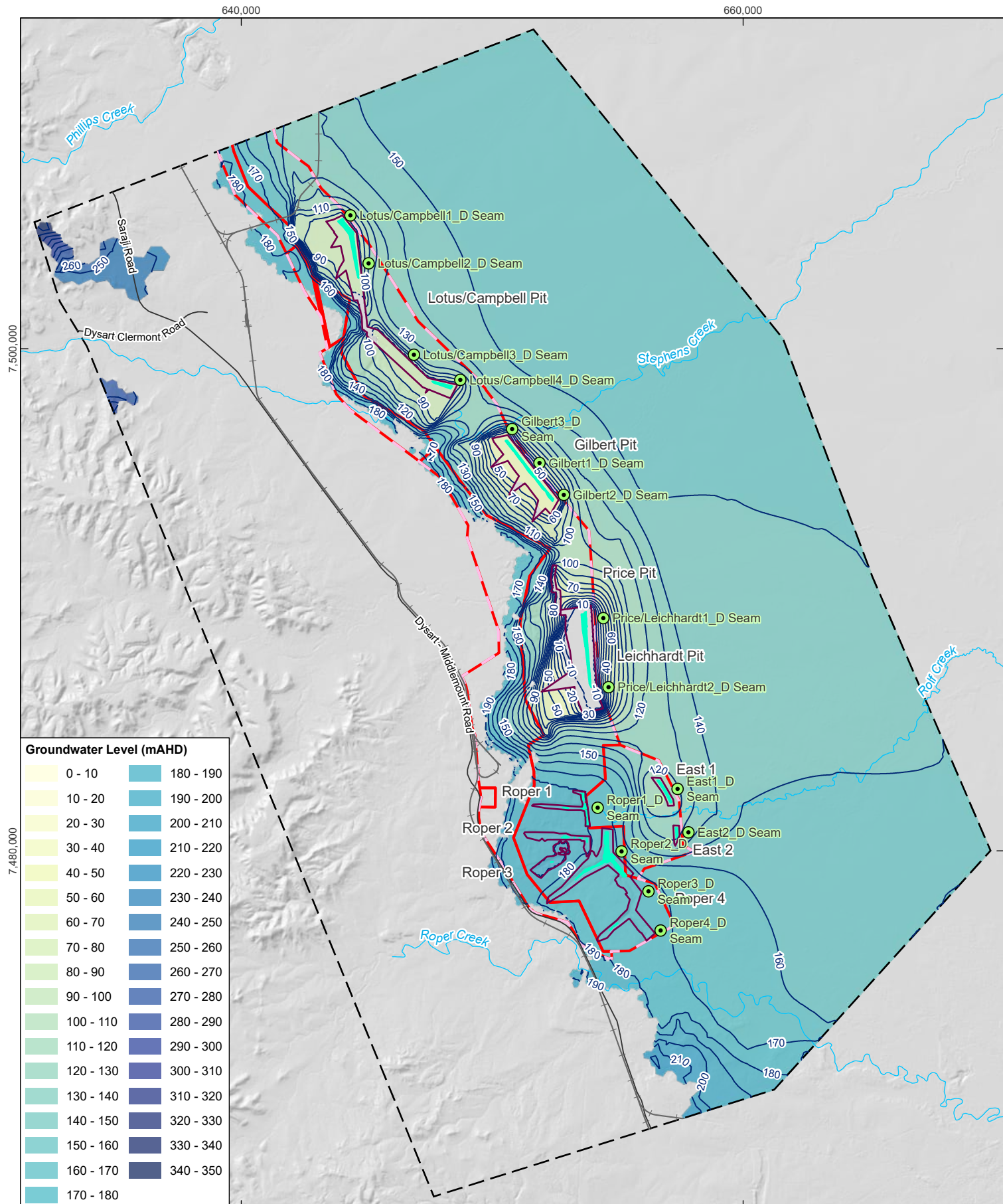
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE H SEAM (LAYER 10) – POST-MINING EQUILIBRIUM (DRIER CLIMATE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE F-5



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB

LEGEND

-  Hydrograph Location
-  Groundwater Contour (mAHD)
-  Railway
-  Void Extent
-  Major Road
-  Void Lake
-  Watercourse
-  SSM Mine Lease
-  Model Boundary
-  SSM EA Boundary

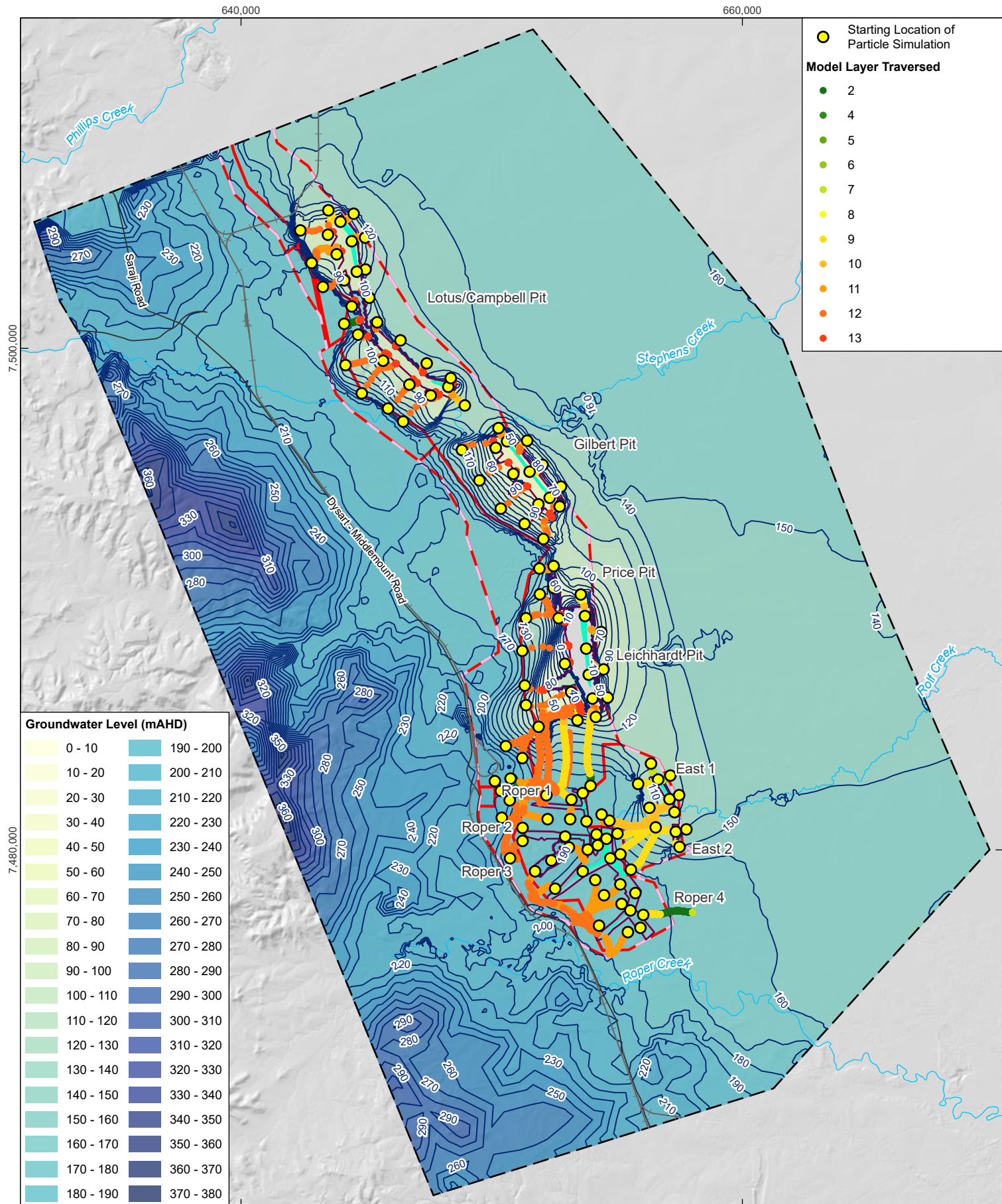
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE D SEAM (LAYER 12) – POST-MINING EQUILIBRIUM (DRIER CLIMATE SCENARIO)



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FIGURE F-6



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 16-Jul-2024
 Drawn by: RB

LEGEND

-  Railway
-  Major Road
-  Watercourse
-  Model Boundary
-  Groundwater Contour (mAHD)
-  Void Extent
-  Void Lake
-  SSM Mine Lease
-  SSM EA Boundary

SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MOVEMENT OF PARTICLES (DRIER CLIMATE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE F-7

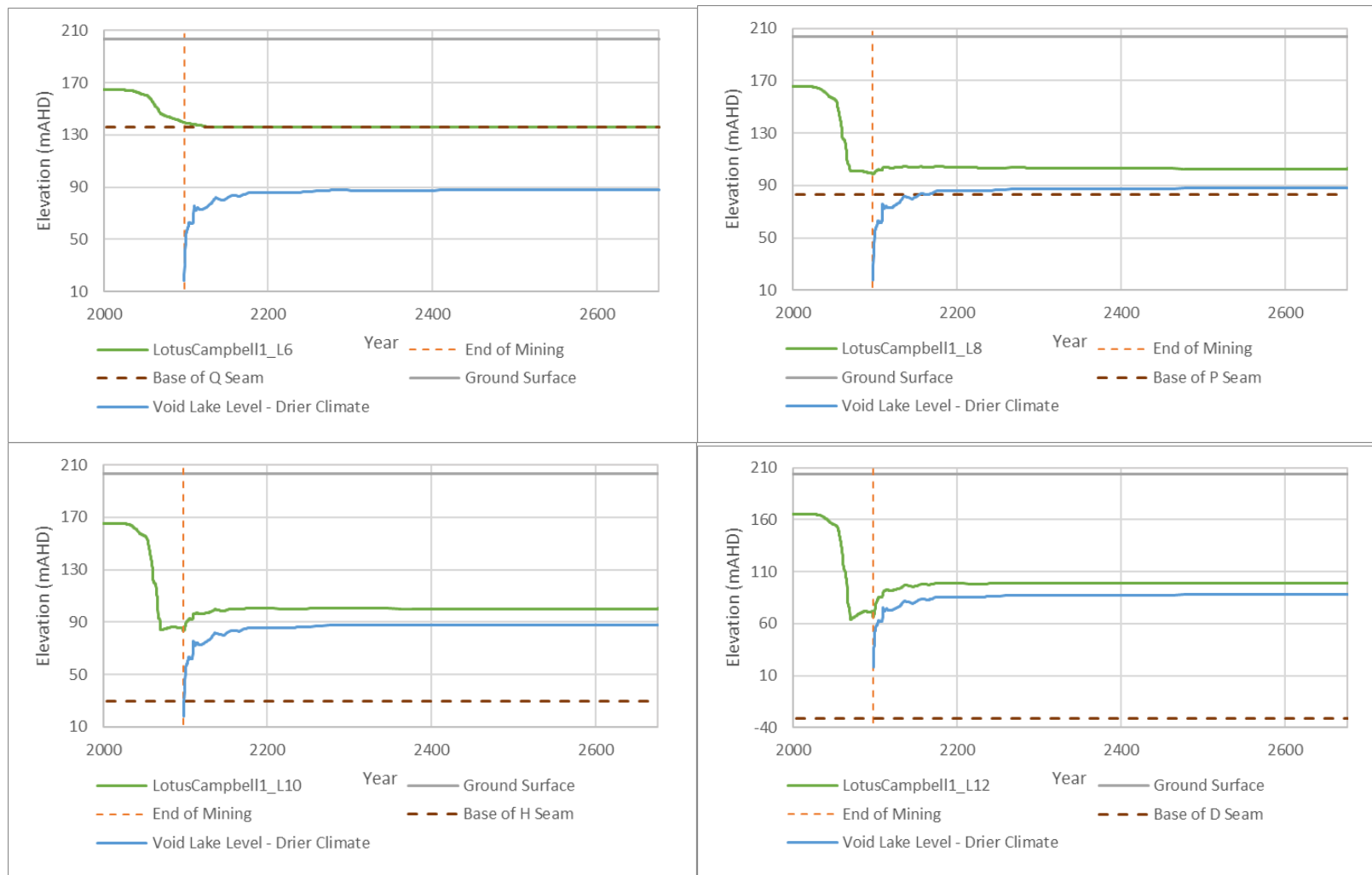


Figure F-8 Coal Measures Predictive Hydrographs adjacent LotusCampbell Void (north) (Drier Climate)



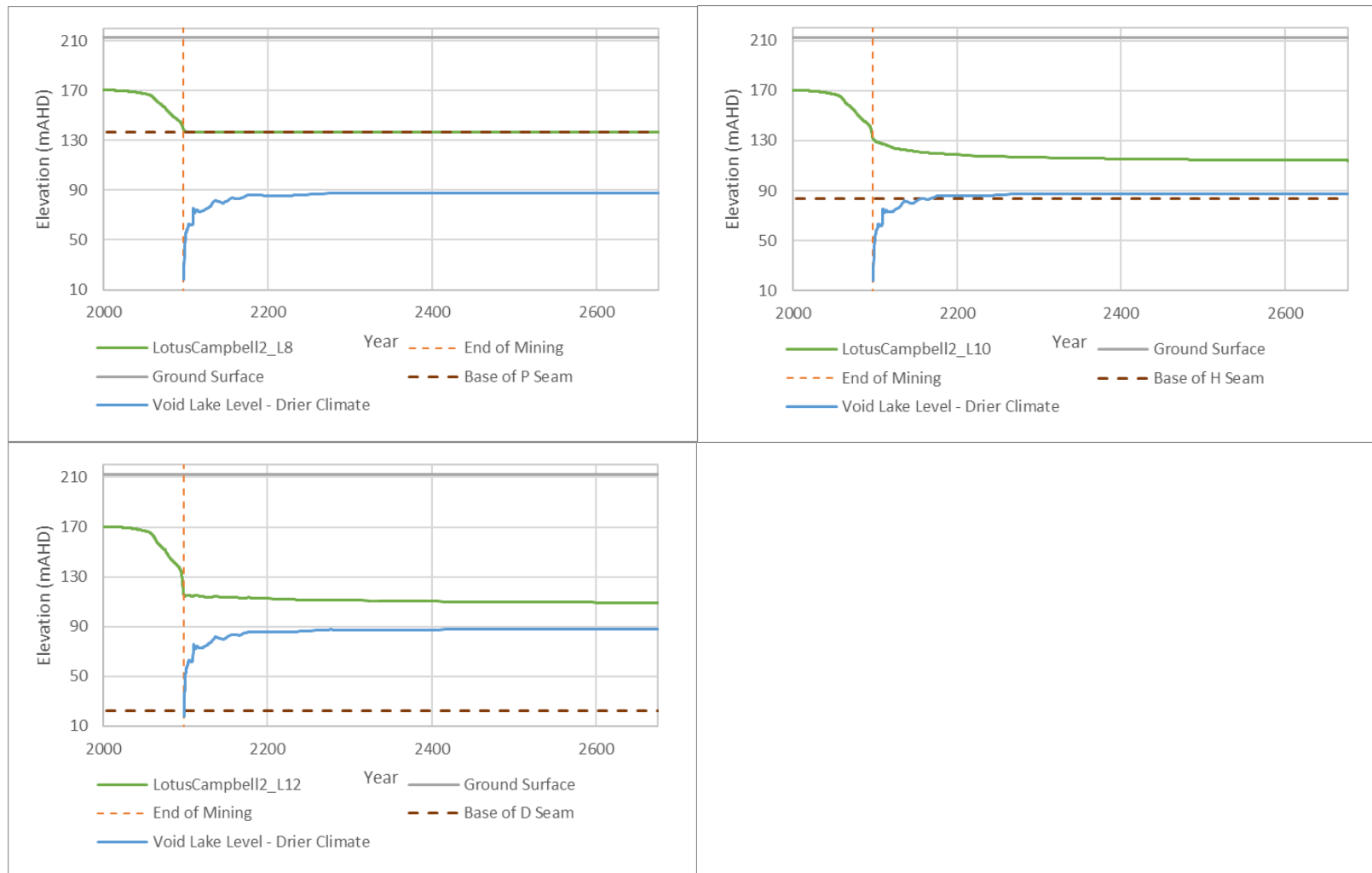


Figure F-9 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (centre1) (Drier Climate)



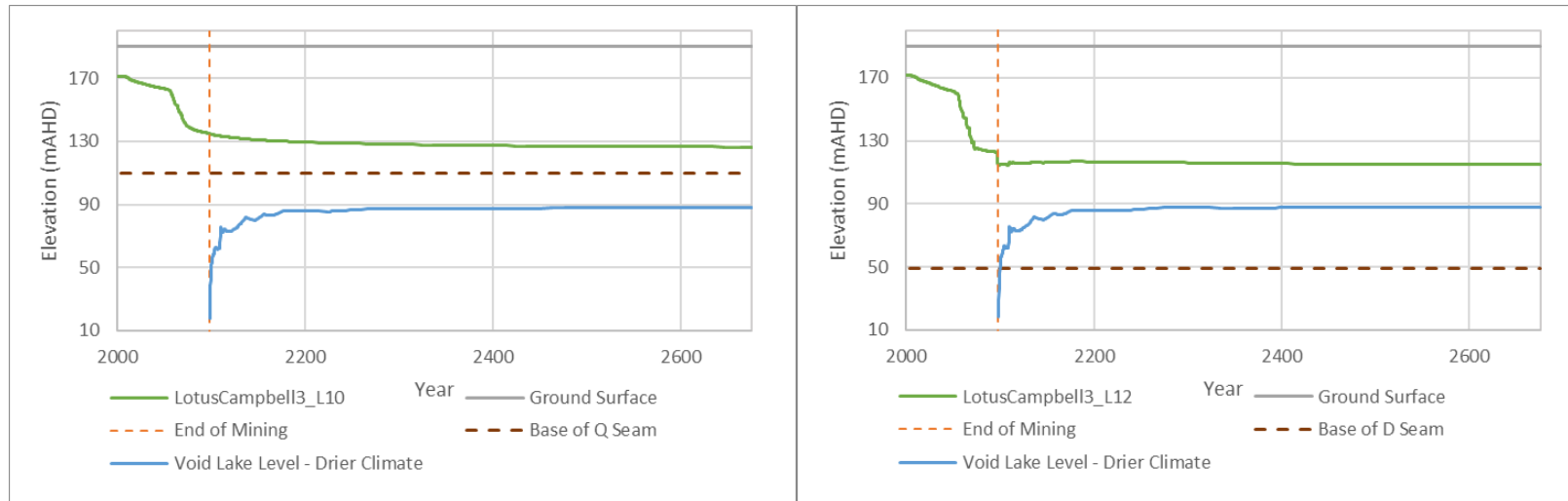


Figure F-10 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (centre2) (Drier Climate)



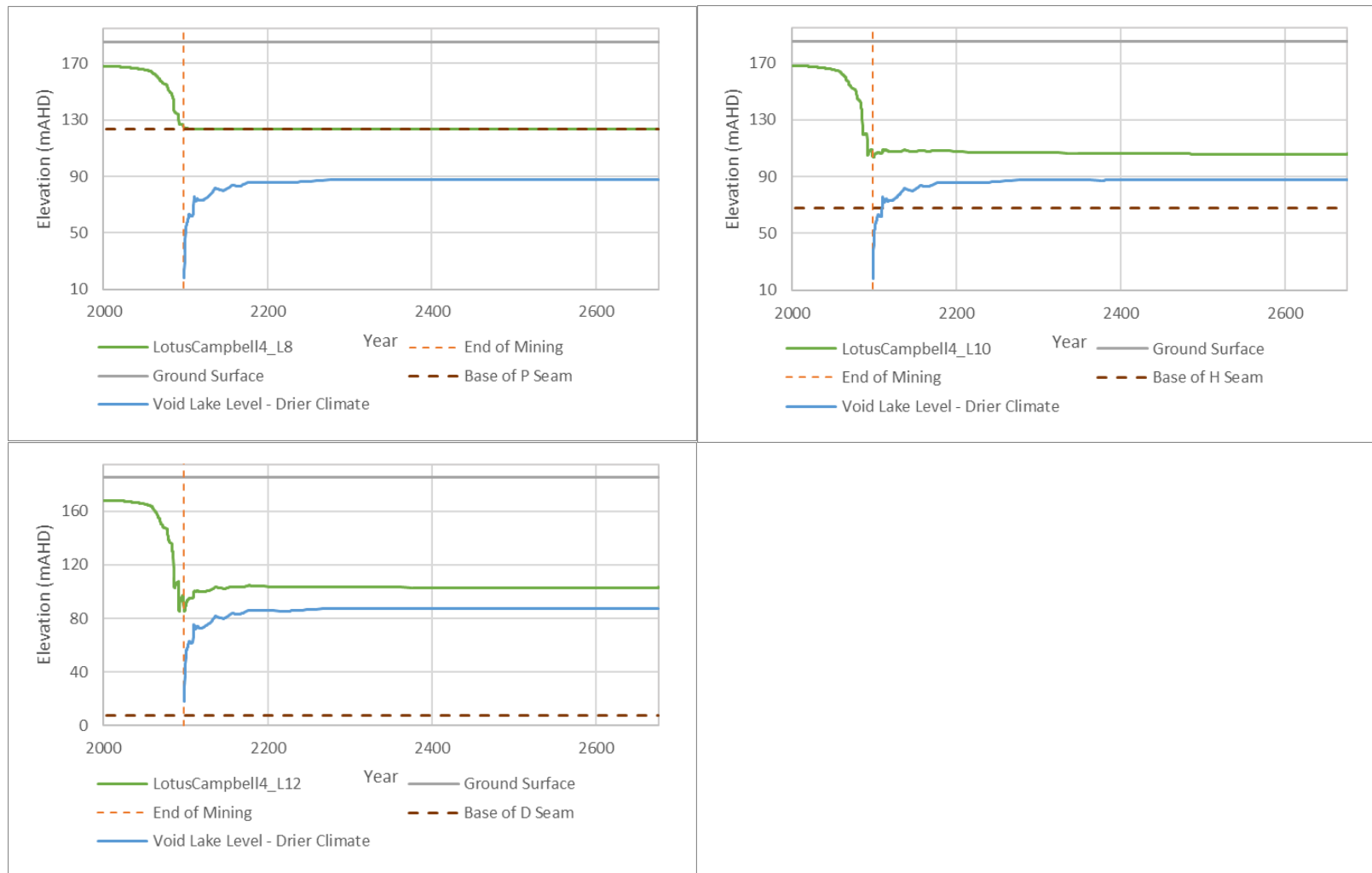


Figure F-11 Coal Measures Predictive Hydrographs adjacent LotusCampbell Void (south) (Drier Climate)



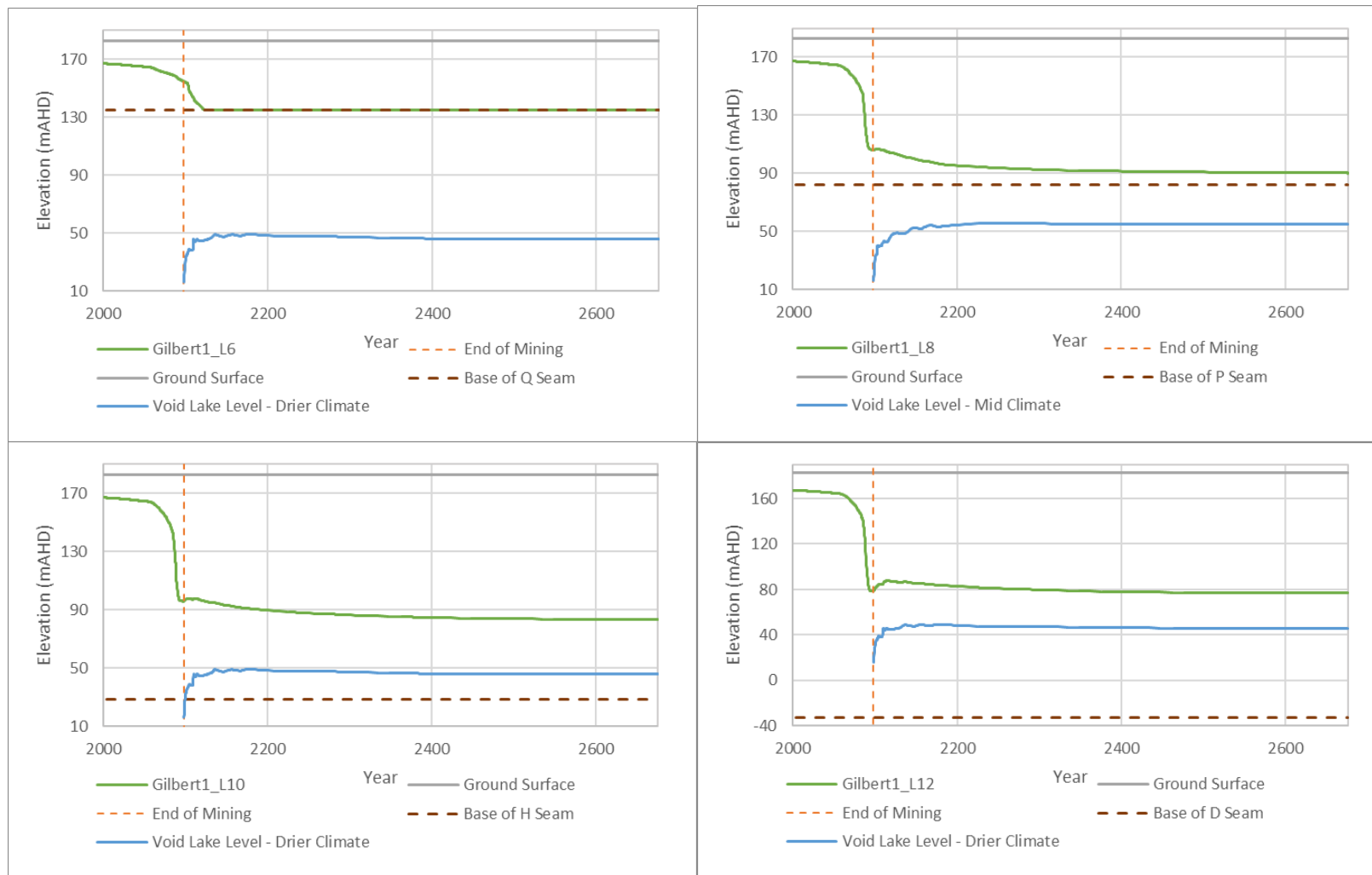


Figure F-12 Coal Measures Predictive Hydrographs adjacent Gilbert Void (north) (Drier Climate)



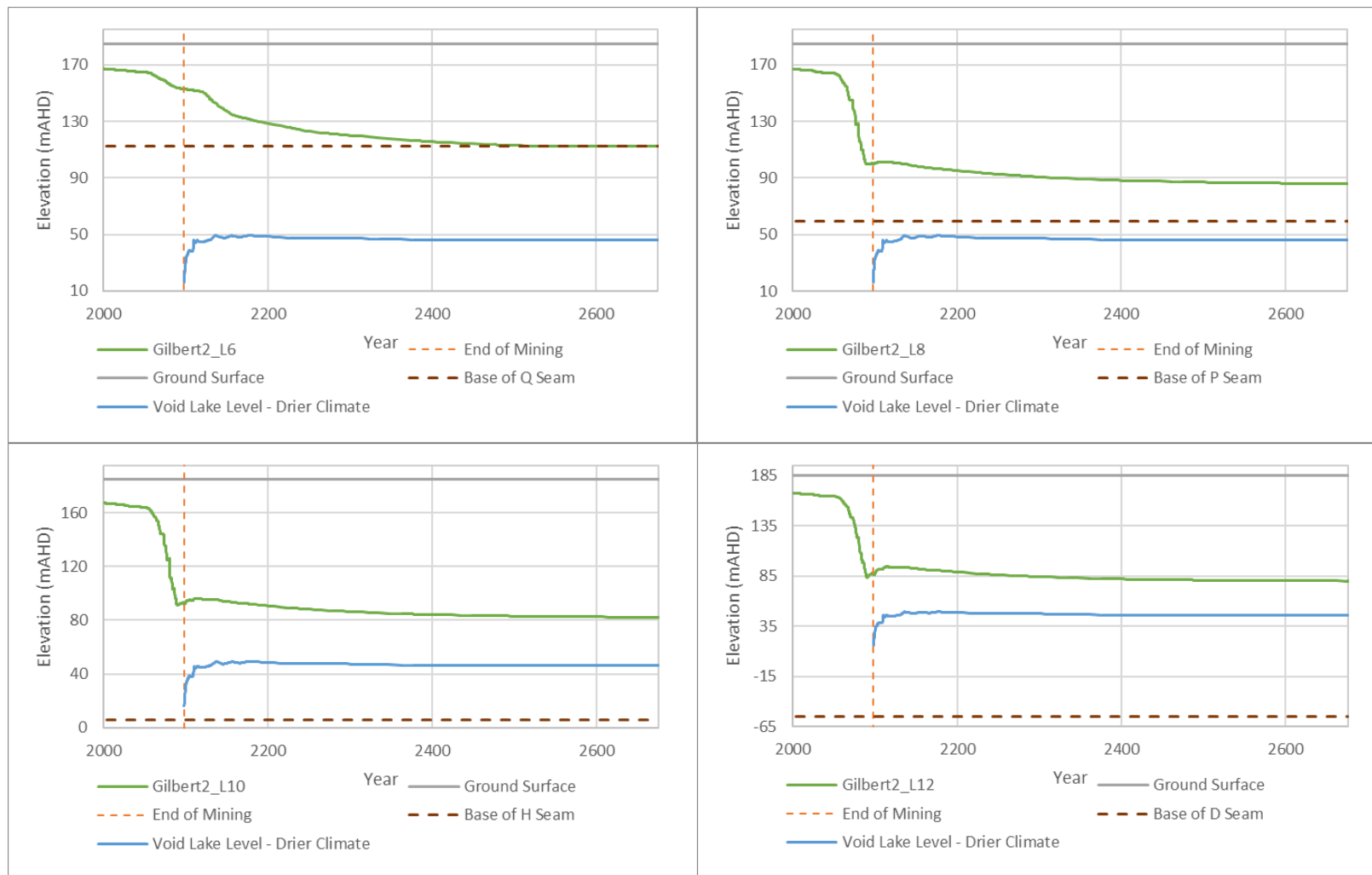


Figure F-13 Coal Measures Predictive Hydrographs adjacent Gilbert Void (centre) (Drier Climate)



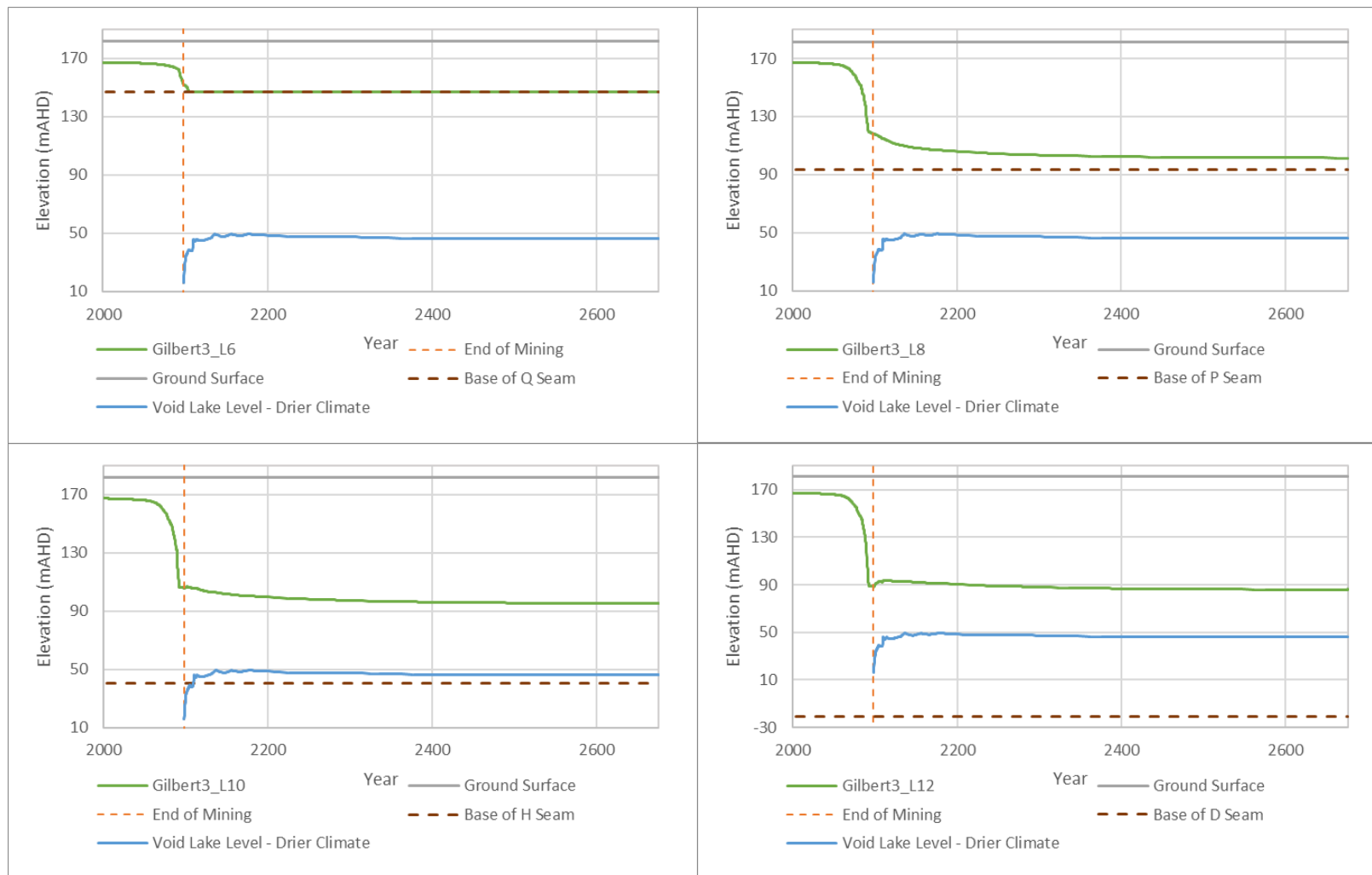


Figure F-14 Coal Measures Predictive Hydrographs adjacent Gilbert Void (south) (Drier Climate)



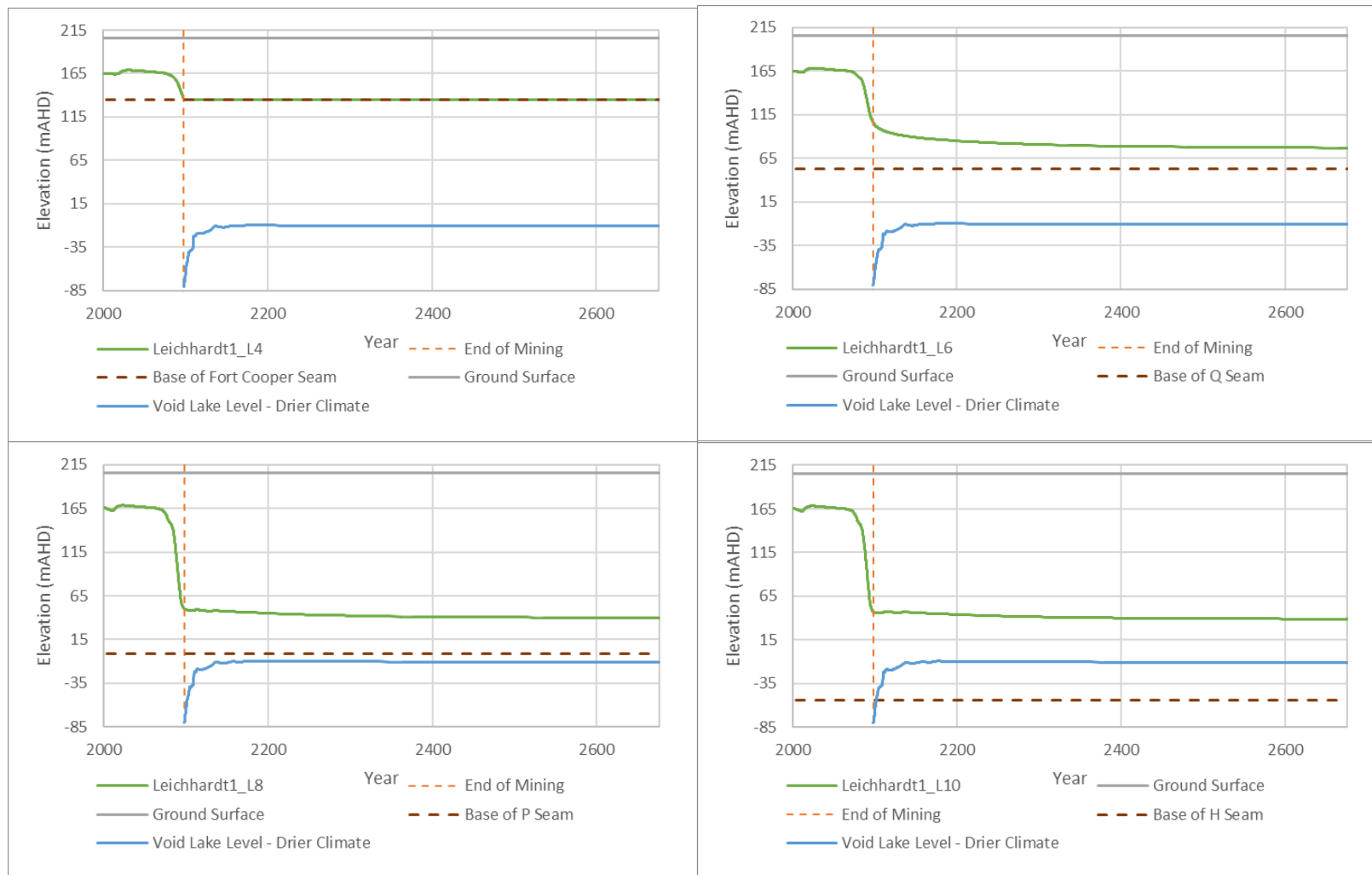


Figure F-15 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (north) (Drier Climate)



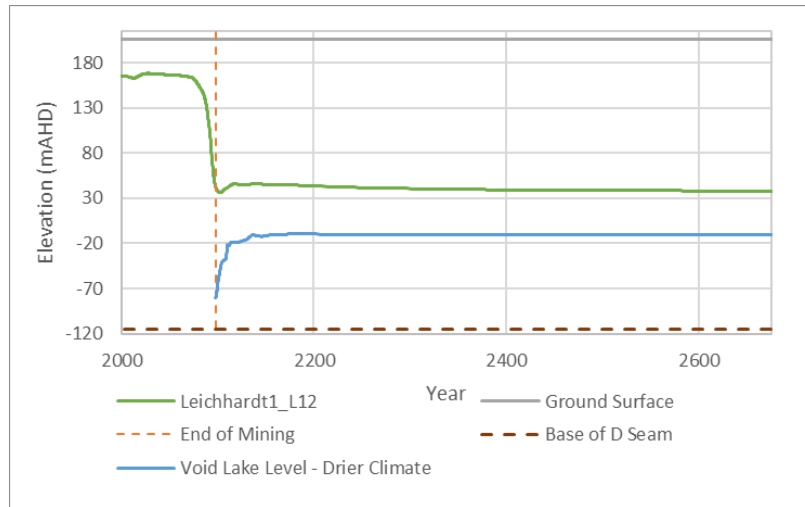


Figure F-15 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (north) (Drier Climate) (cont.)



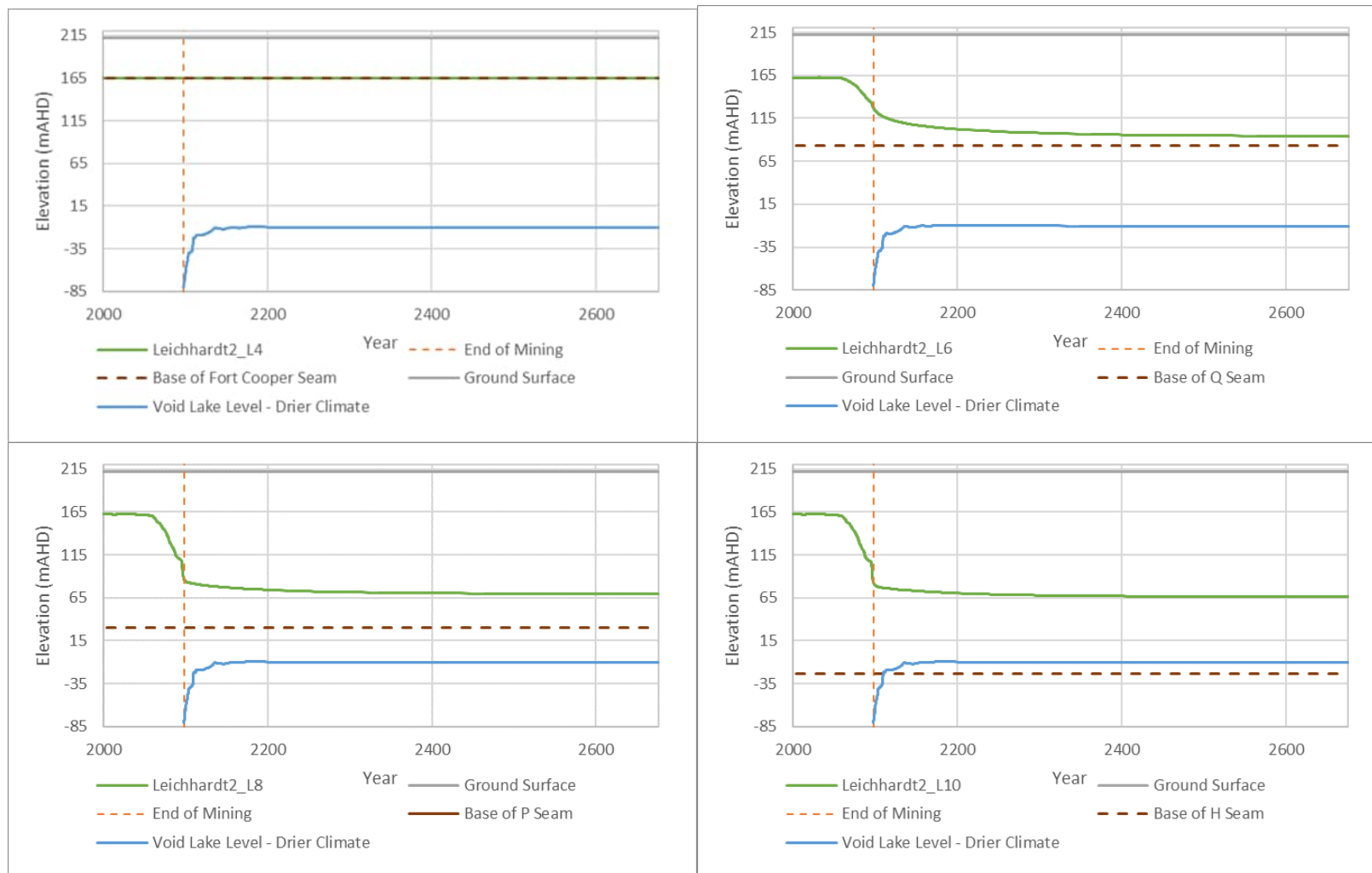


Figure F-16 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (south) (Drier Climate)



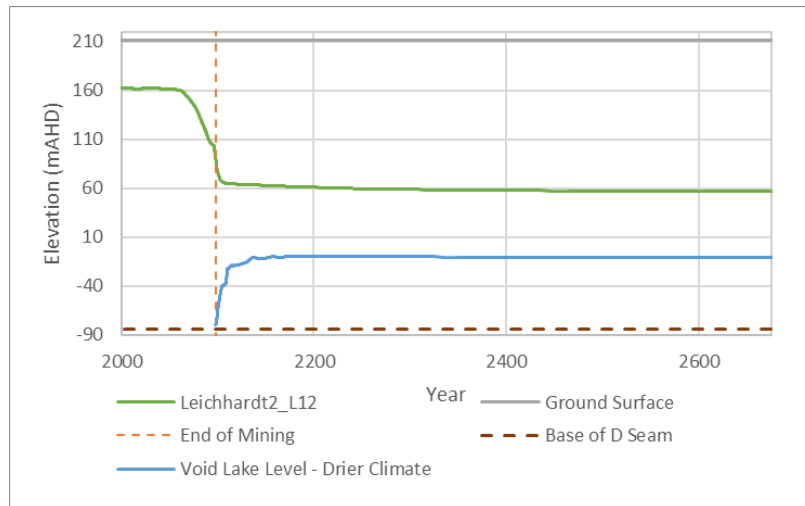


Figure F-16 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (south) (Drier Climate) (cont.)



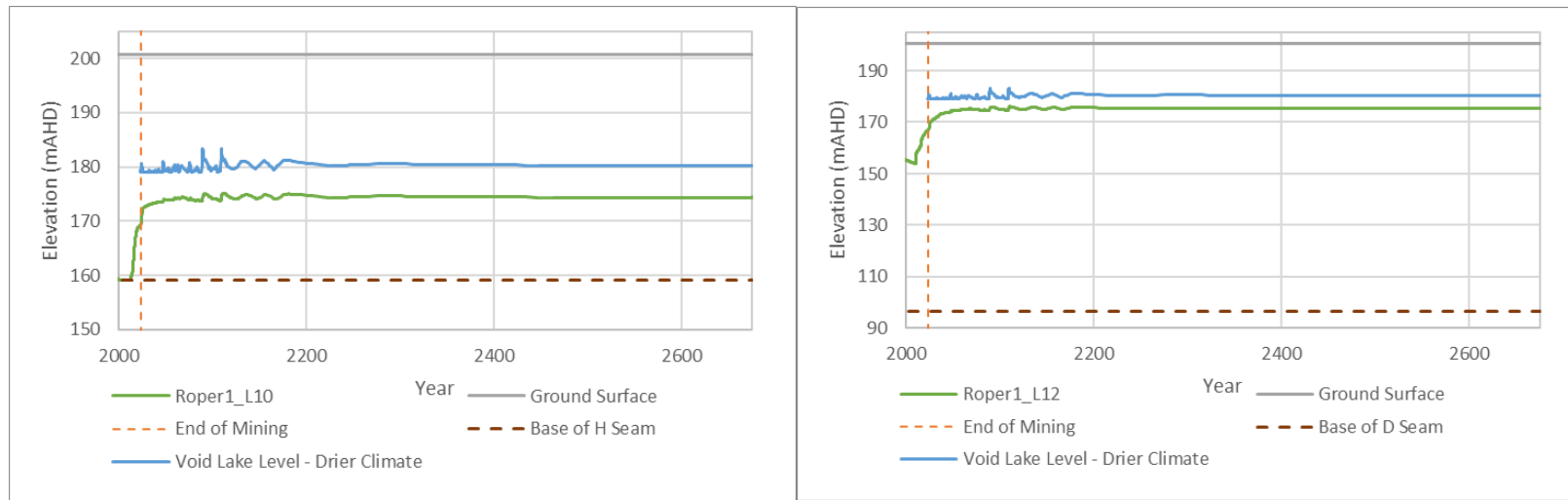


Figure F-17 Coal Measures Predictive Hydrographs adjacent Roper Voids (north) (Drier Climate)



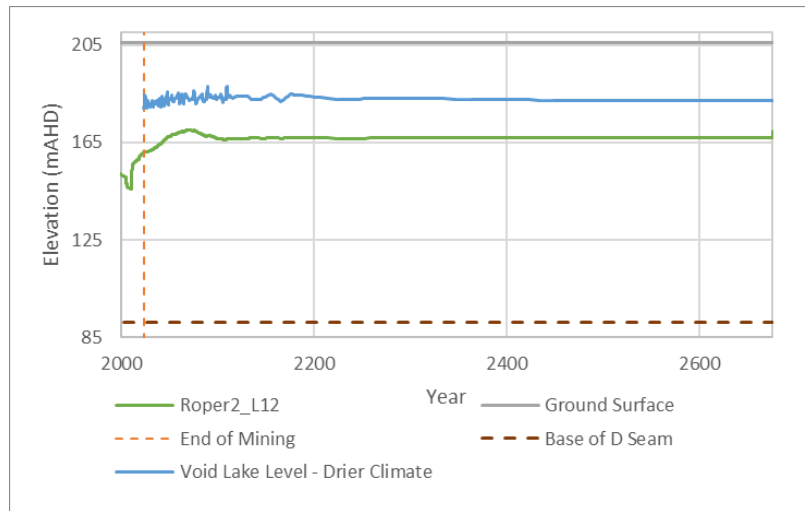


Figure F-18 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 1) (Drier Climate)



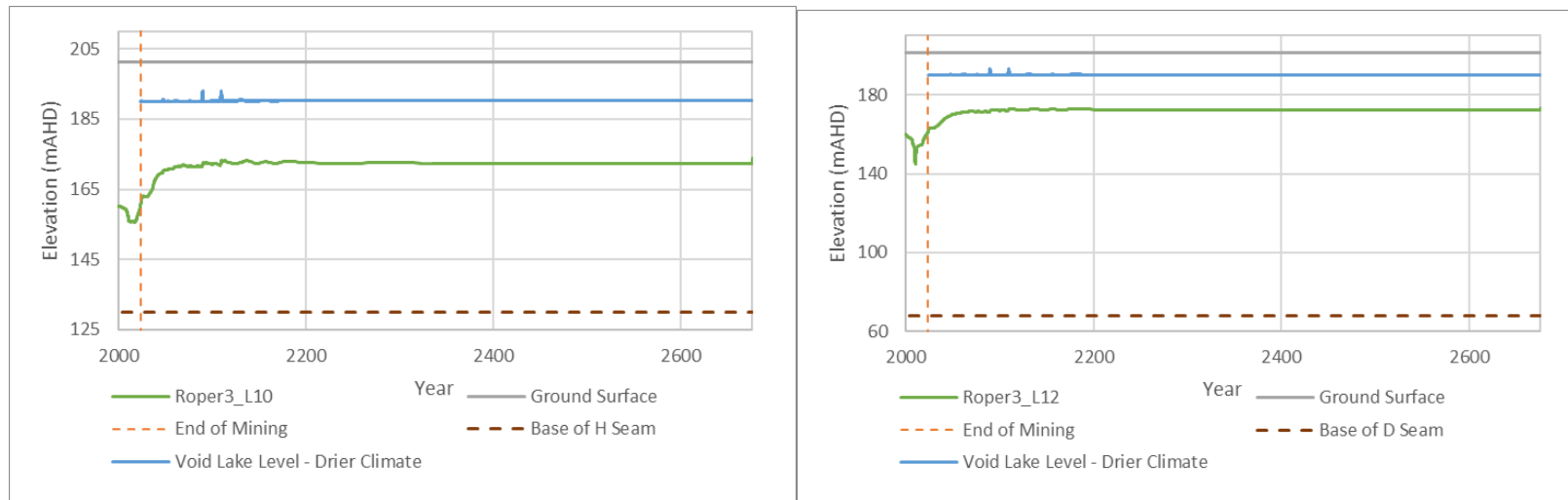


Figure F-19 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 2) (Drier Climate)



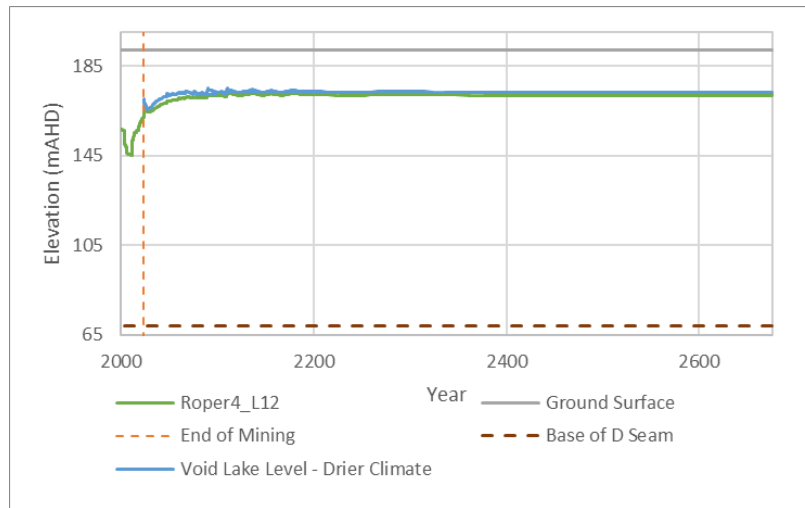


Figure F-20 Coal Measures Predictive Hydrographs adjacent Roper Voids (south) (Drier Climate)



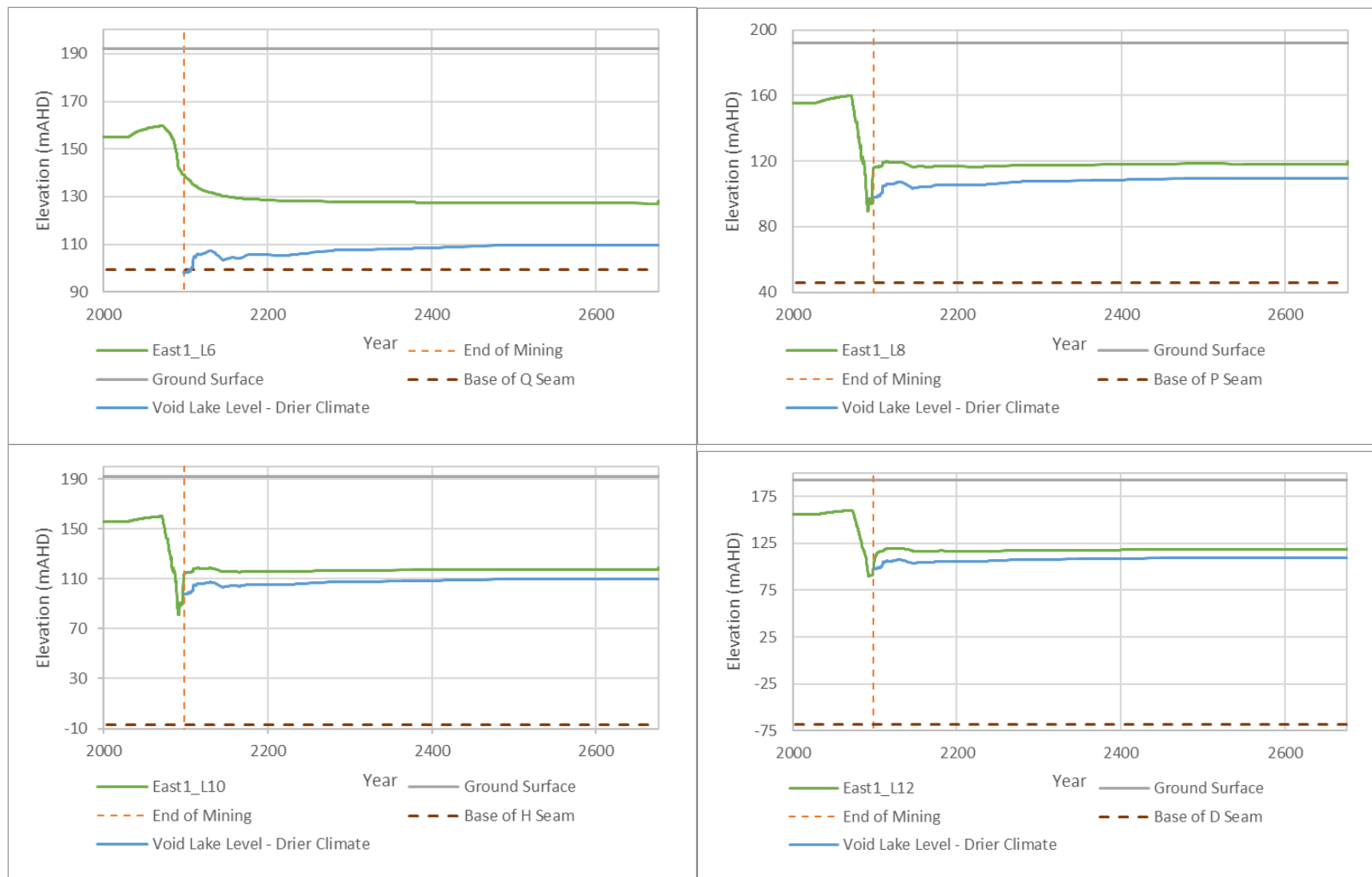


Figure F-21 Coal Measures Predictive Hydrographs adjacent East 1 Void (Drier Climate)



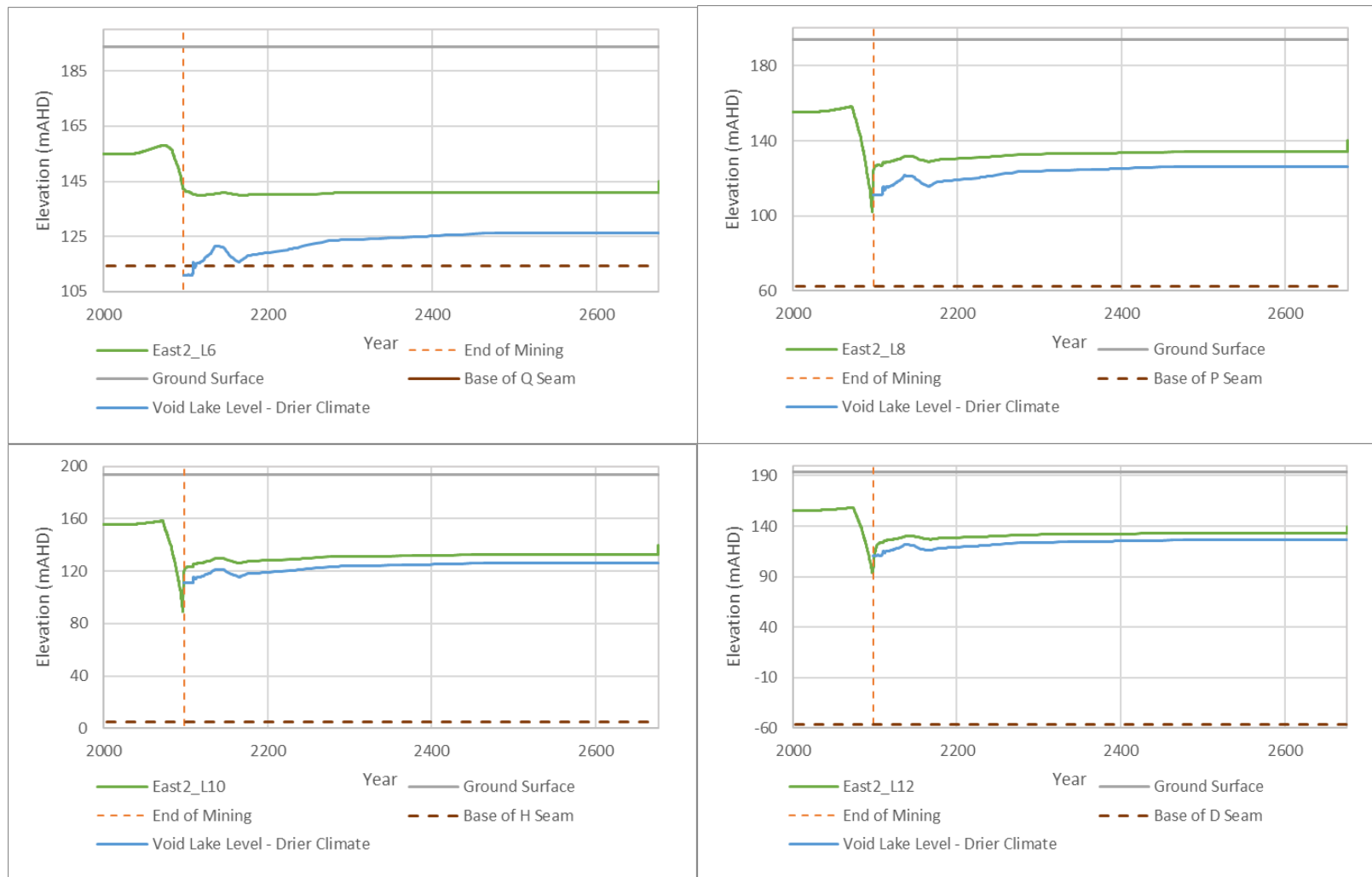


Figure F-22 Coal Measures Predictive Hydrographs adjacent East 2 Void (Drier Climate)





Appendix G Wetter Climate Scenario Model Predictions

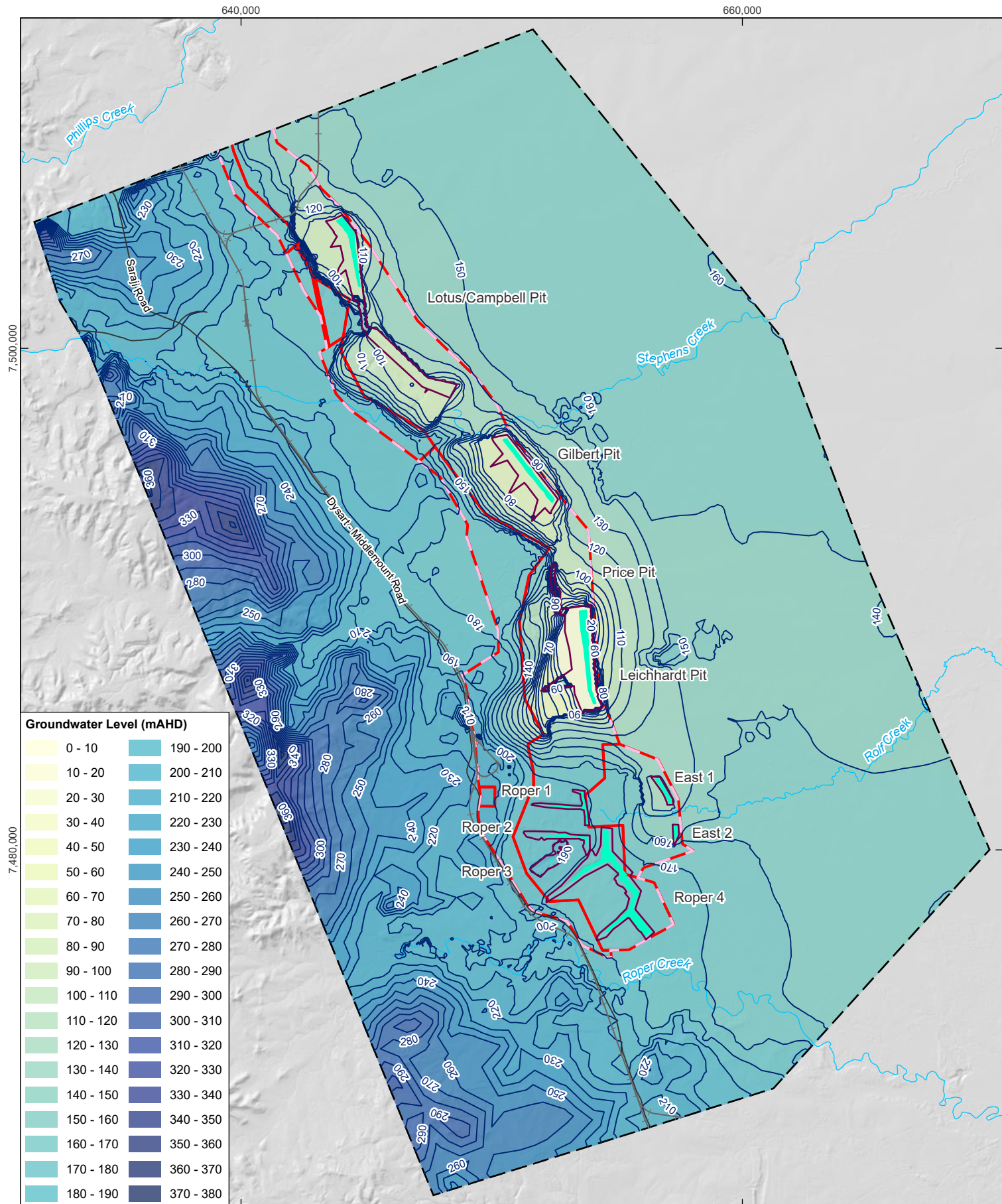
Saraji South Mine

Groundwater Modelling Technical Report

BMA

SLR Project No.: 620.31444.00000

22 August 2024



Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 30-May-2024
 Drawn by: RB

LEGEND

- Railway
- Major Road
- Watercourse
- Model Boundary
- Groundwater Contour (mAHd)
- Void Extent
- Void Lake
- SSM Mine Lease
- SSM EA Boundary

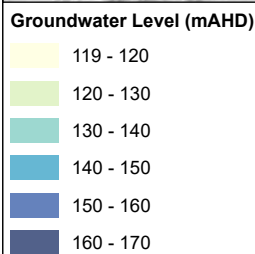
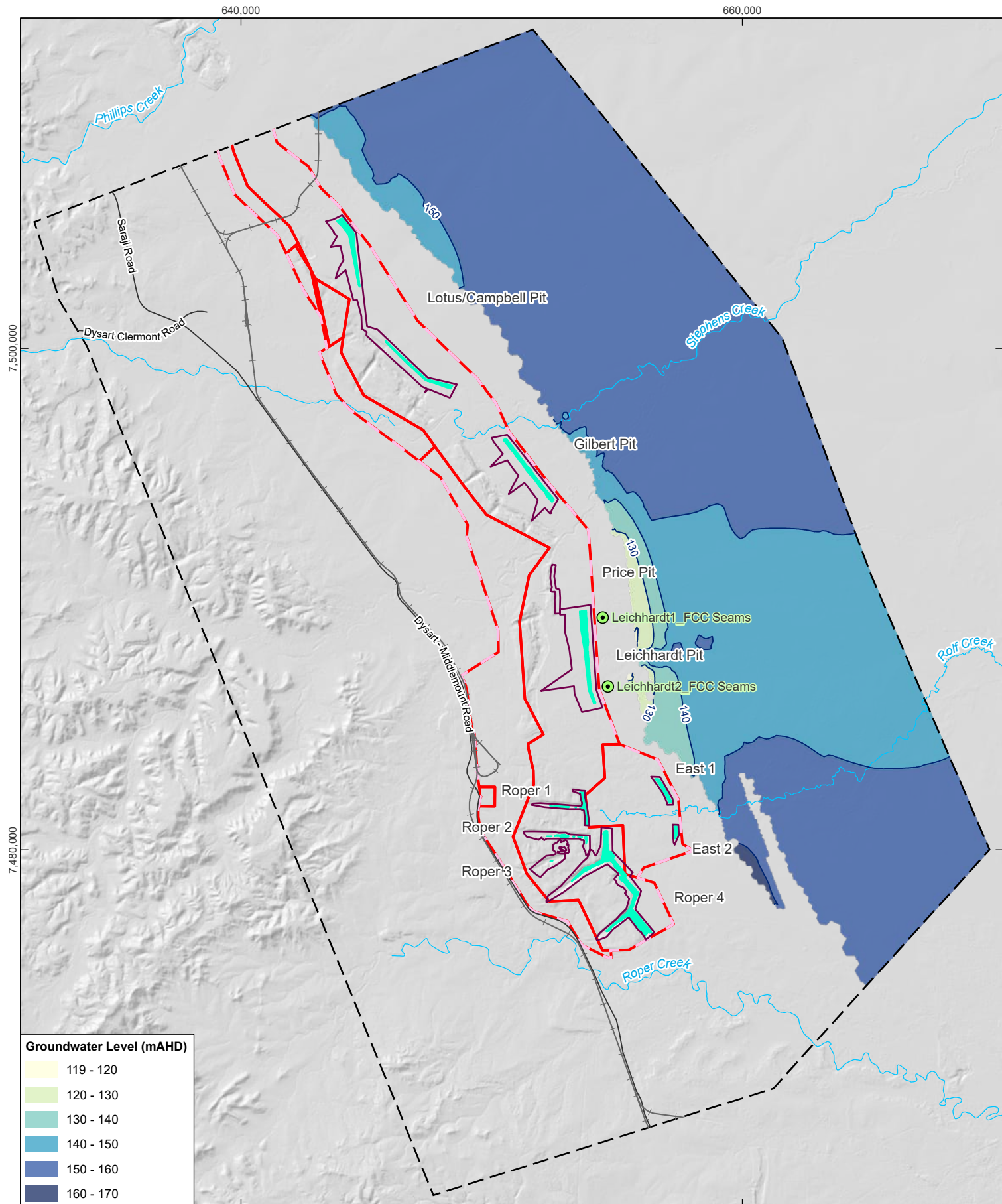
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE ELEVATION – POST-MINING EQUILIBRIUM (WETTER CLIMATE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE G-1



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB

LEGEND

- | | |
|---------------------|----------------------------|
| Hydrograph Location | Groundwater Contour (mAHd) |
| Railway | Void Extent |
| Major Road | Void Lake |
| Watercourse | SSM Mine Lease |
| Model Boundary | SSM EA Boundary |

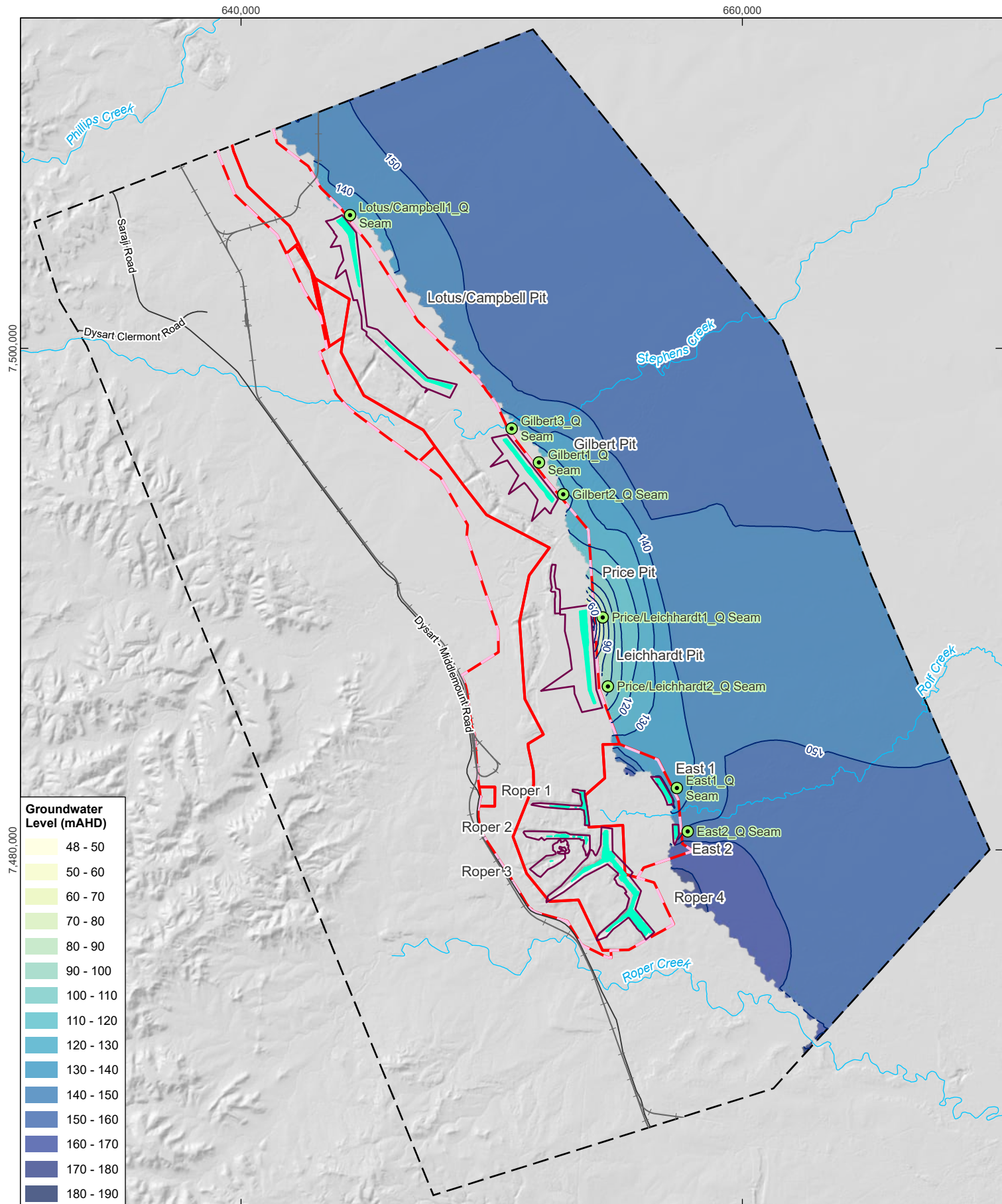
**SARAJI SOUTH MINE
GROUNDWATER MODELLING
TECHNICAL REPORT**

**PREDICTED GROUNDWATER LEVELS
IN THE FORT COOPER SEAMS (LAYER 4) –
POST-MINING EQUILIBRIUM
(WETTER CLIMATE SCENARIO)**



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FIGURE G-2

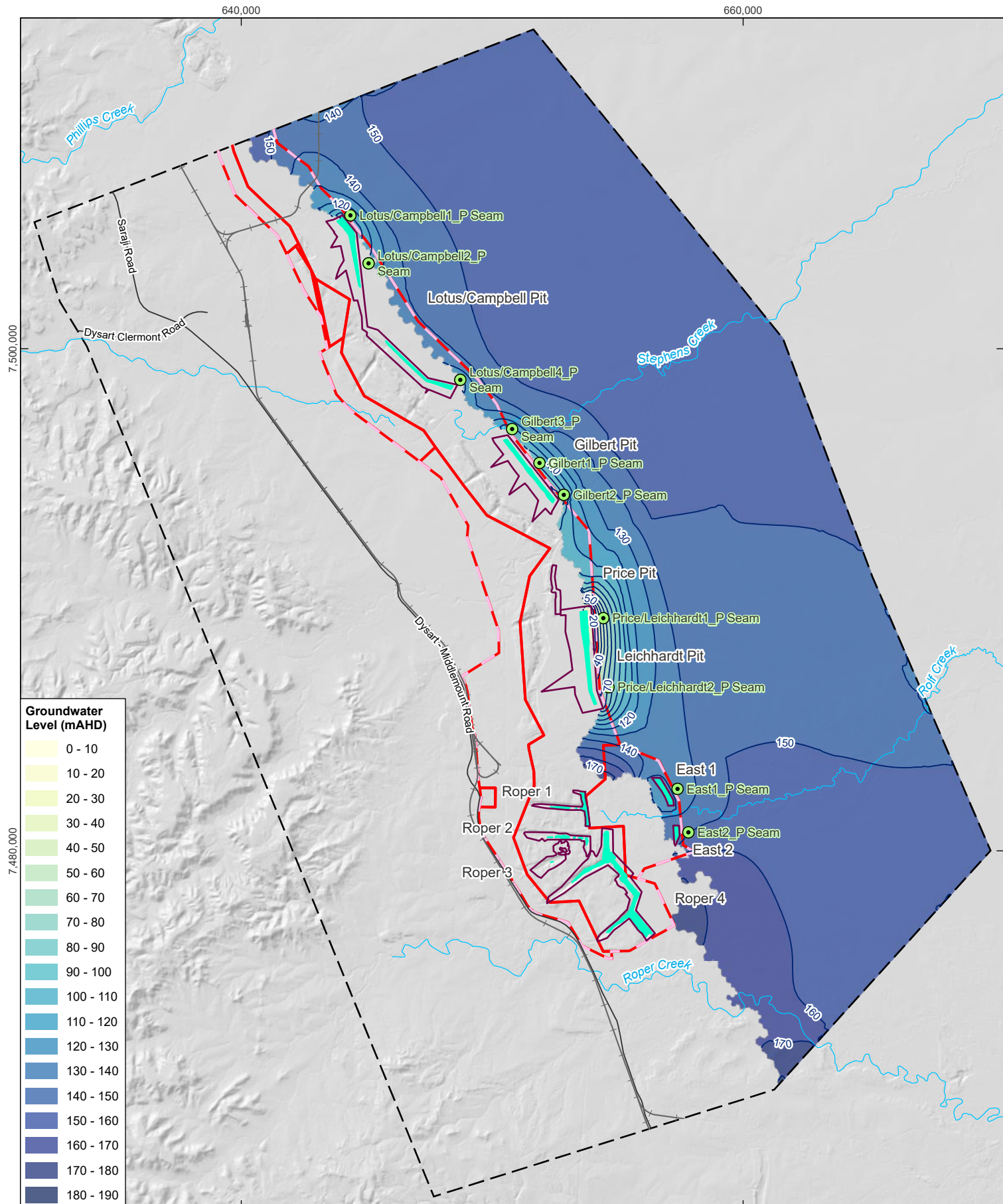


Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB



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FIGURE G-3



Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 31-May-2024
Drawn by: RB

LEGEND

- Hydrograph Location
- Railway
- Major Road
- Watercourse
- Model Boundary
- Groundwater Contour (mAHD)
- Void Extent
- Void Lake
- SSM Mine Lease
- SSM EA Boundary

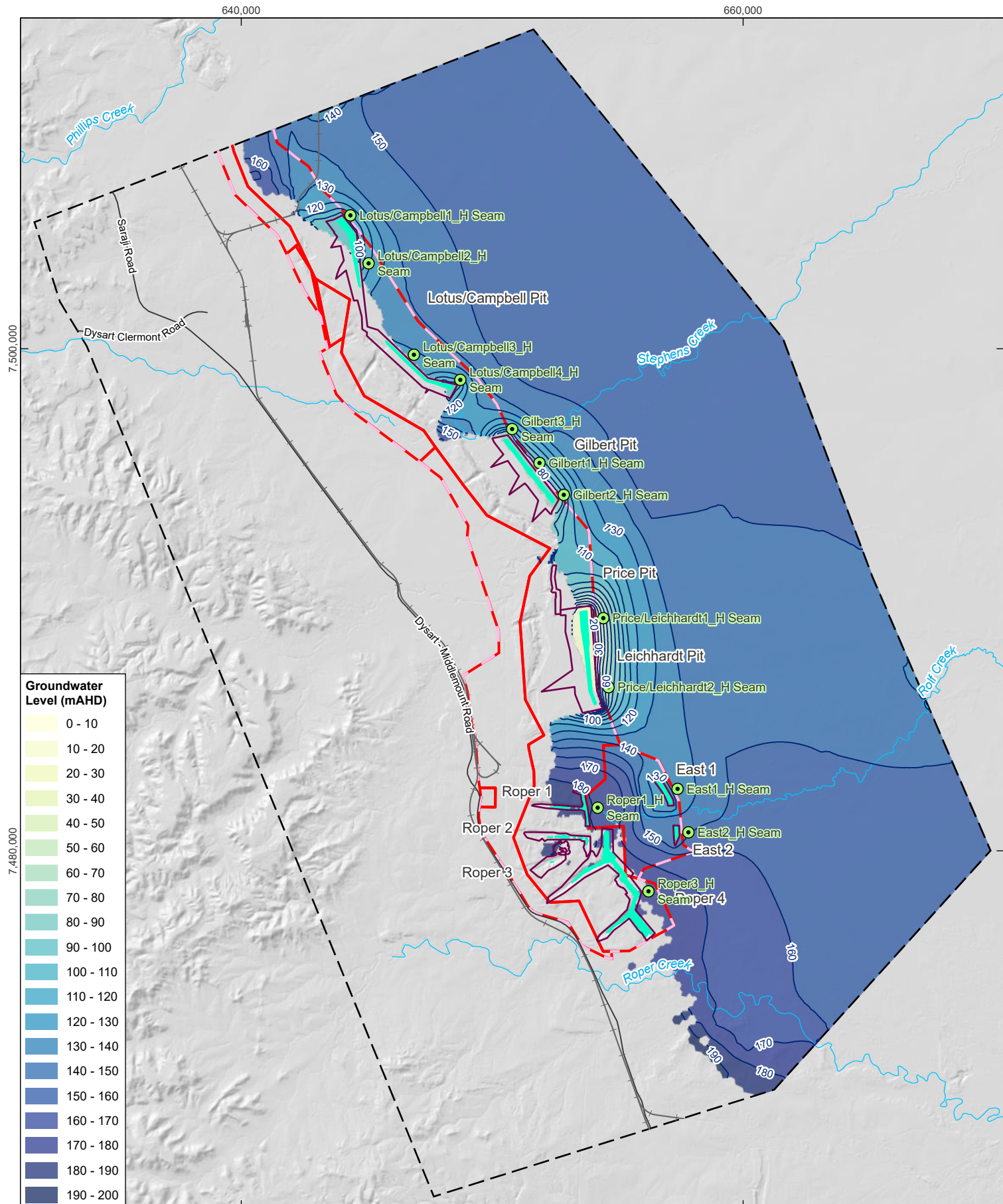
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE P SEAM (LAYER 8) – POST-MINING EQUILIBRIUM (WETTER CLIMATE SCENARIO)



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FIGURE G-4

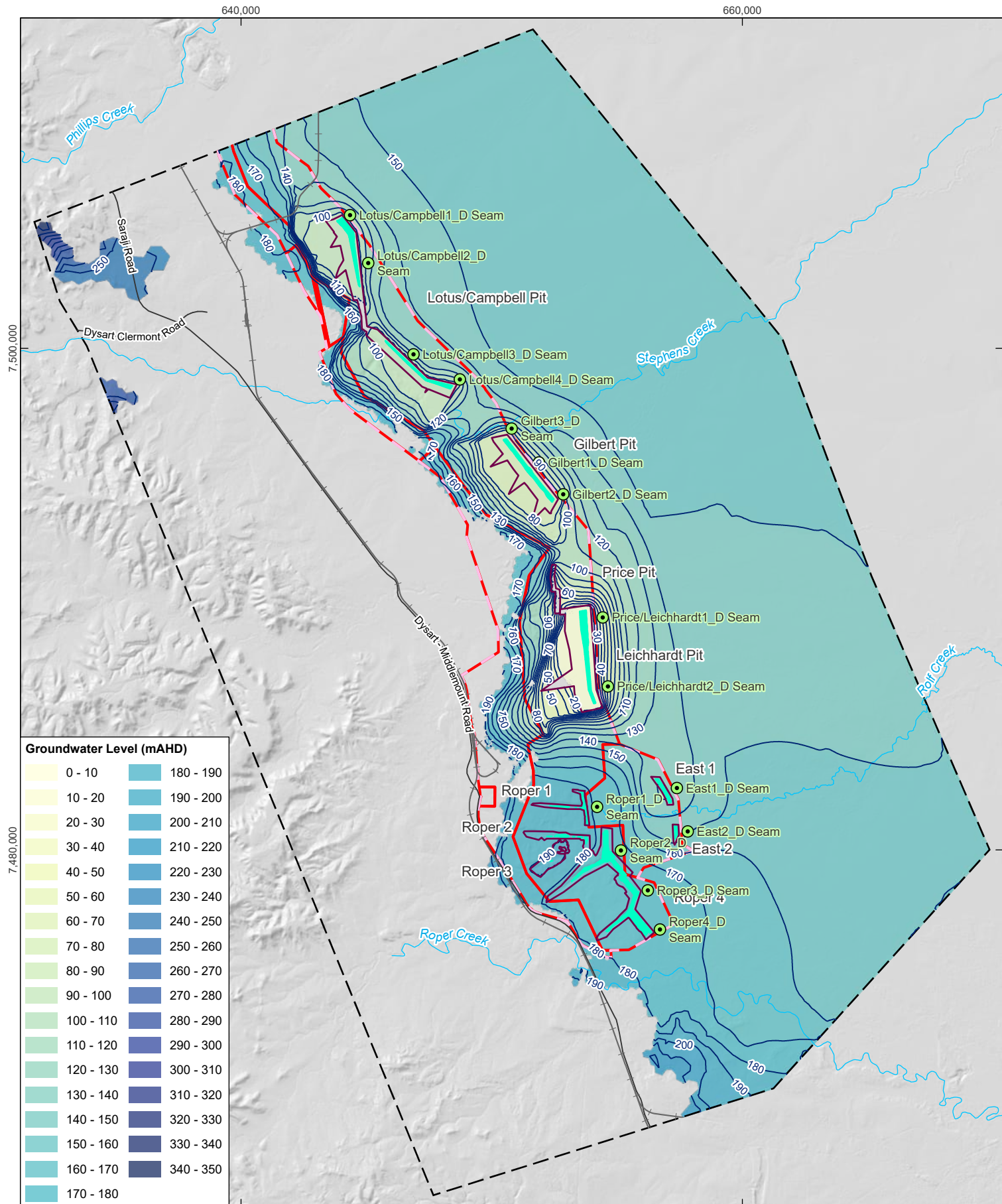


Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:200,000 at A4
Project Number: 620.314444.00000
Date Drawn: 31-May-2024
Drawn by: RB



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FIGURE G-5



 0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 31-May-2024
 Drawn by: RB

LEGEND

-  Hydrograph Location
-  Groundwater Contour (mAHD)
-  Railway
-  Void Extent
-  Major Road
-  Void Lake
-  Watercourse
-  SSM Mine Lease
-  Model Boundary
-  SSM EA Boundary

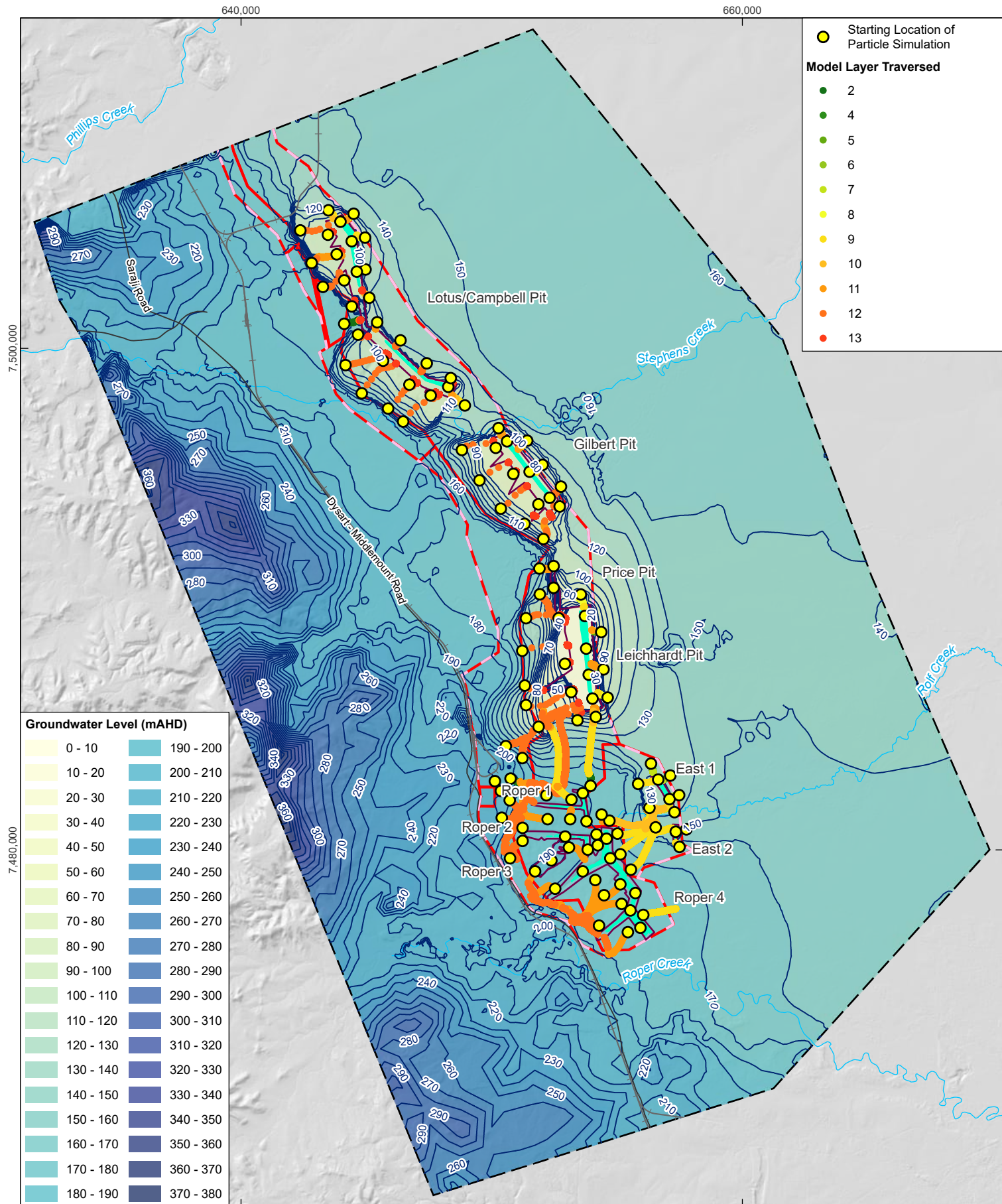
SARAJI SOUTH MINE GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN THE D SEAM (LAYER 12) – POST-MINING EQUILIBRIUM (WETTER CLIMATE SCENARIO)



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FIGURE G-6



- Starting Location of Particle Simulation
- Model Layer Traversed**
- 2
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
 - 13

Groundwater Level (mAHD)

0 - 10	190 - 200
10 - 20	200 - 210
20 - 30	210 - 220
30 - 40	220 - 230
40 - 50	230 - 240
50 - 60	240 - 250
60 - 70	250 - 260
70 - 80	260 - 270
80 - 90	270 - 280
90 - 100	280 - 290
100 - 110	290 - 300
110 - 120	300 - 310
120 - 130	310 - 320
130 - 140	320 - 330
140 - 150	330 - 340
150 - 160	340 - 350
160 - 170	350 - 360
170 - 180	360 - 370
180 - 190	370 - 380

0 2.5 5 km
 Coordinate System: GDA 1994 MGA Zone 55
 Scale: 1:200,000 at A4
 Project Number: 620.314444.00000
 Date Drawn: 16-Jul-2024
 Drawn by: RB

- LEGEND**
- Railway
 - Major Road
 - Watercourse
 - Model Boundary
 - Groundwater Contour (mAHD)
 - Void Extent
 - Void Lake
 - SSM Mine Lease
 - SSM EA Boundary

**SARAJI SOUTH MINE
GROUNDWATER MODELLING
TECHNICAL REPORT**

**PREDICTED MOVEMENT OF PARTICLES
(WETTER CLIMATE SCENARIO)**



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FIGURE G-7

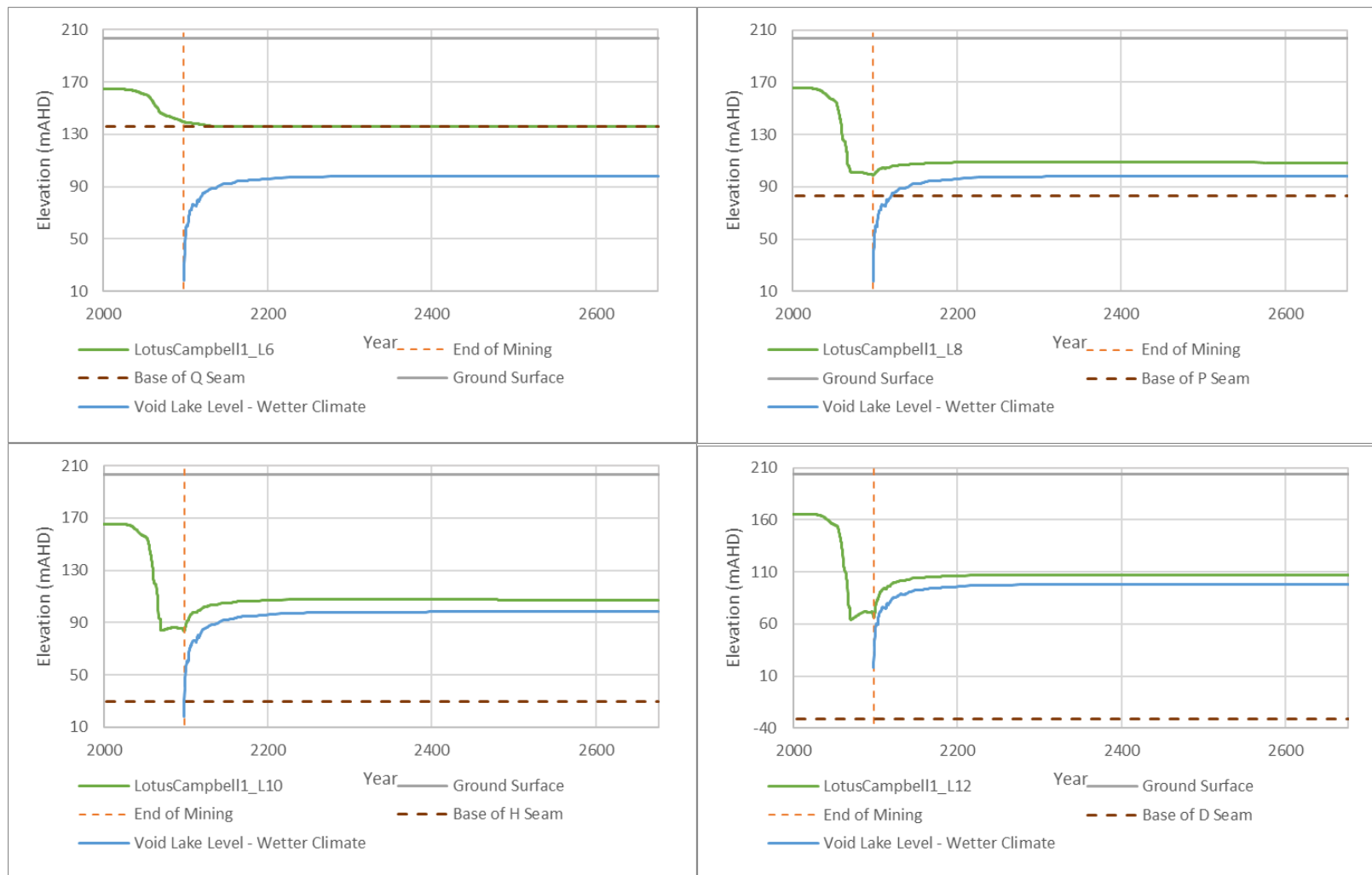


Figure G-8 Coal Measures Predictive Hydrographs adjacent LotusCampbell Void (north) (Wetter Climate)



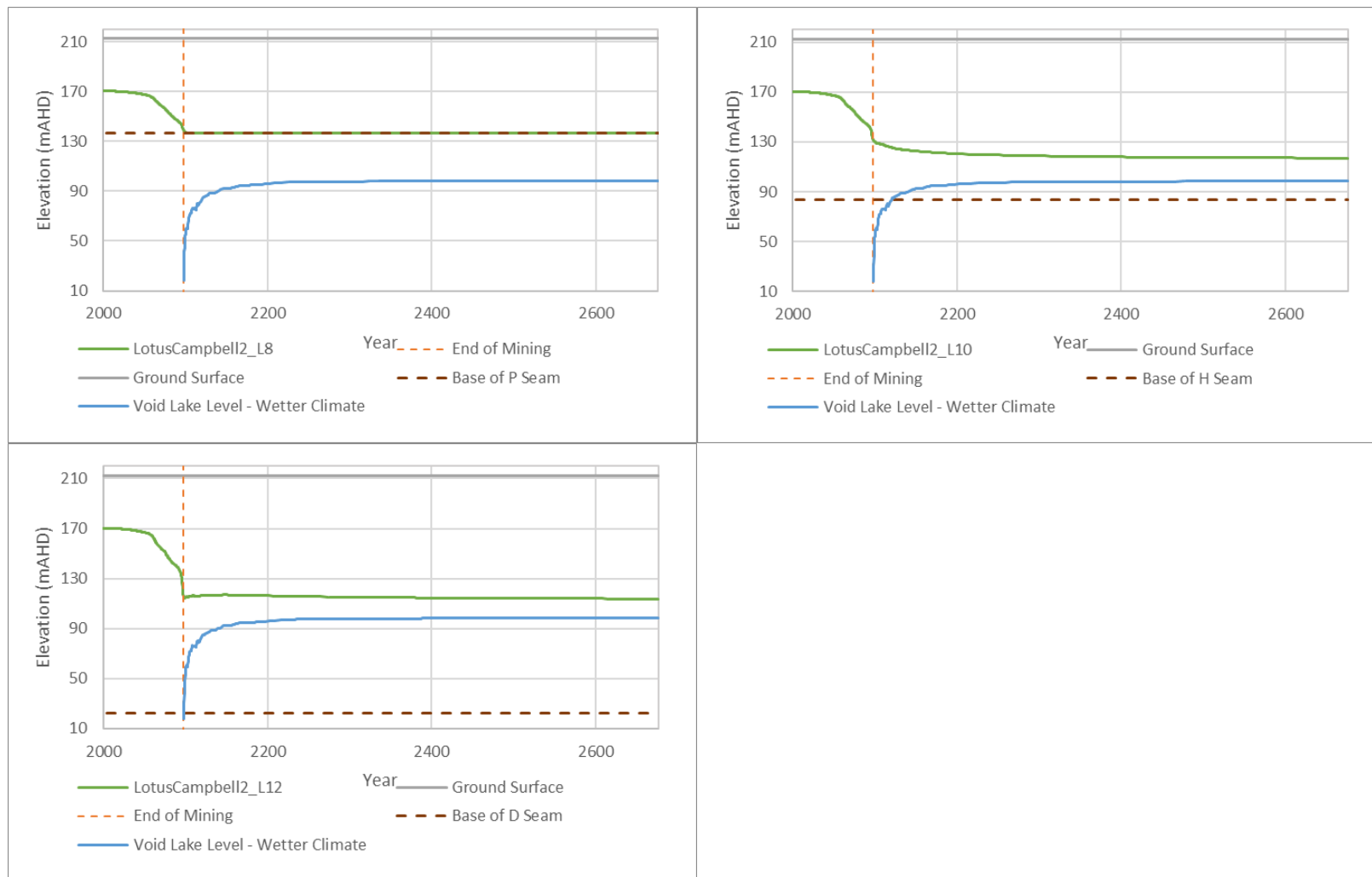


Figure G-9 Coal Measures Predictive Hydrographs adjacent LotusCampbell Void (centre1) (Wetter Climate)



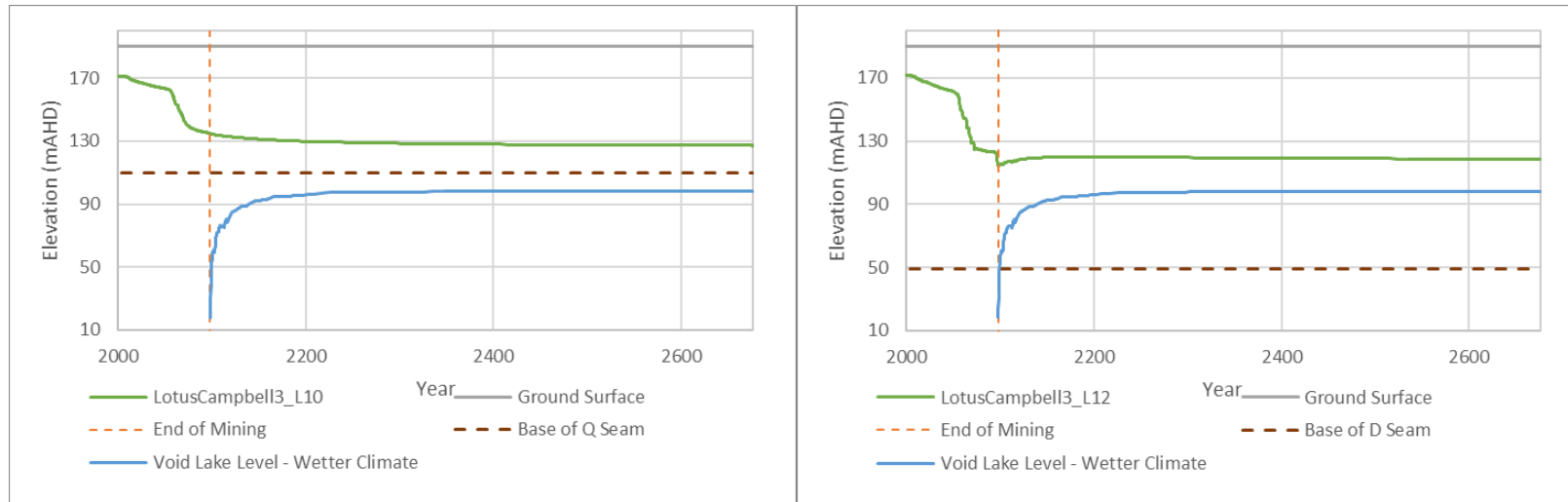


Figure G-10 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (centre2) (Wetter Climate)



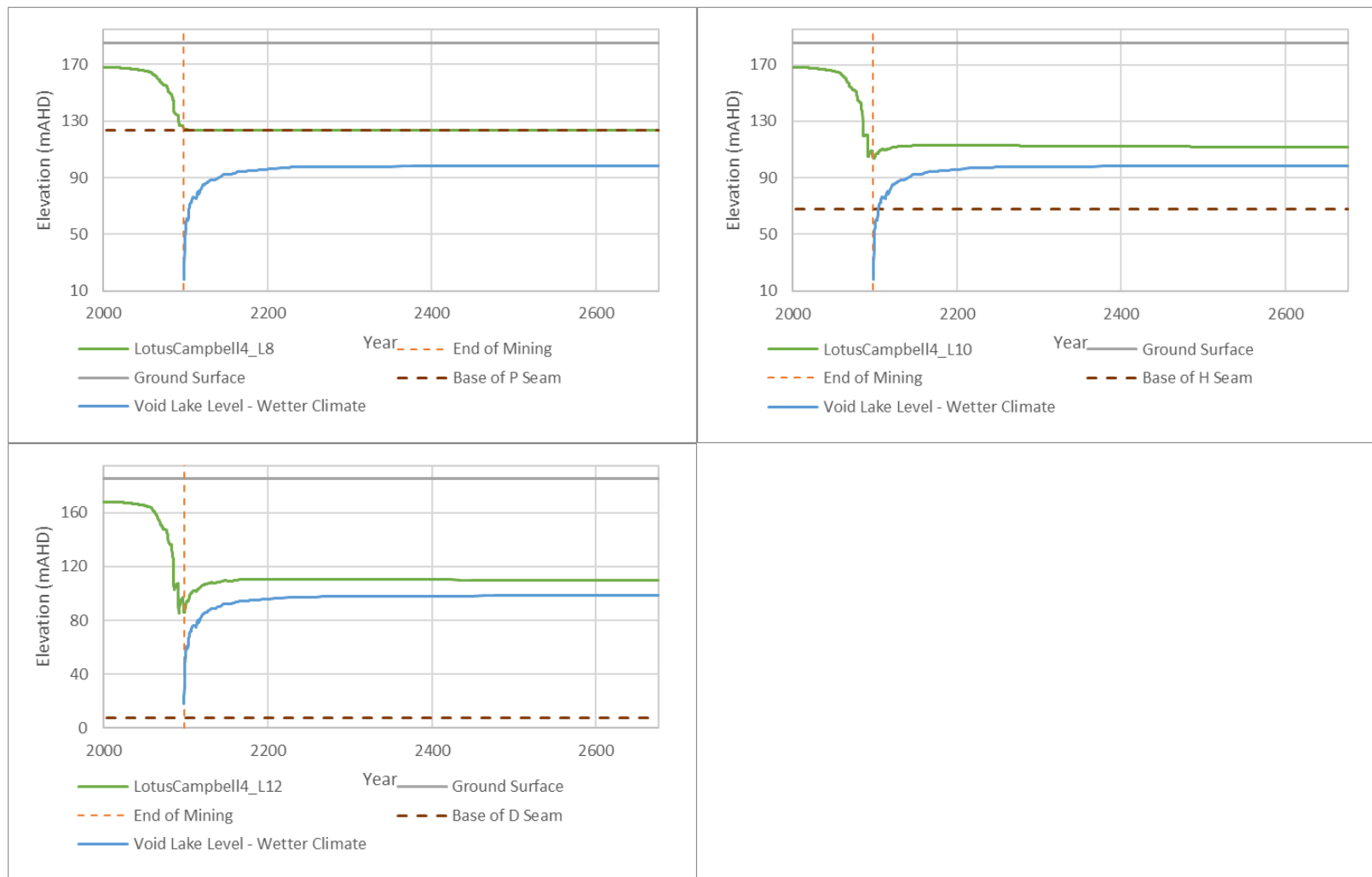


Figure G-11 Coal Measures Predictive Hydrographs adjacent Lotus\Campbell Void (south) (Wetter Climate)



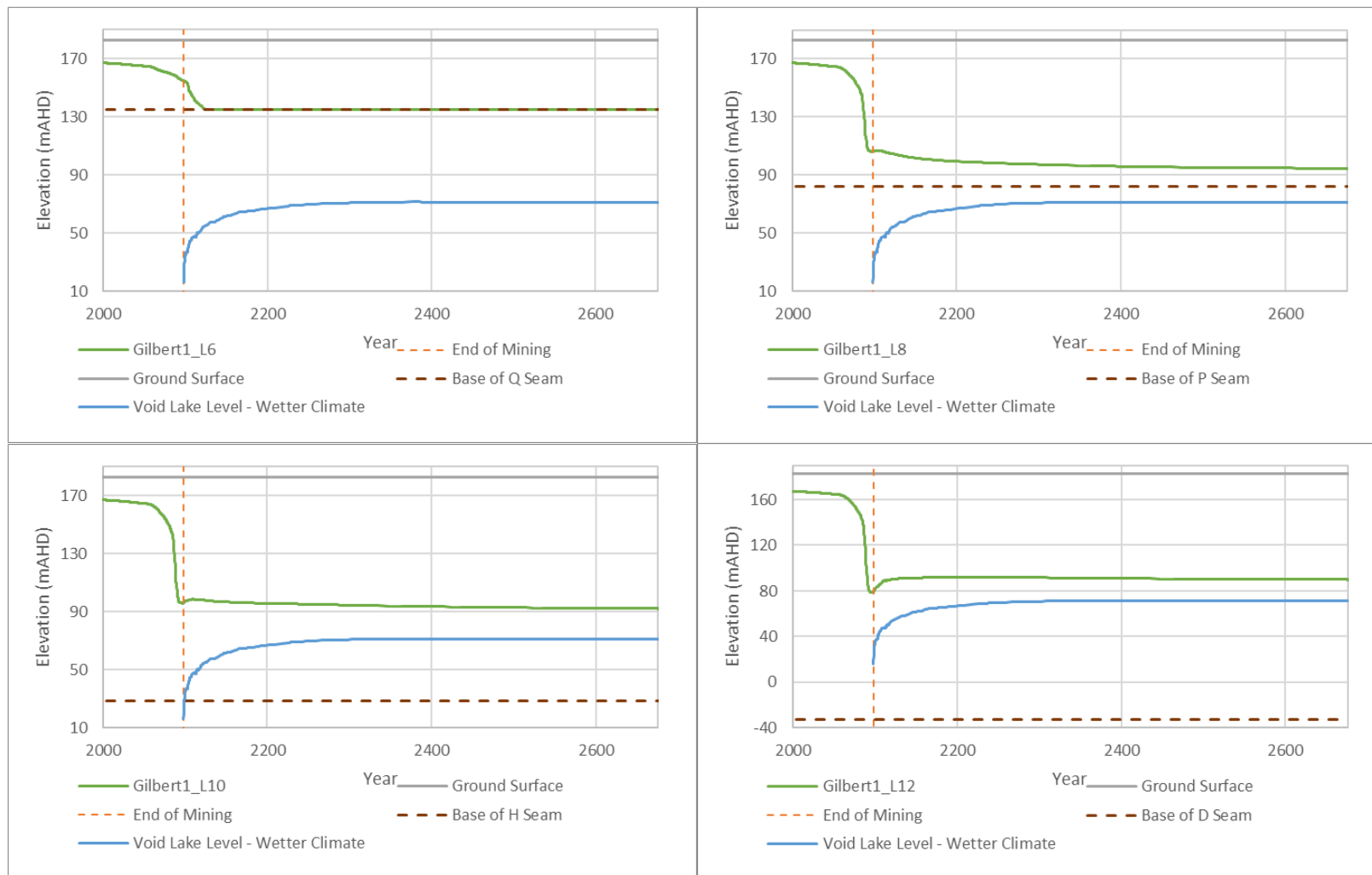


Figure G-12 Coal Measures Predictive Hydrographs adjacent Gilbert Void (north) (Wetter Climate)



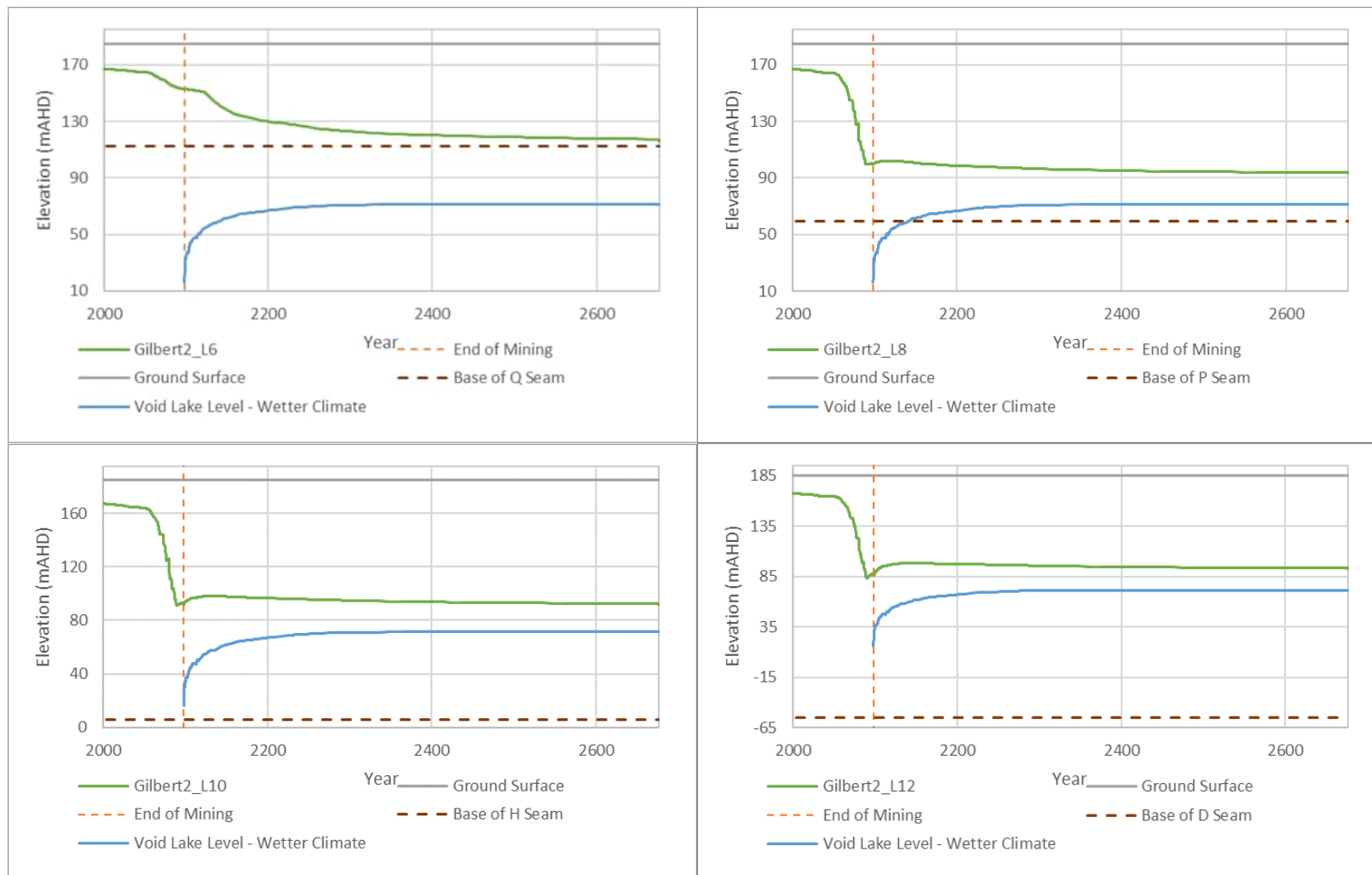


Figure G-13 Coal Measures Predictive Hydrographs adjacent Gilbert Void (centre) (Wetter Climate)



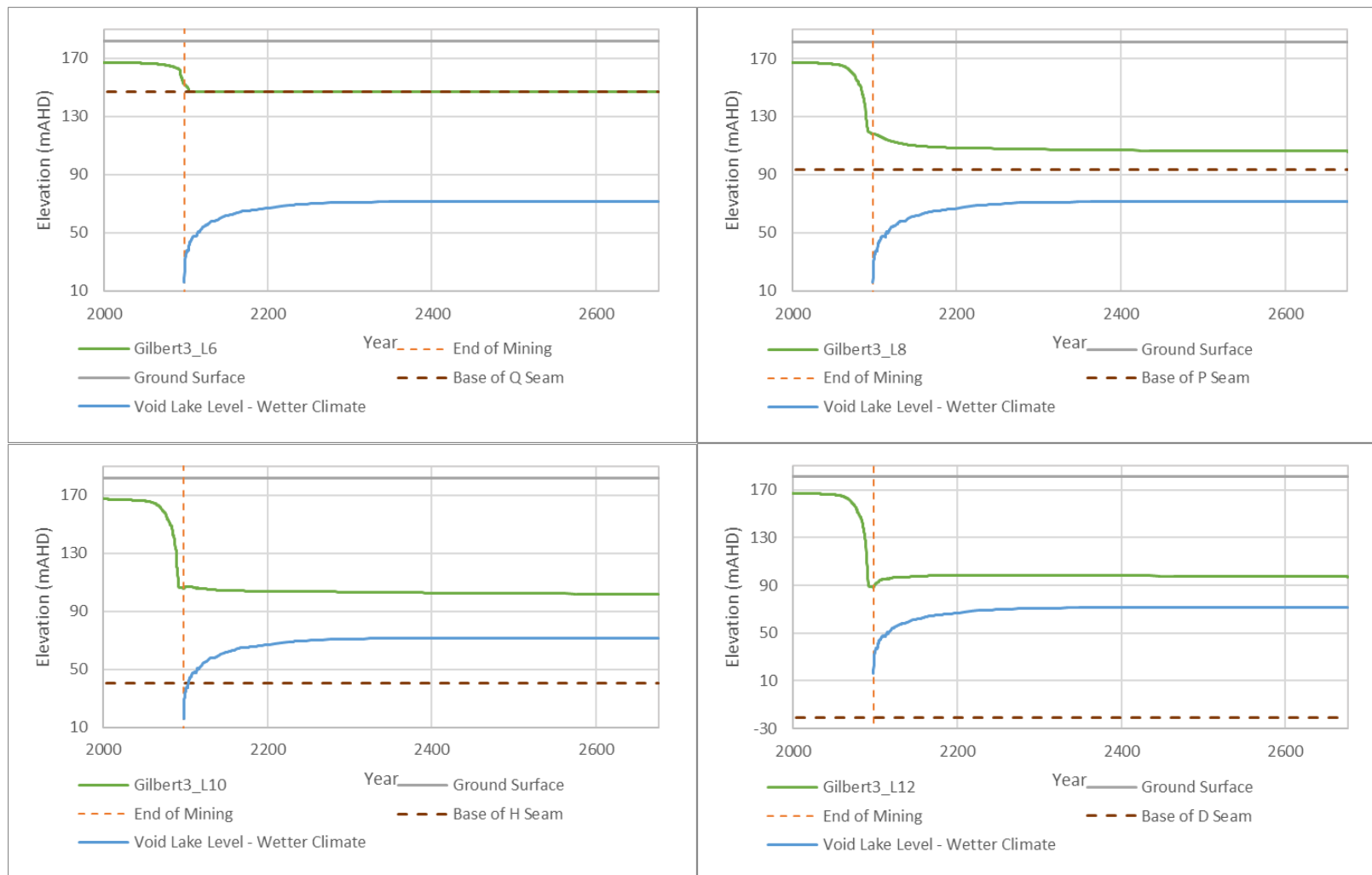


Figure G-14 Coal Measures Predictive Hydrographs adjacent Gilbert Void (south) (Wetter Climate)



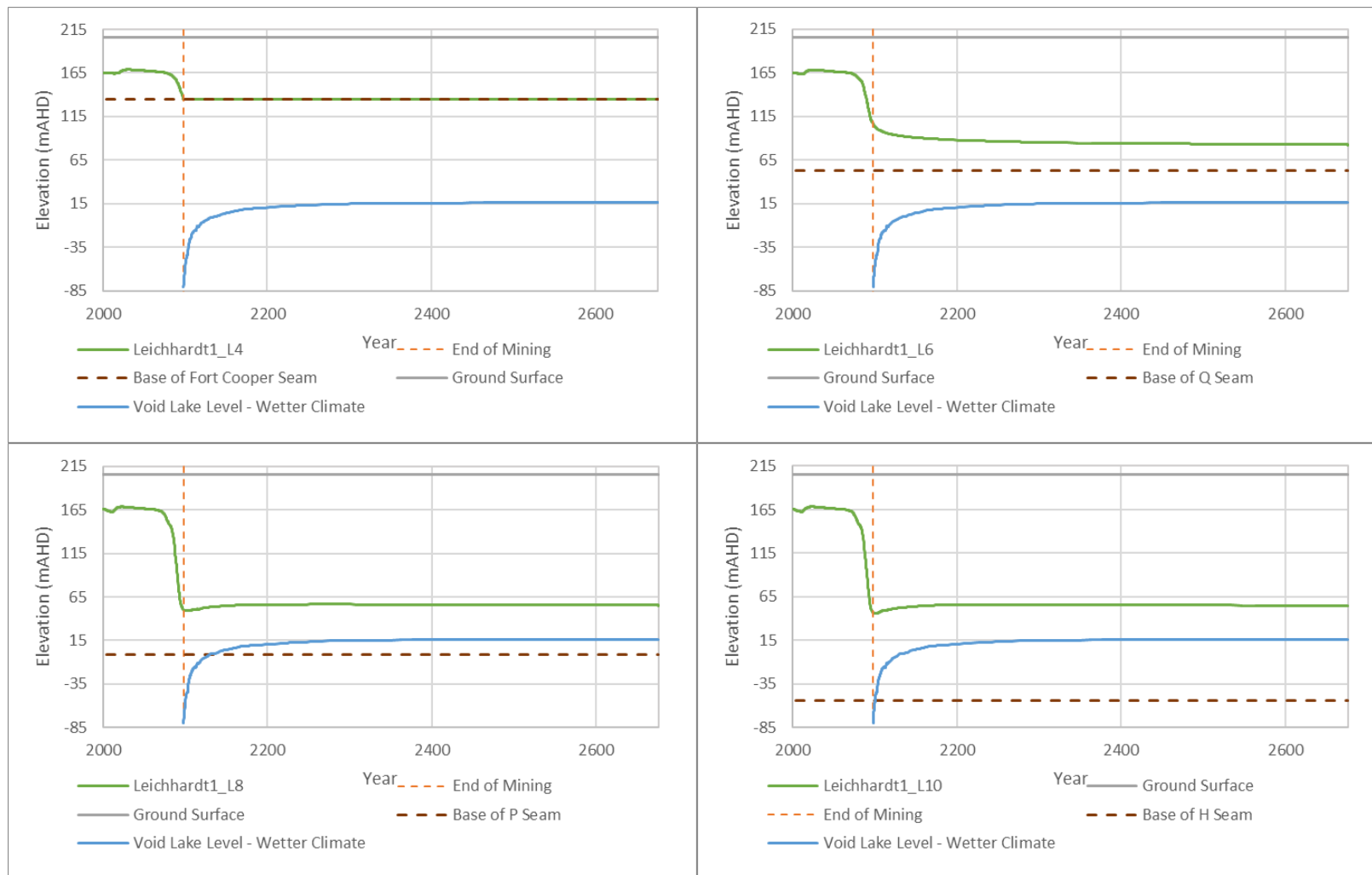


Figure G-15 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (north) (Wetter Climate)



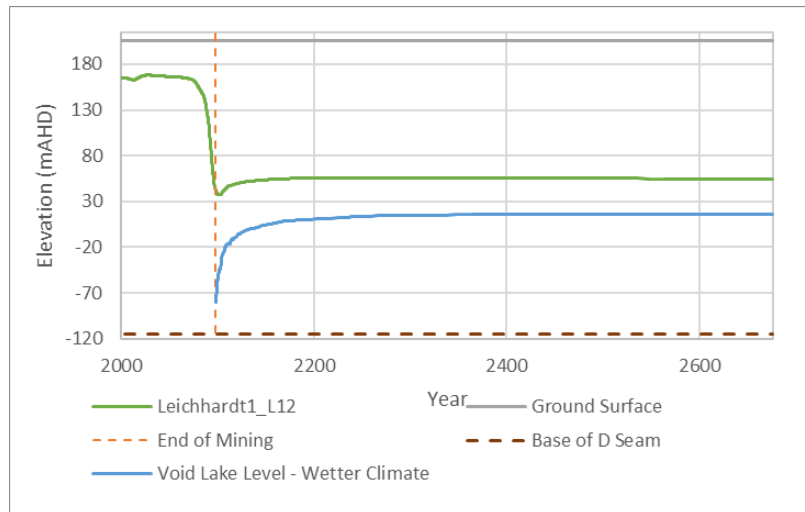


Figure G-15 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (north) (Wetter Climate) (cont.)



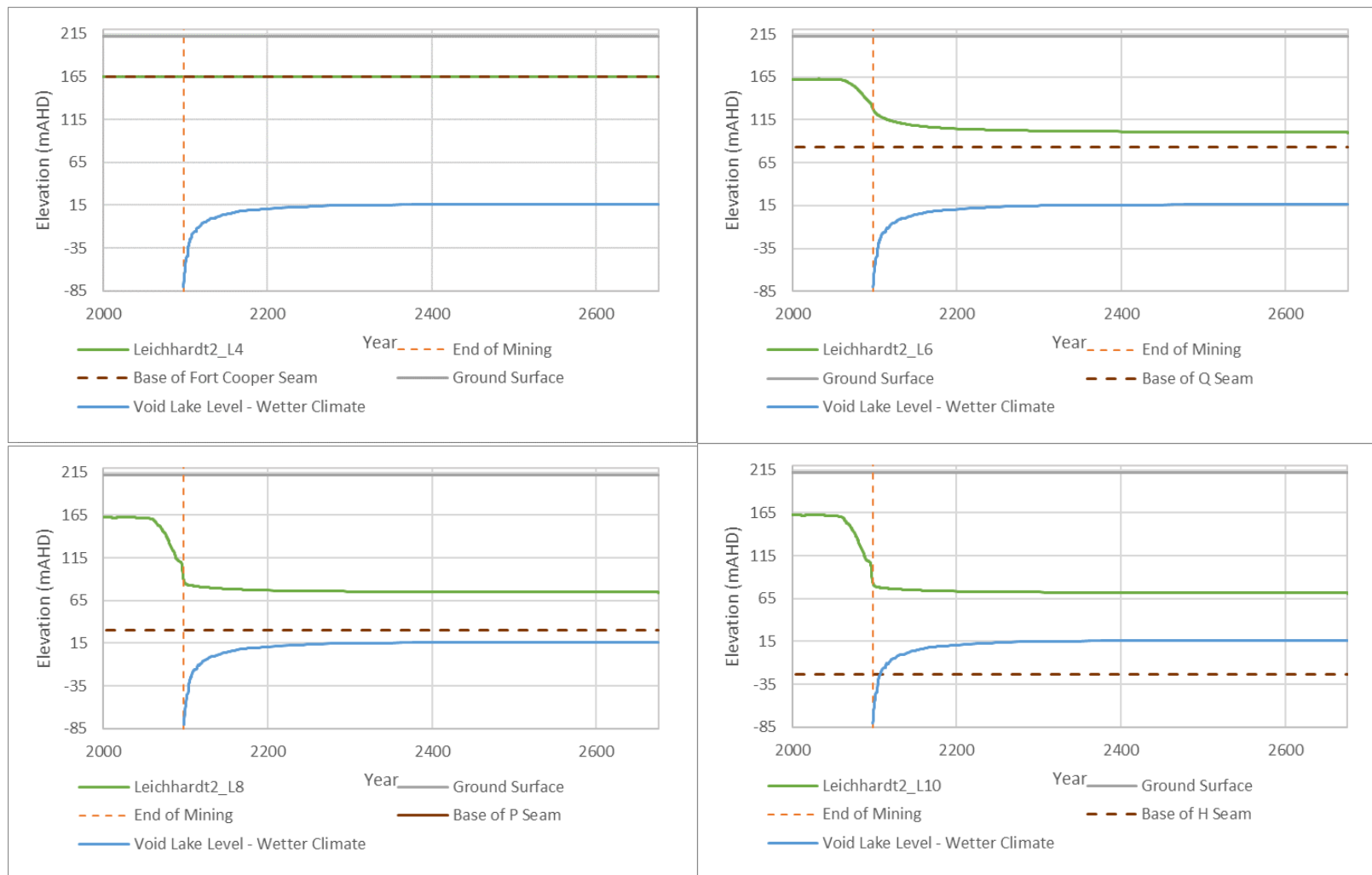


Figure G-16 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (south) (Wetter Climate)



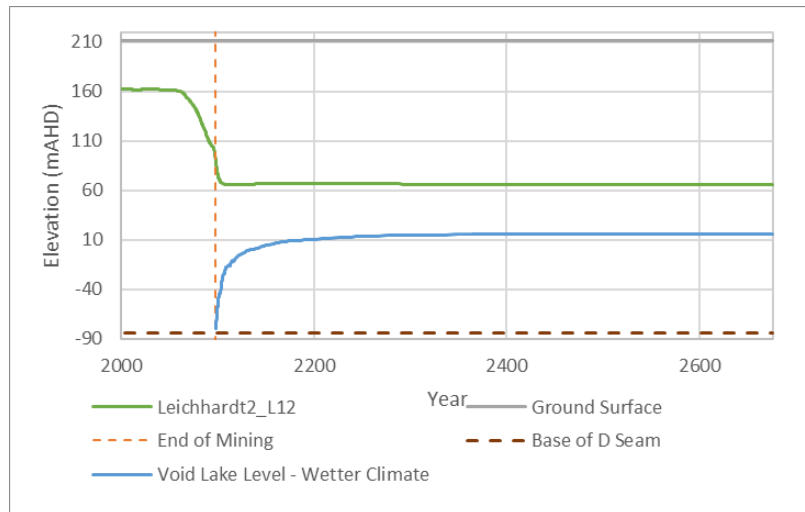


Figure G-16 Coal Measures Predictive Hydrographs adjacent Price\Leichardt Void (south) (Wetter Climate) (cont.)



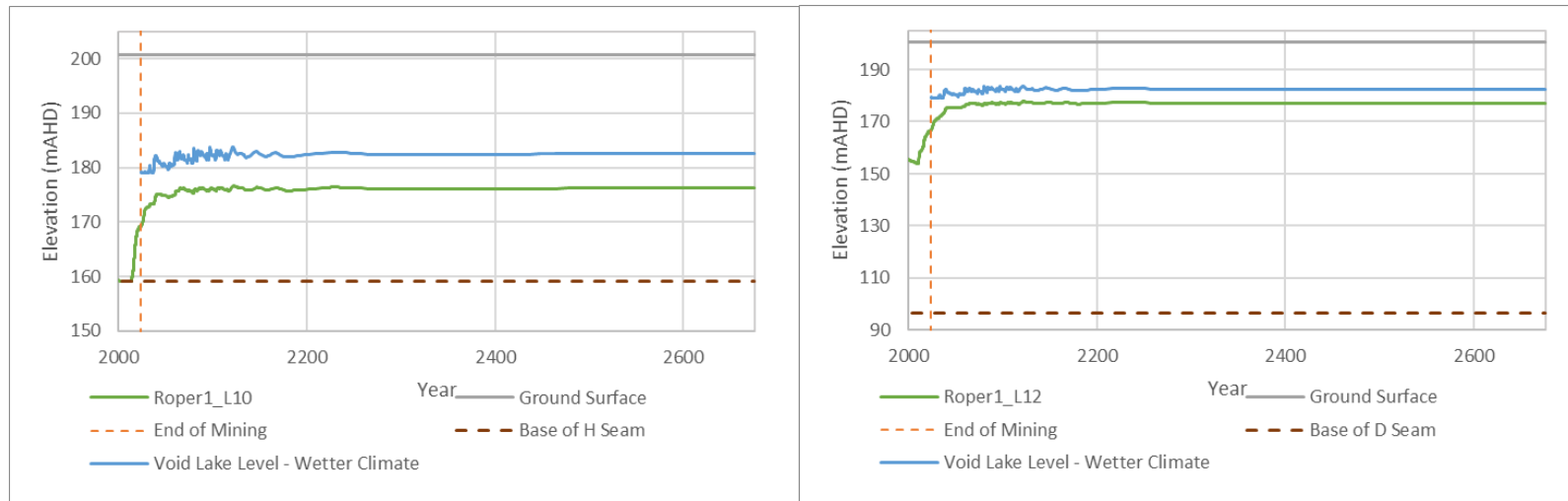


Figure G-17 Coal Measures Predictive Hydrographs adjacent Roper Voids (north) (Wetter Climate)



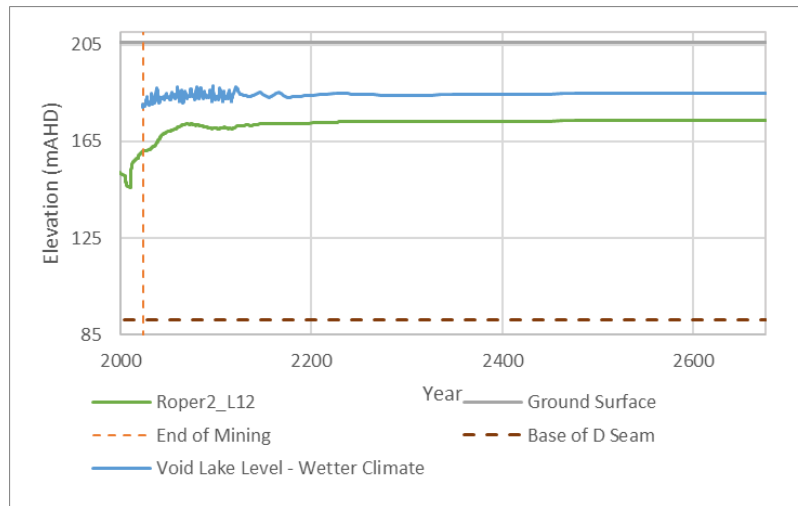


Figure G-18 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 1) (Wetter Climate)



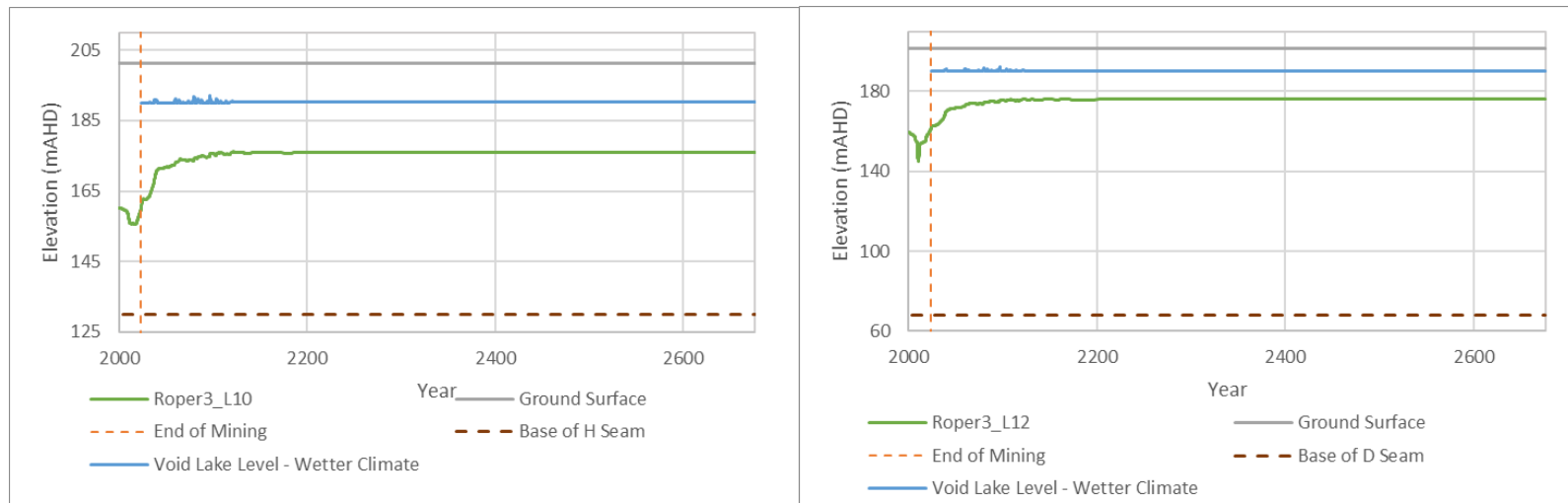


Figure G-19 Coal Measures Predictive Hydrographs adjacent Roper Voids (centre 2) (Wetter Climate)



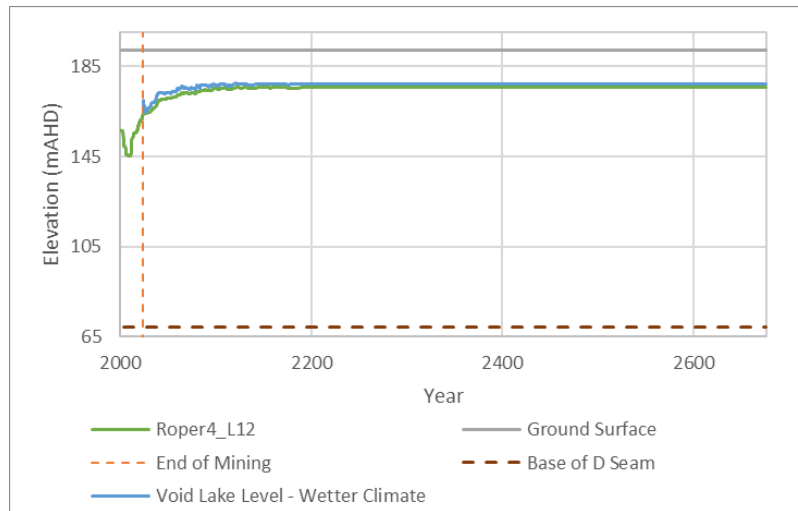


Figure G-20 Coal Measures Predictive Hydrographs adjacent Roper Voids (south) (Wetter Climate)



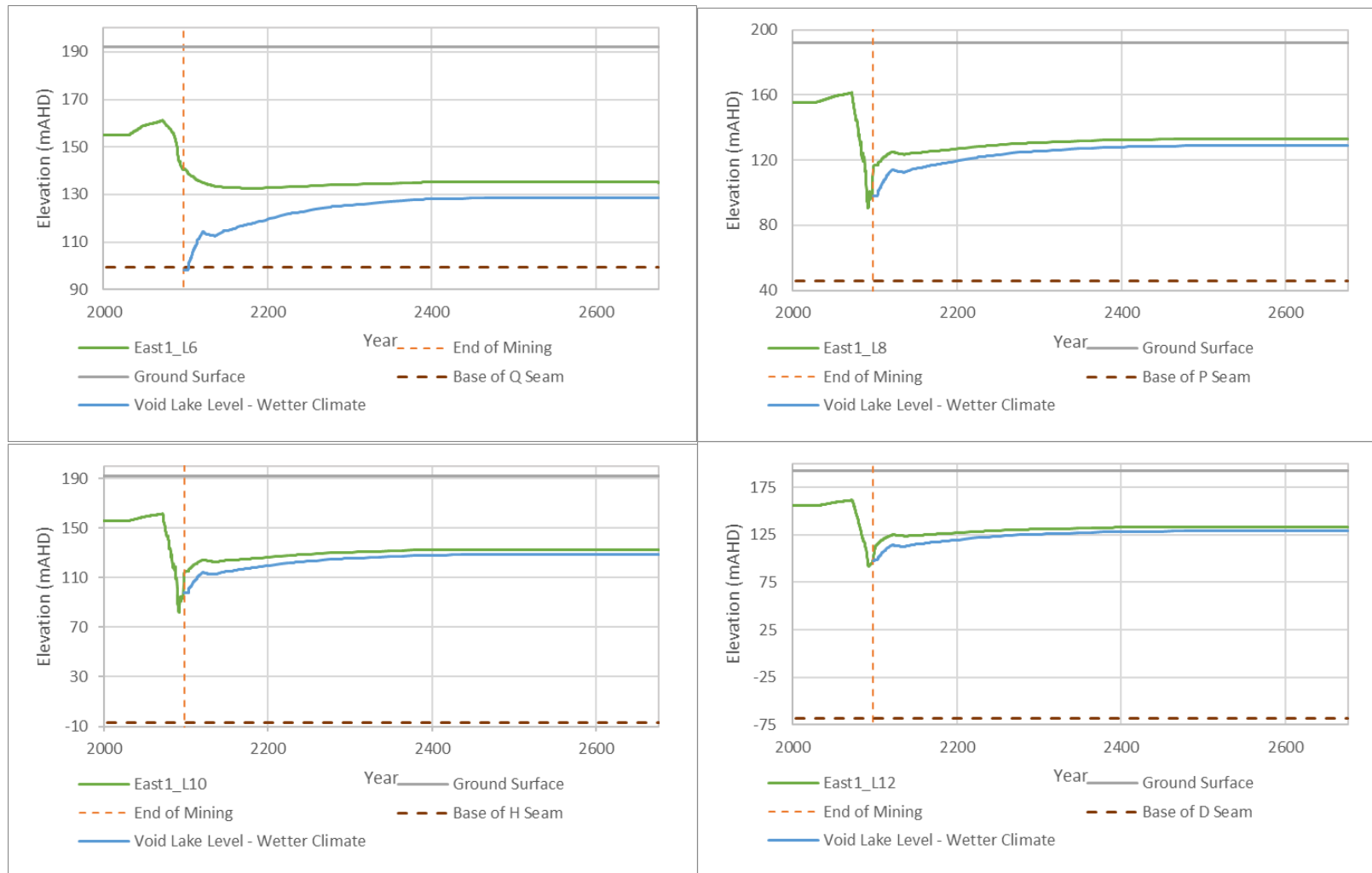


Figure G-21 Coal Measures Predictive Hydrographs adjacent East1 Void (Wetter Climate)



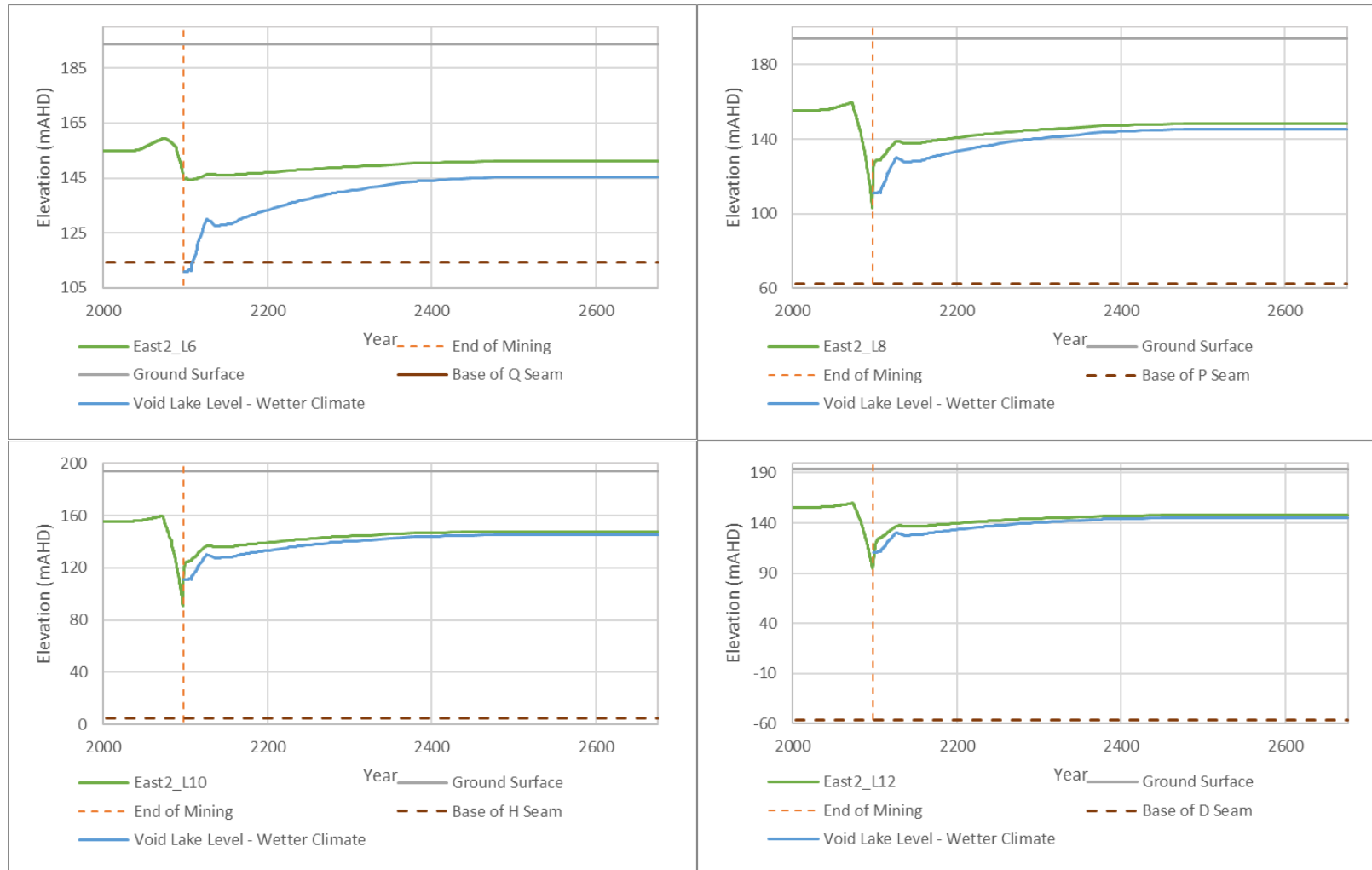
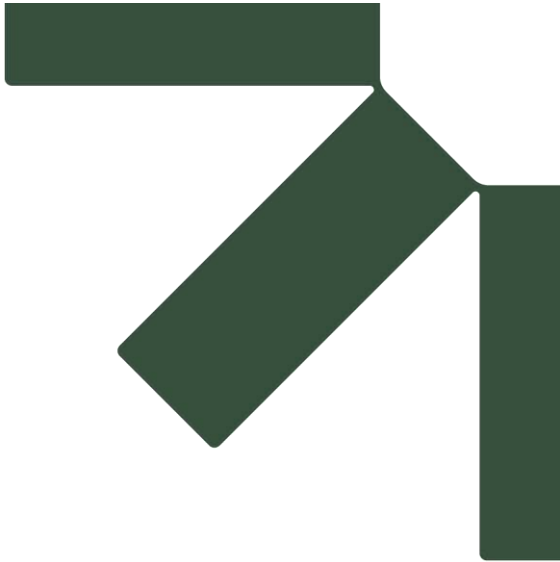


Figure G-22 Coal Measures Predictive Hydrographs adjacent East2 Void (Wetter Climate)





Appendix H Appendix H PEST IES Parameters Distribution

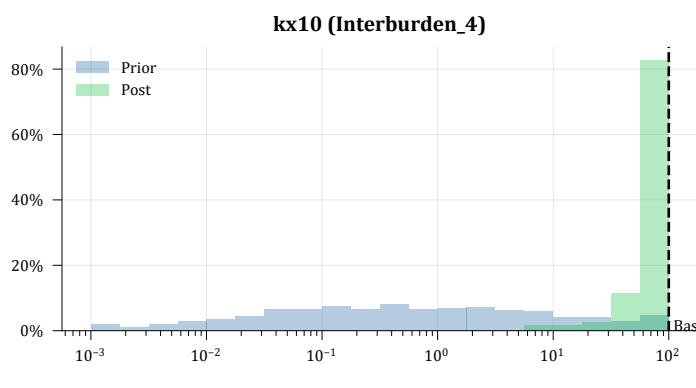
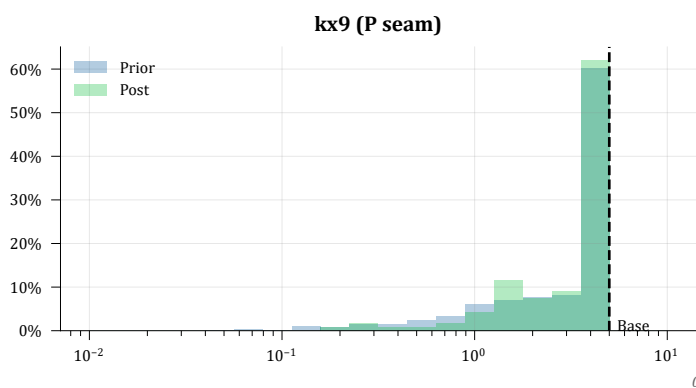
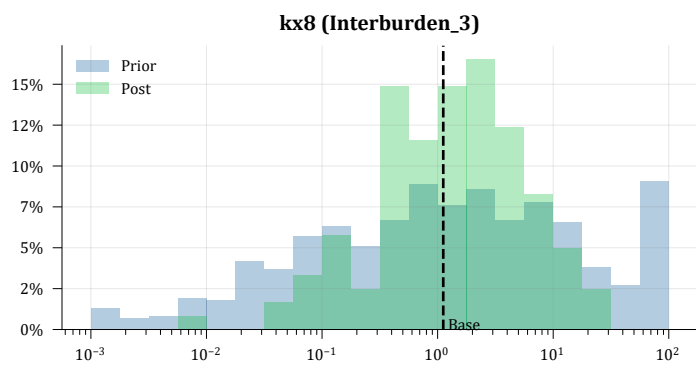
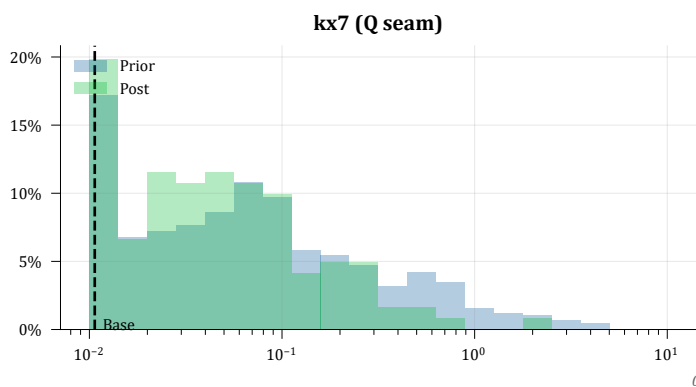
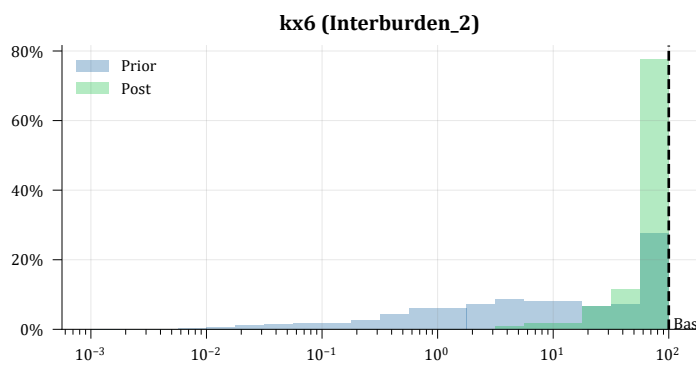
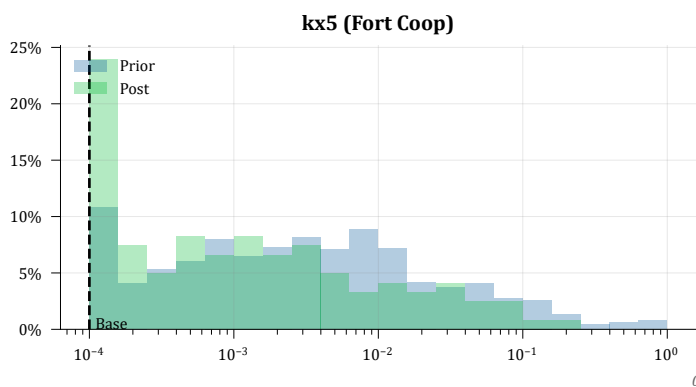
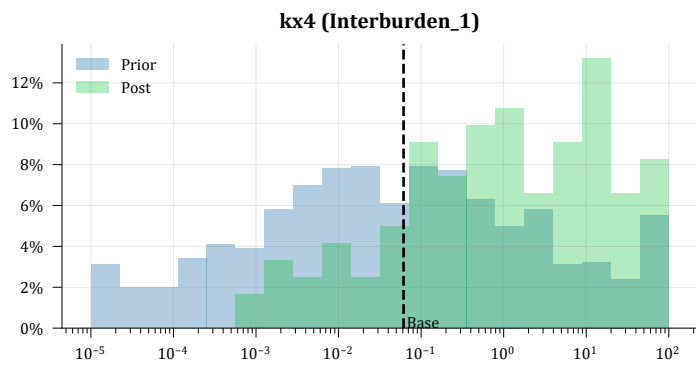
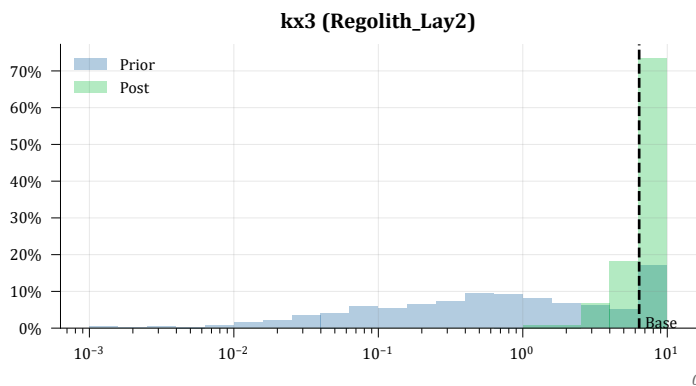
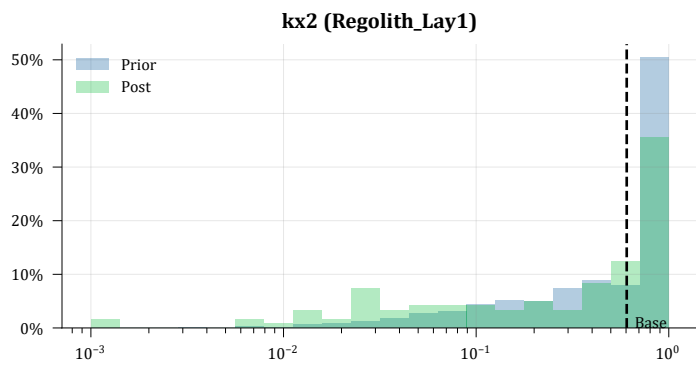
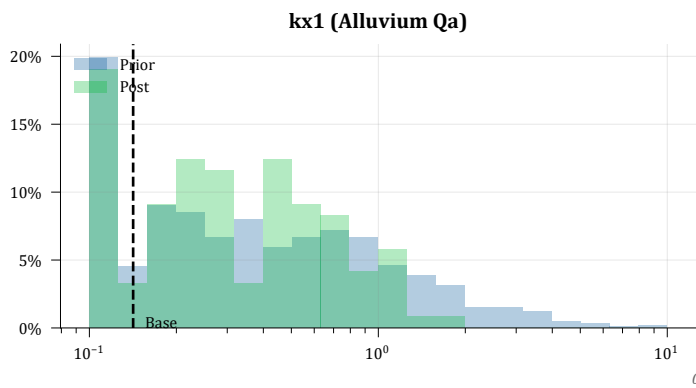
Saraji South Mine

Groundwater Modelling Technical Report

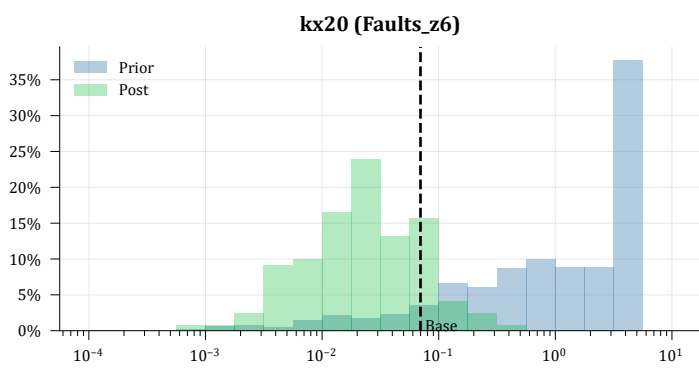
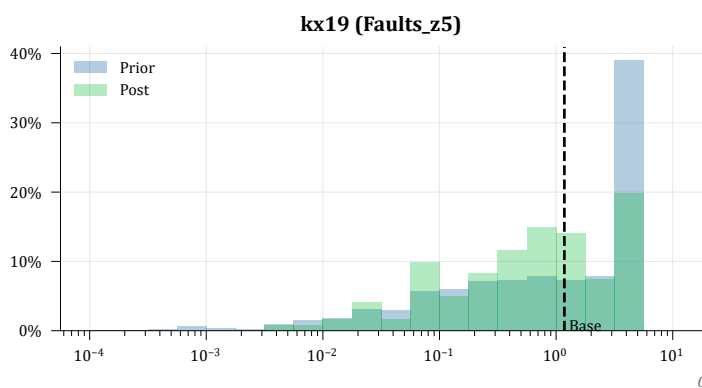
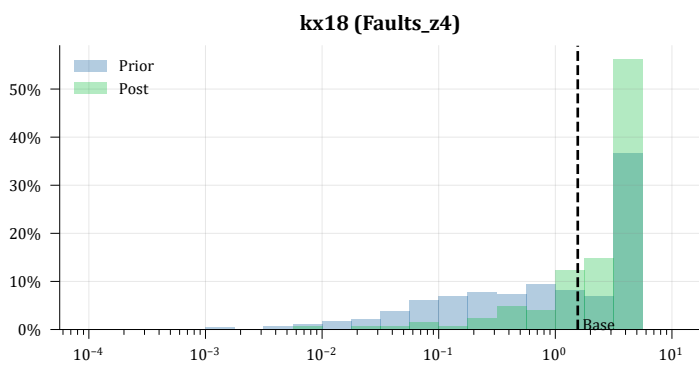
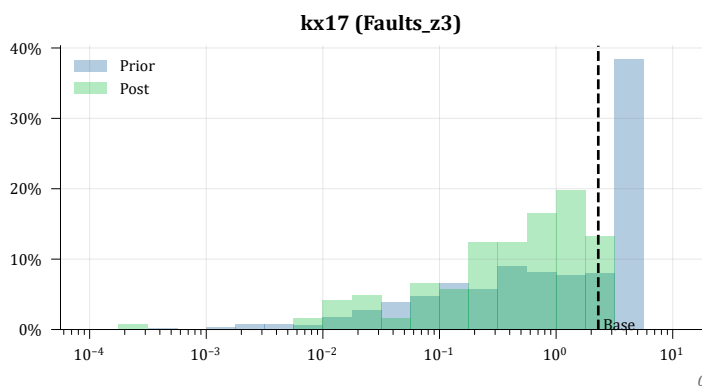
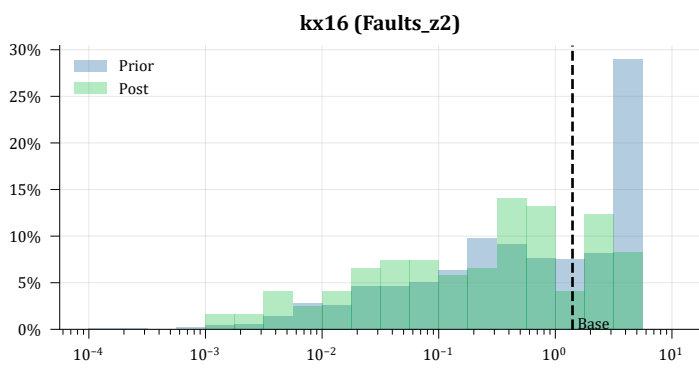
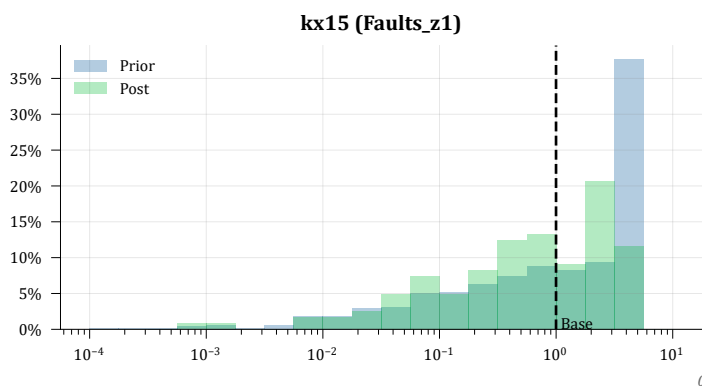
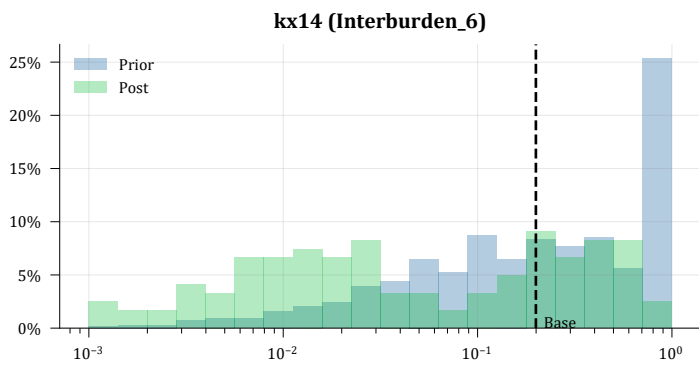
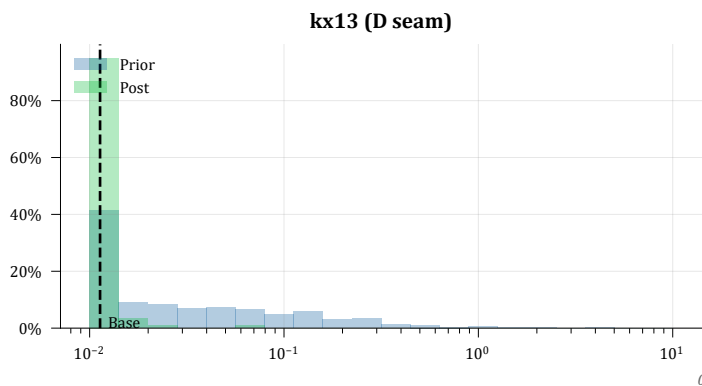
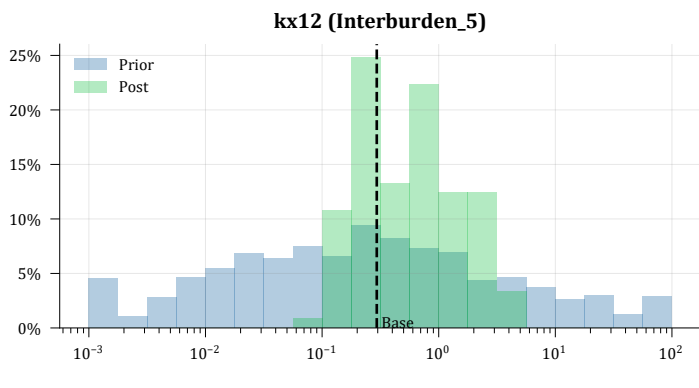
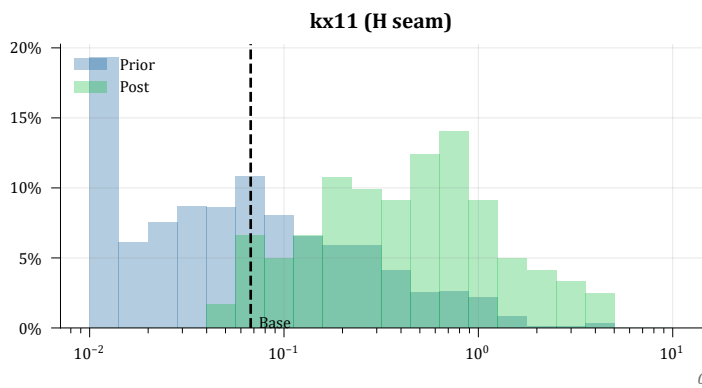
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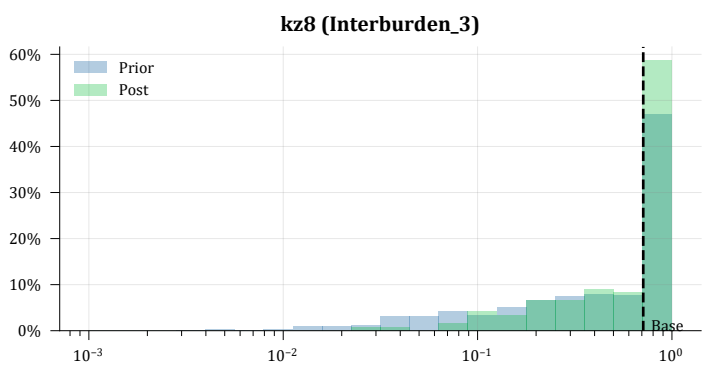
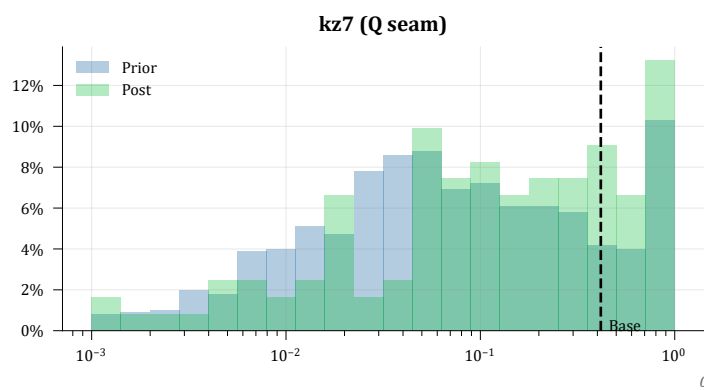
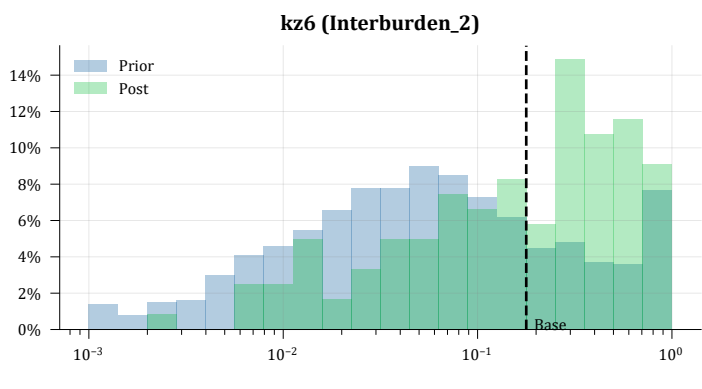
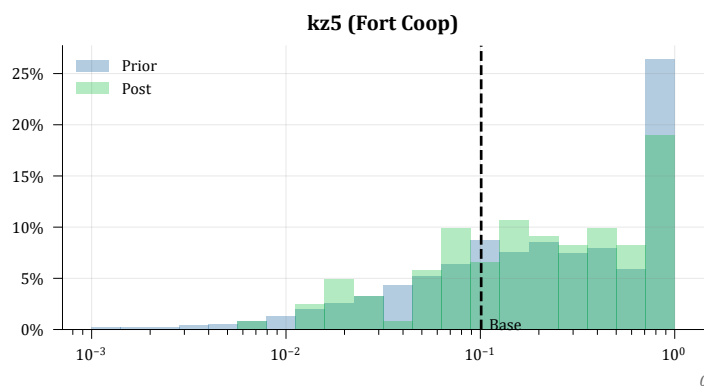
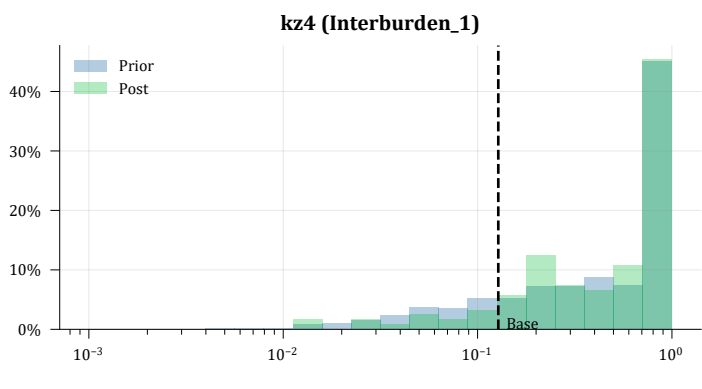
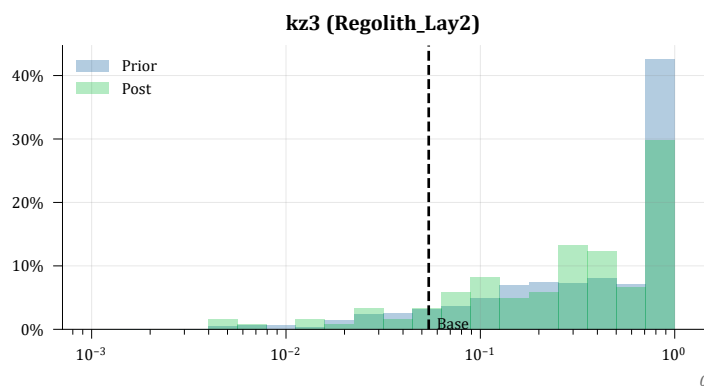
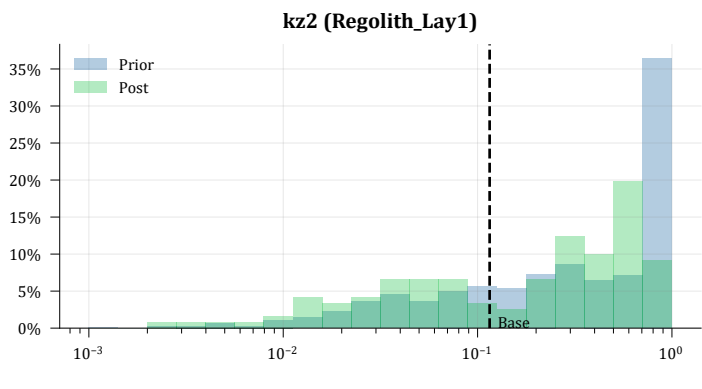
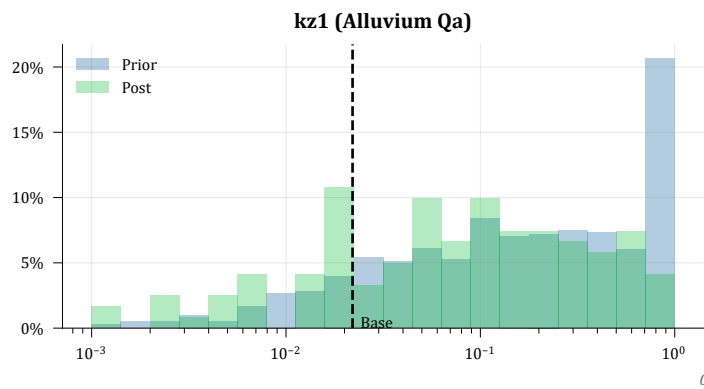
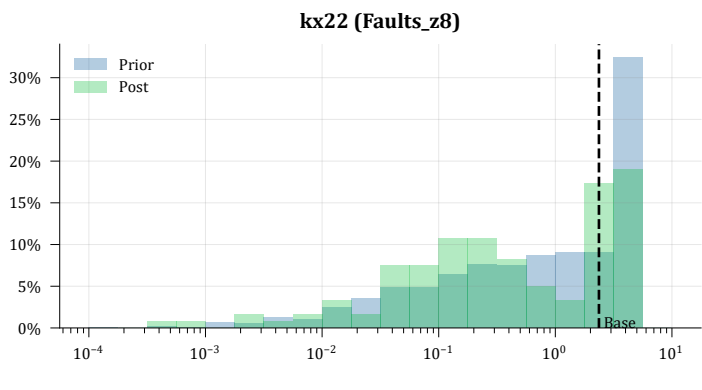
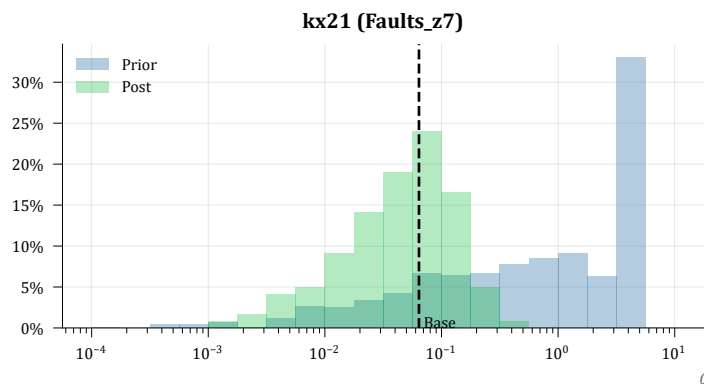
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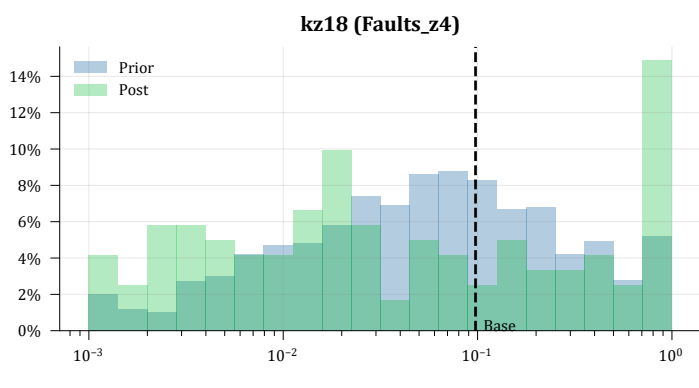
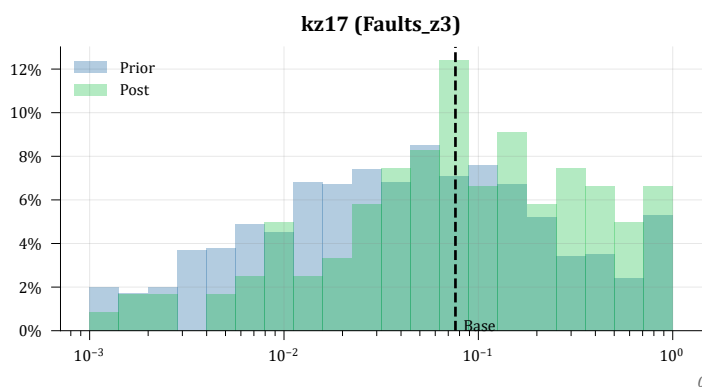
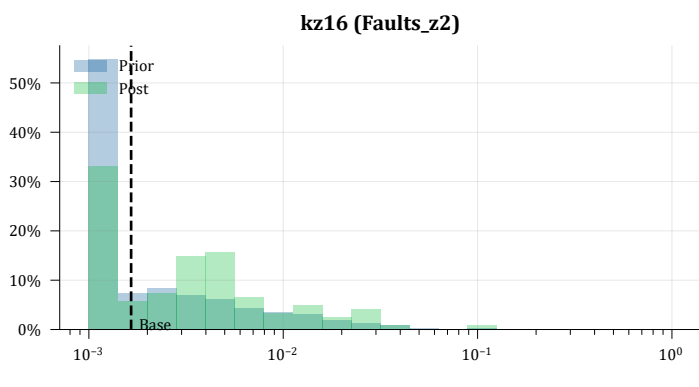
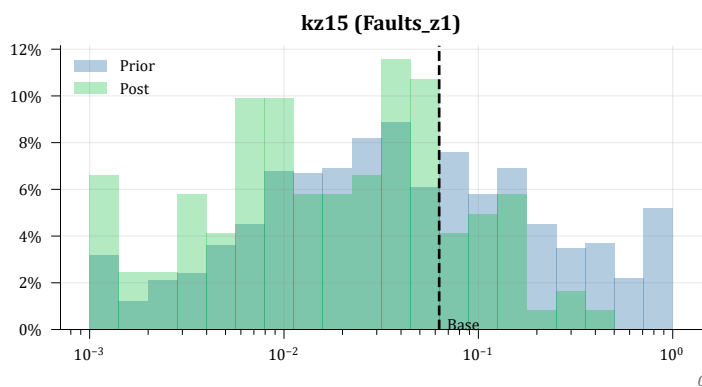
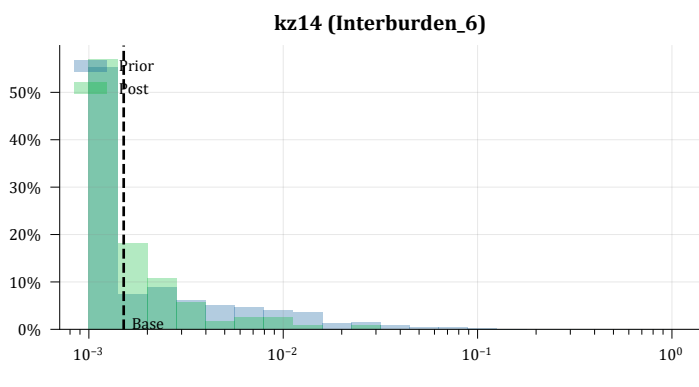
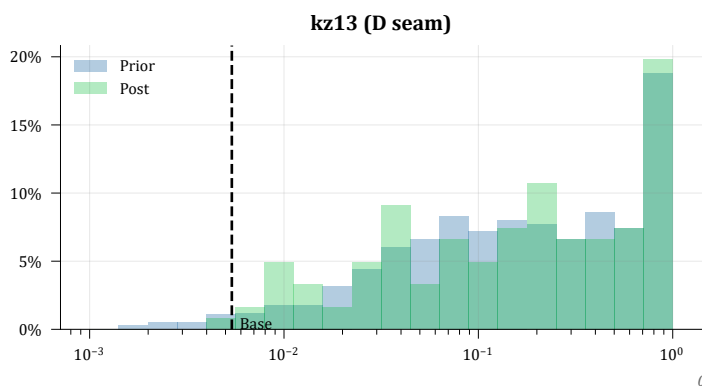
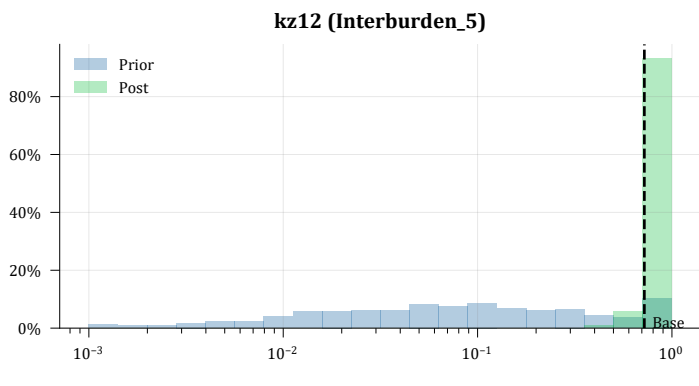
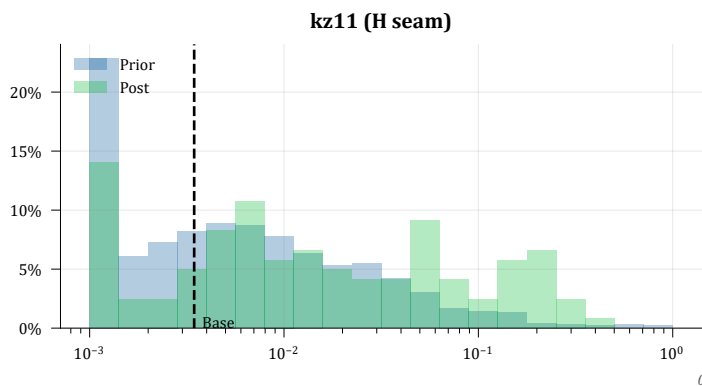
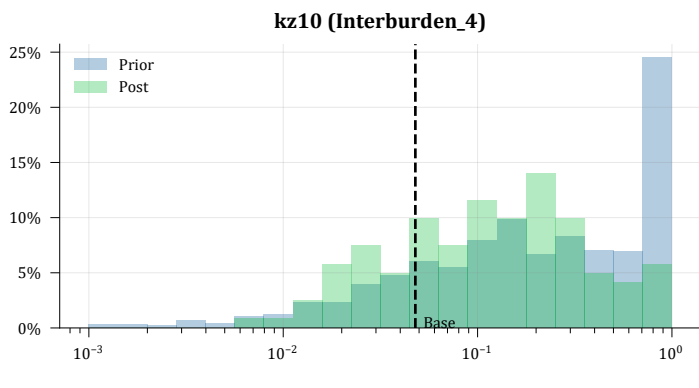
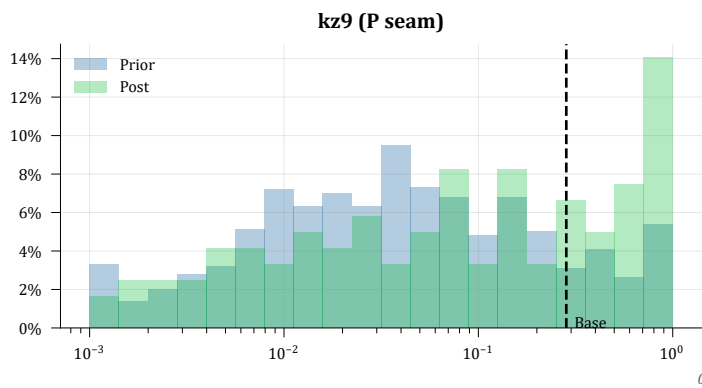
22 August 2024

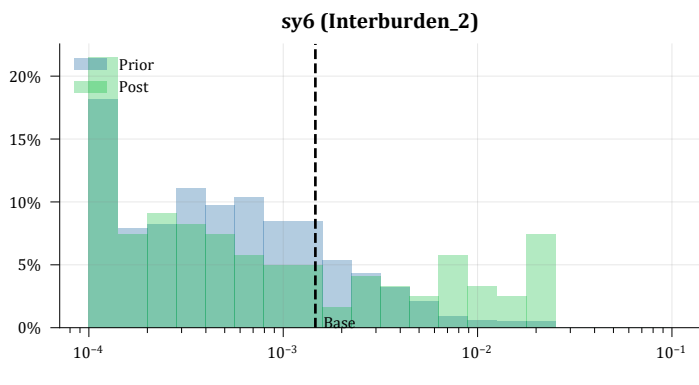
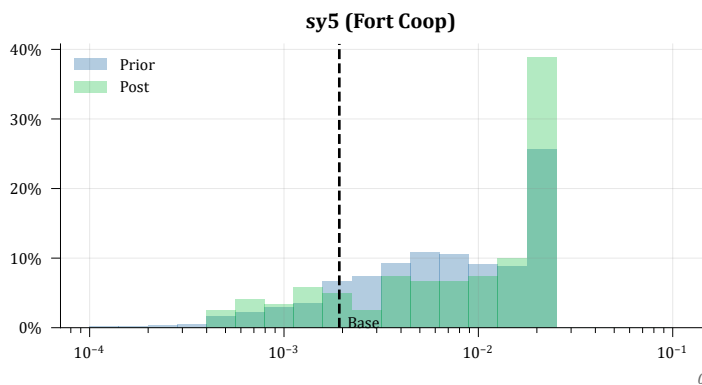
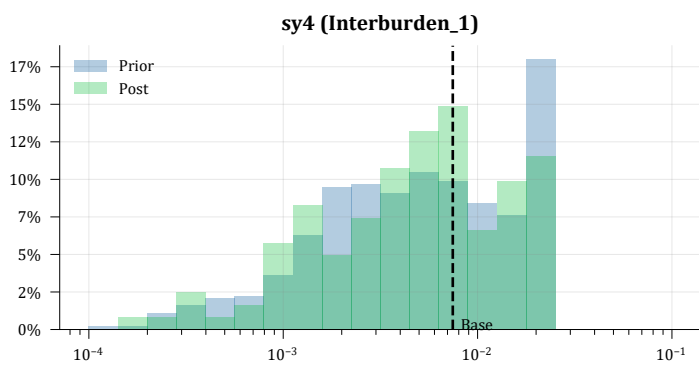
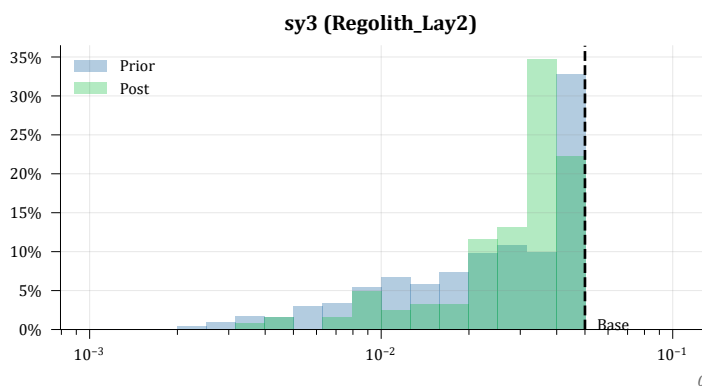
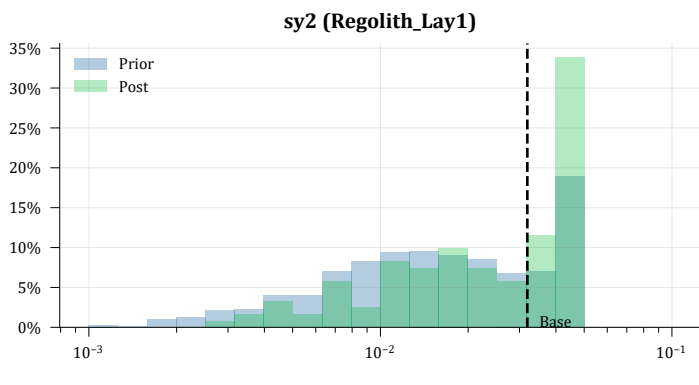
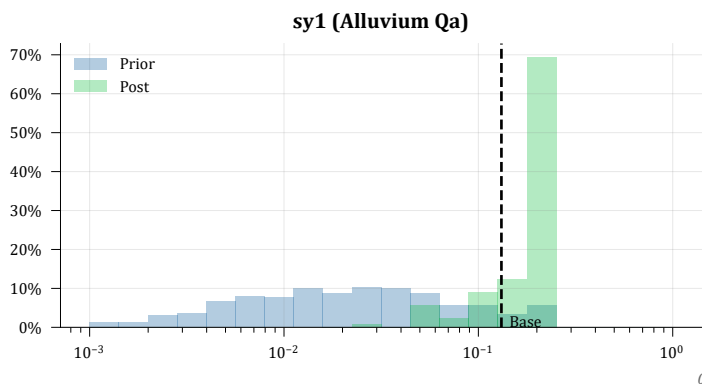
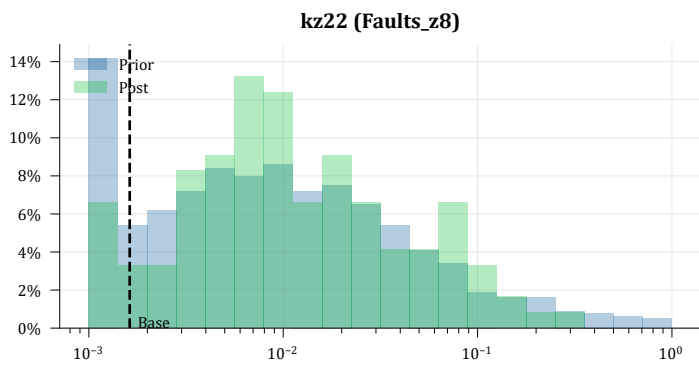
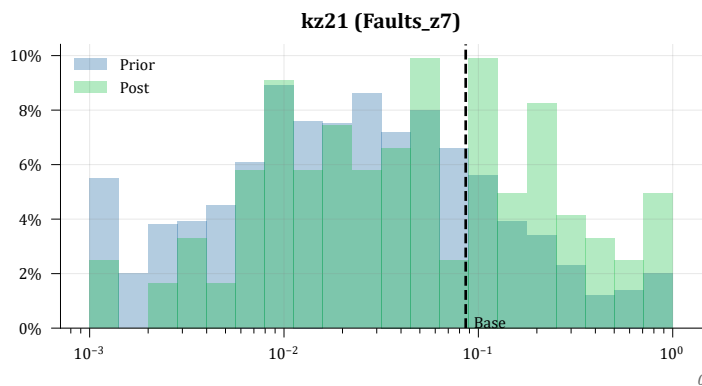
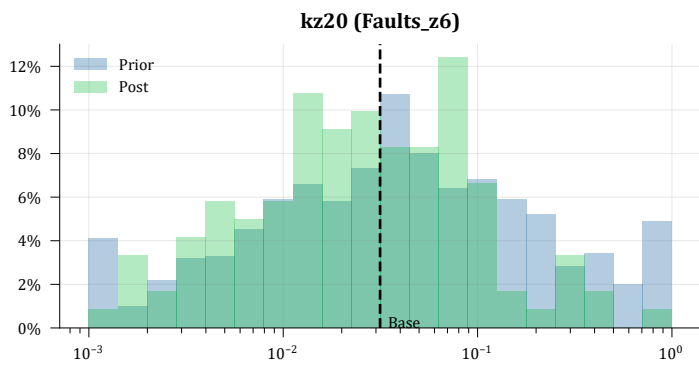
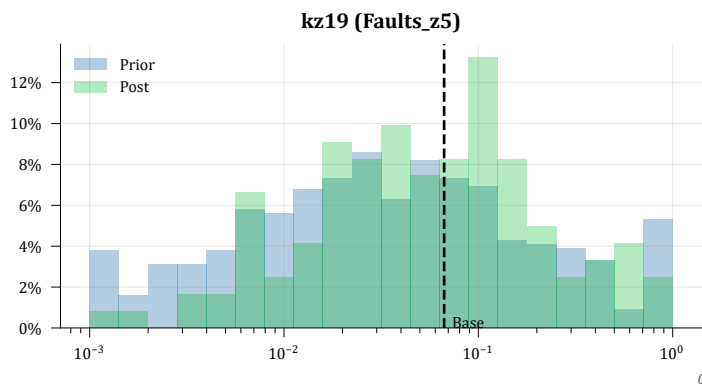


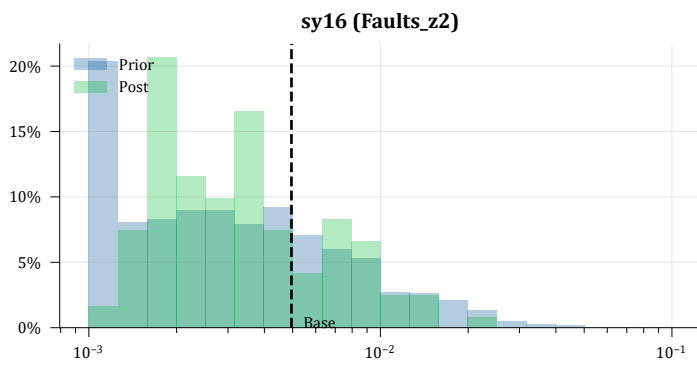
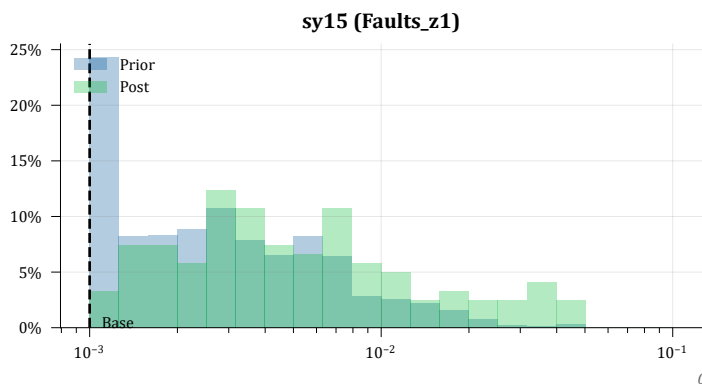
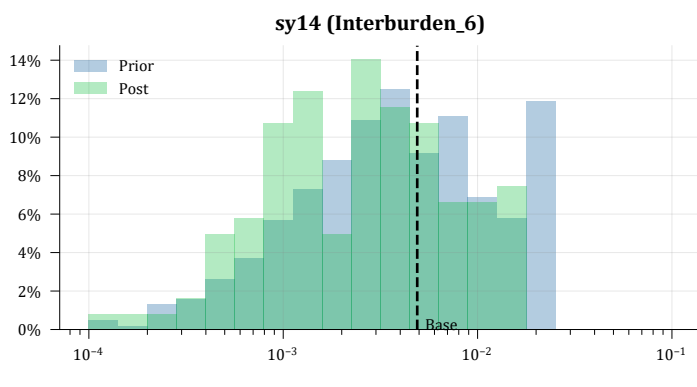
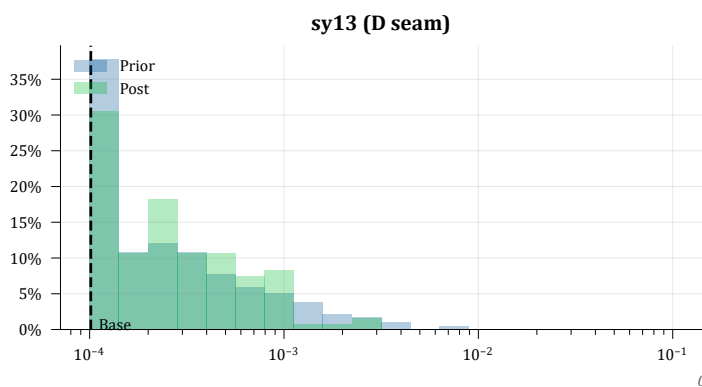
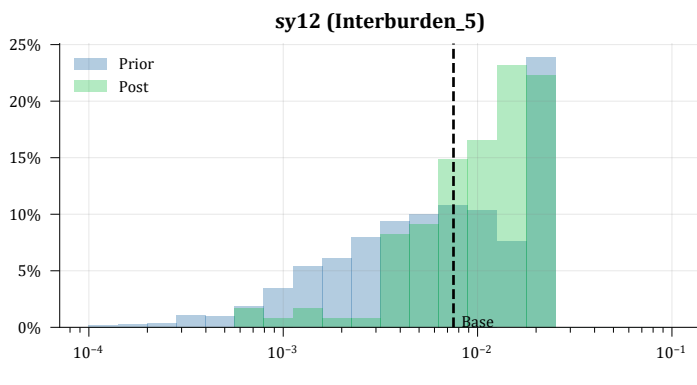
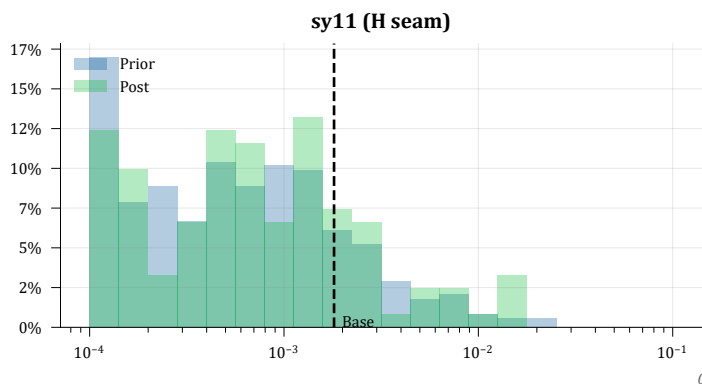
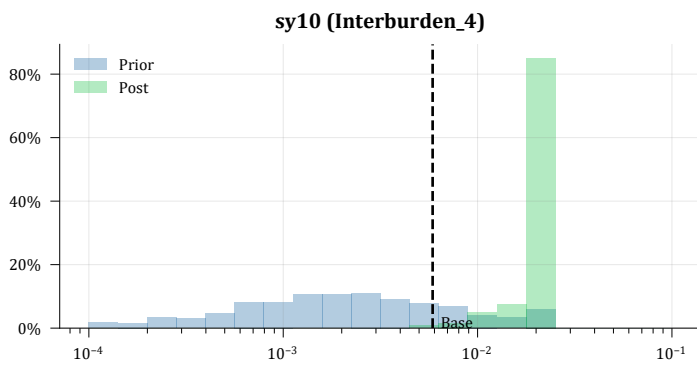
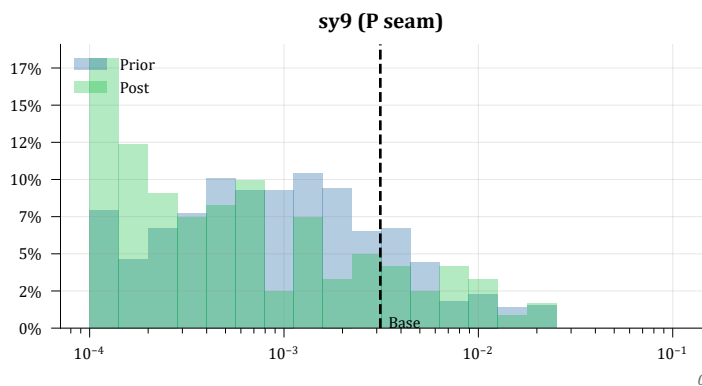
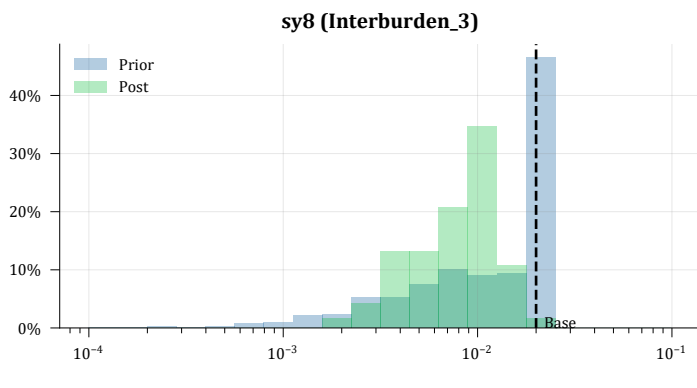
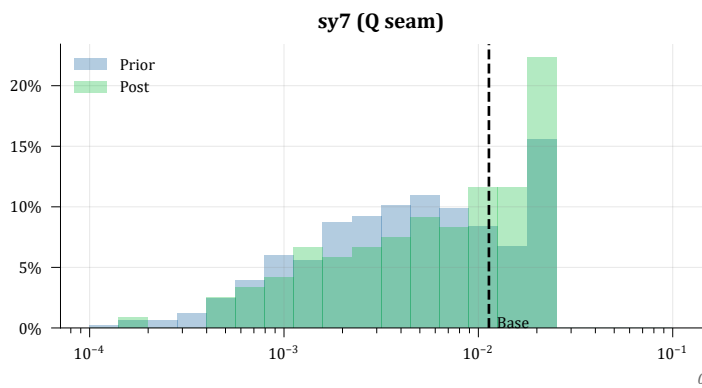
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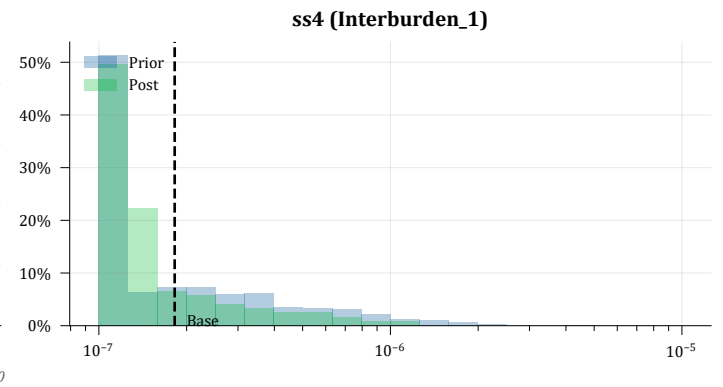
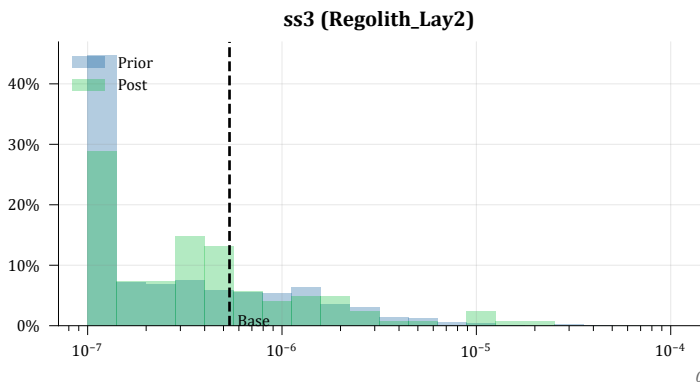
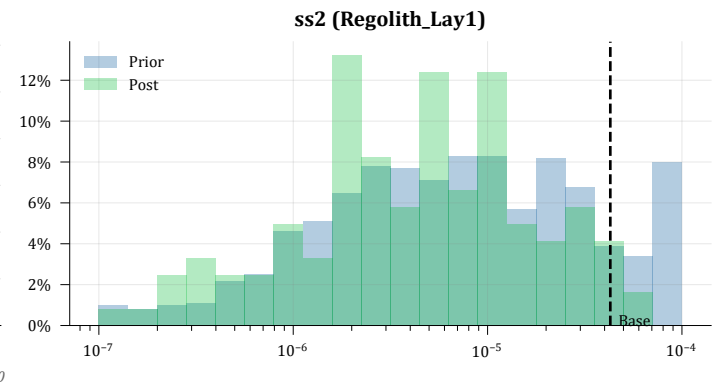
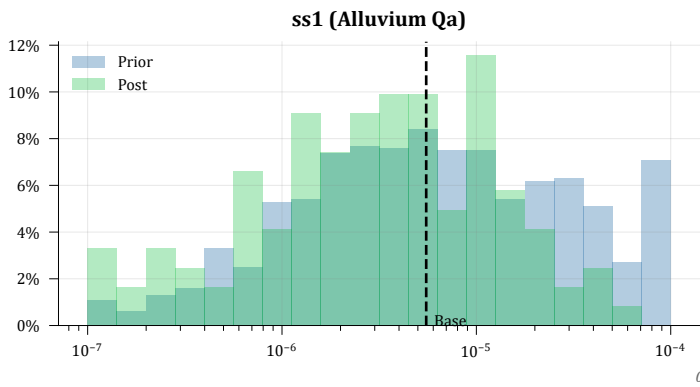
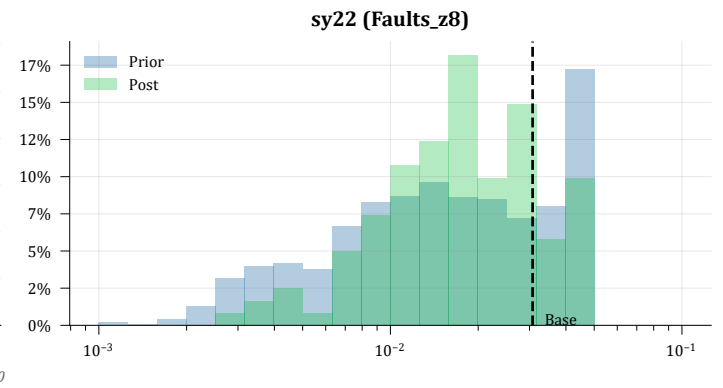
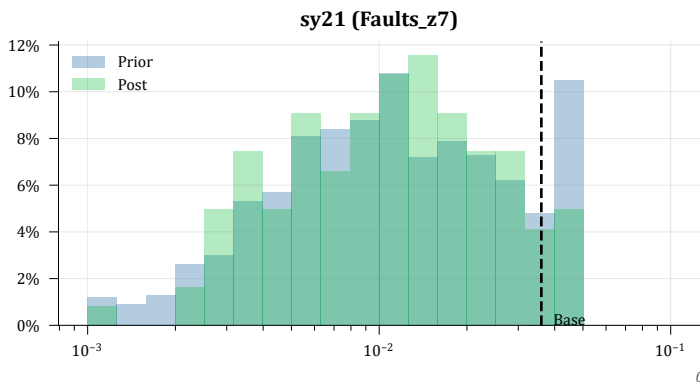
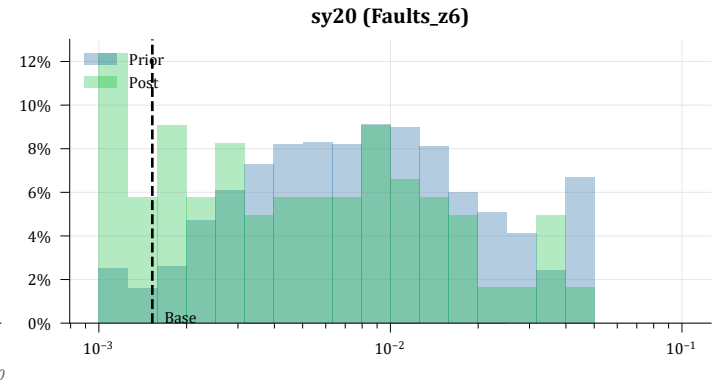
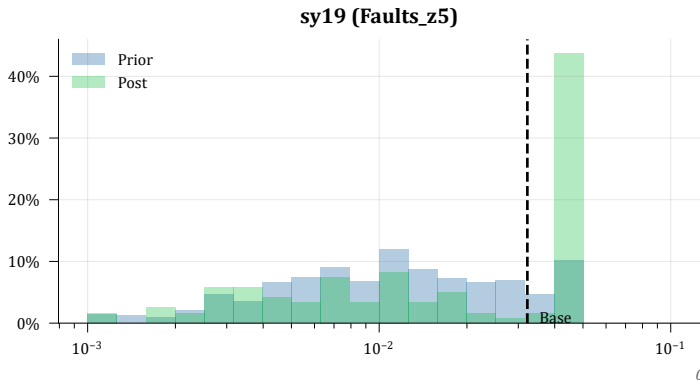
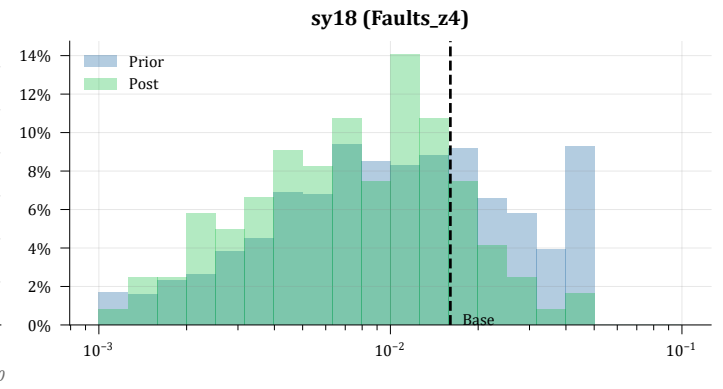
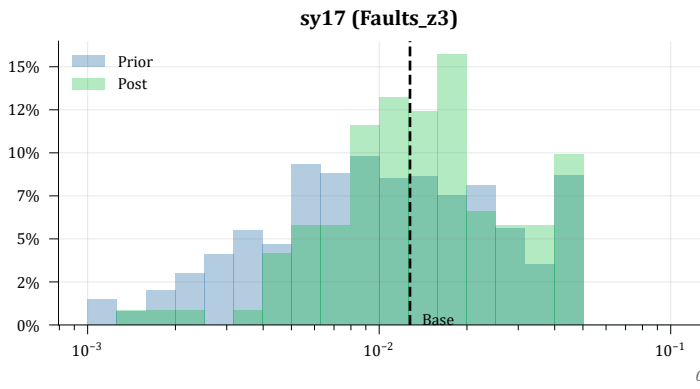


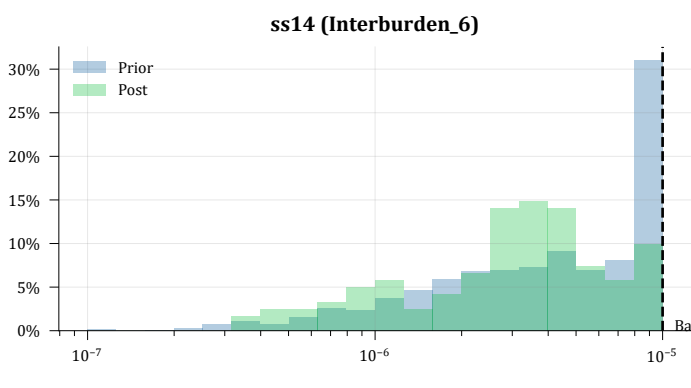
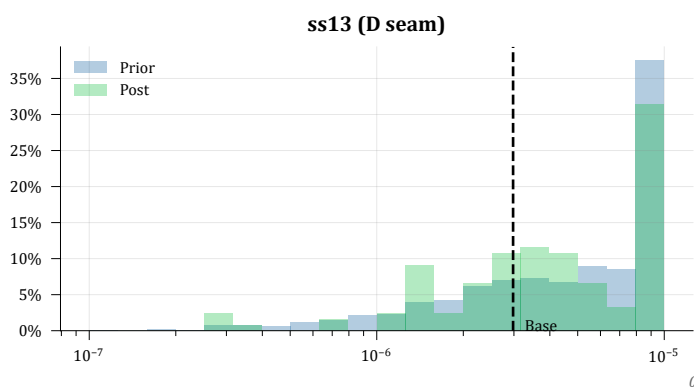
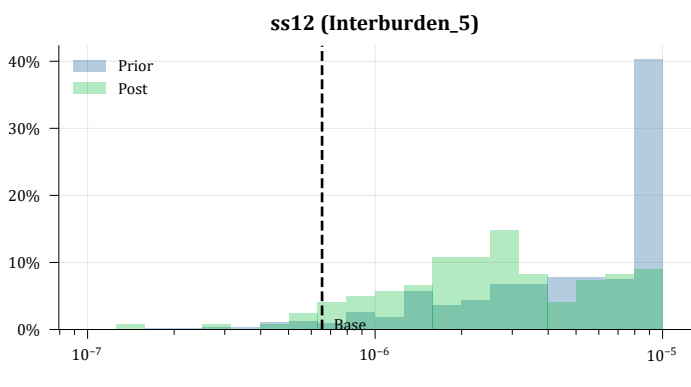
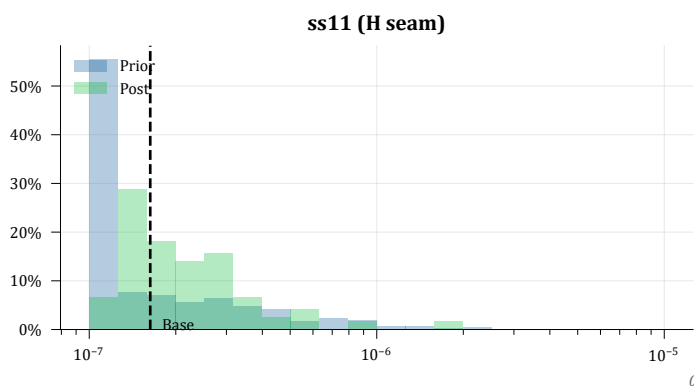
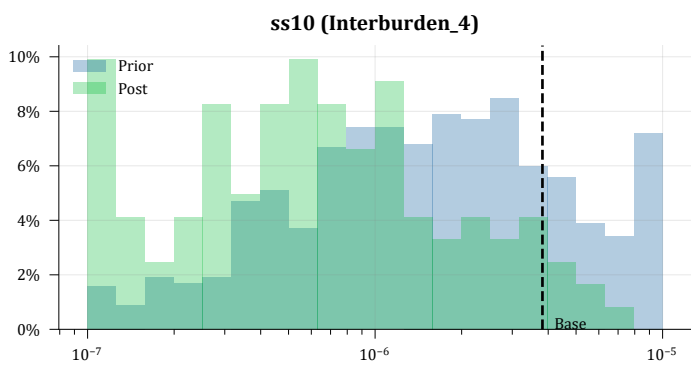
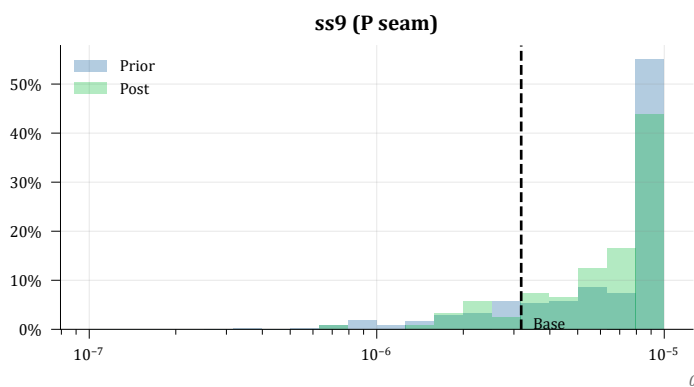
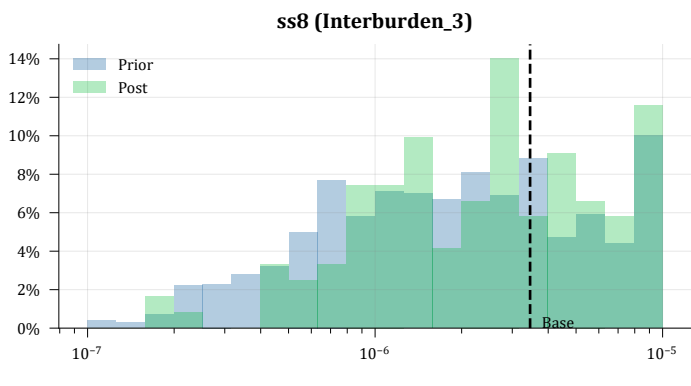
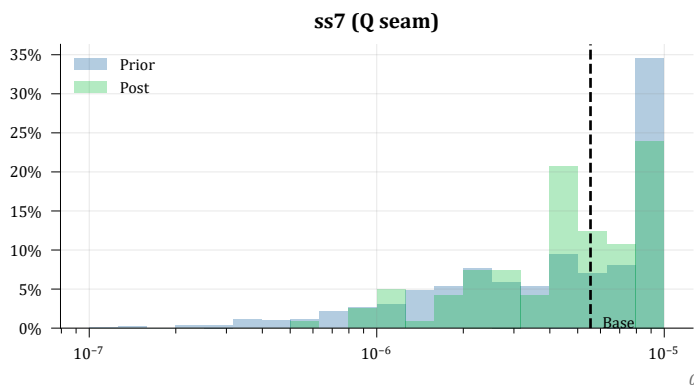
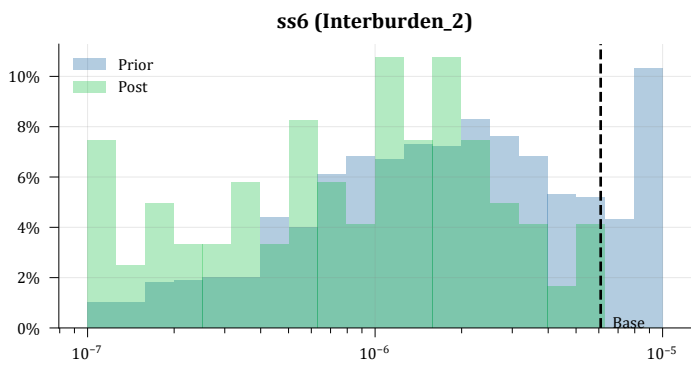
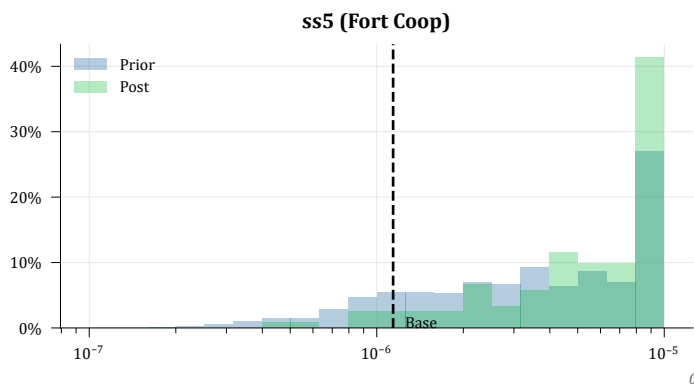




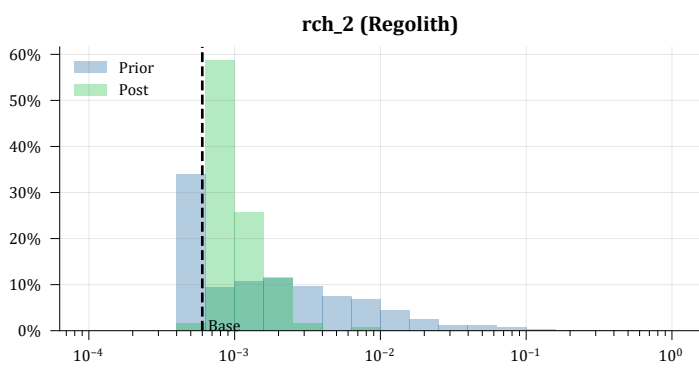
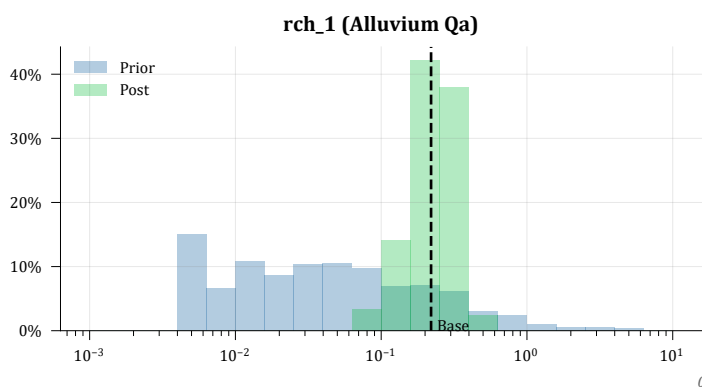
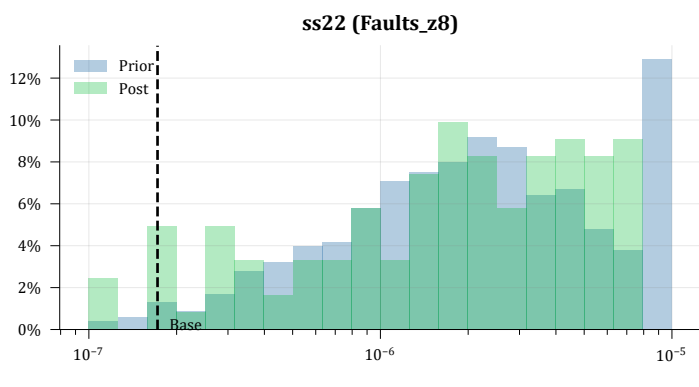
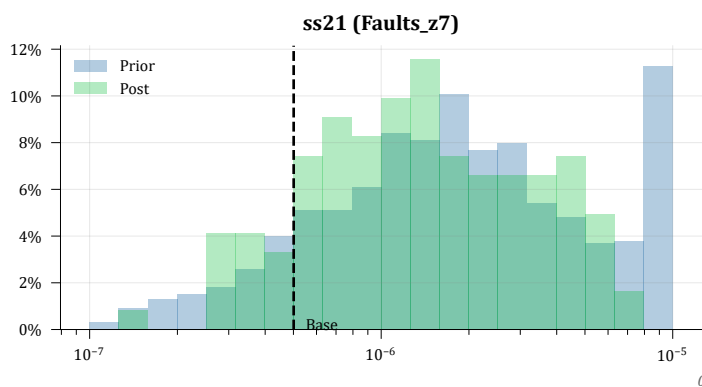
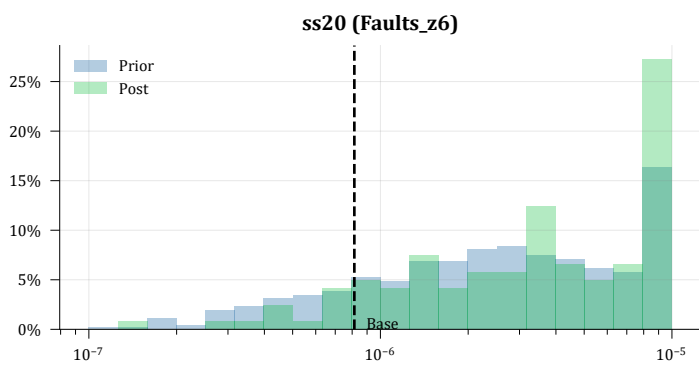
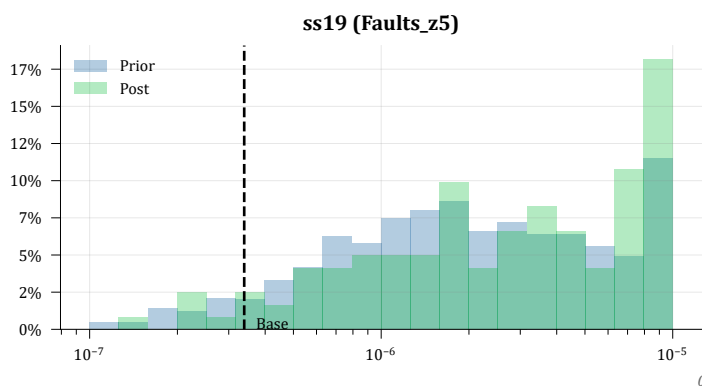
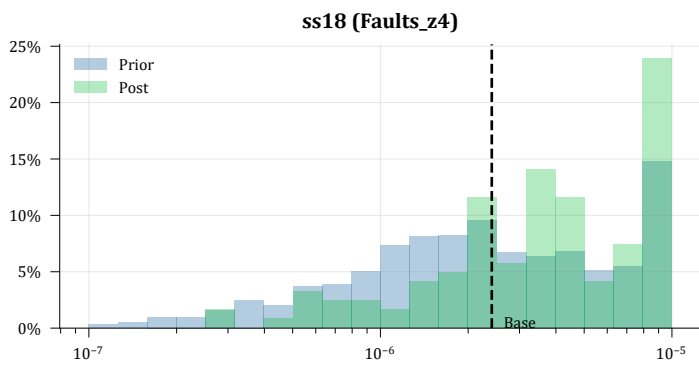
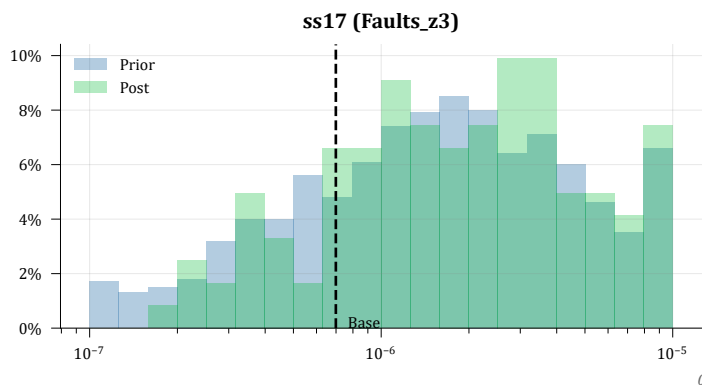
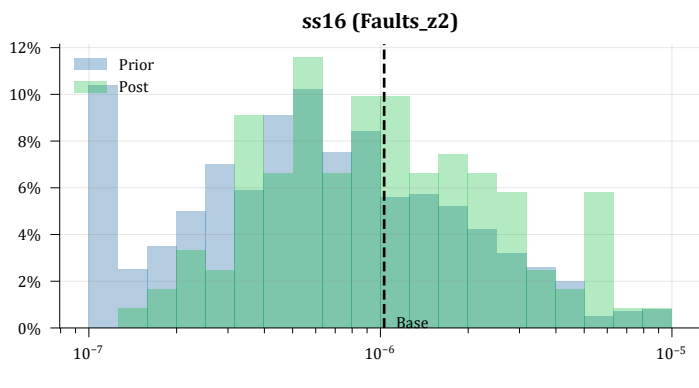
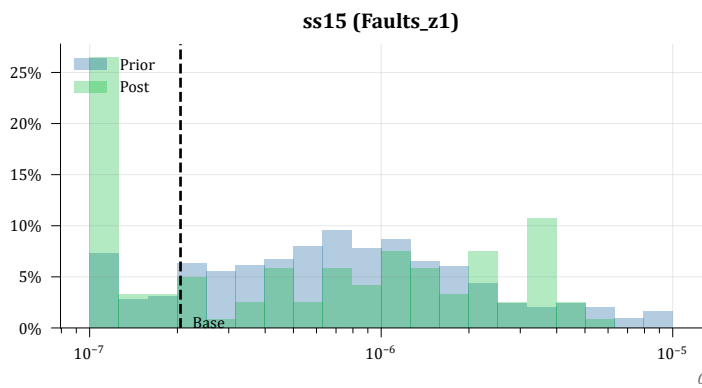


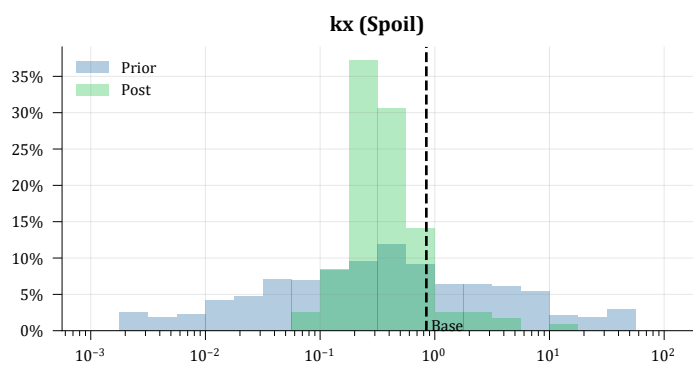
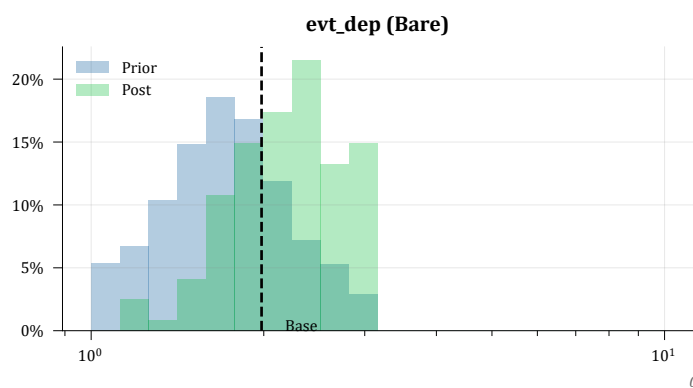
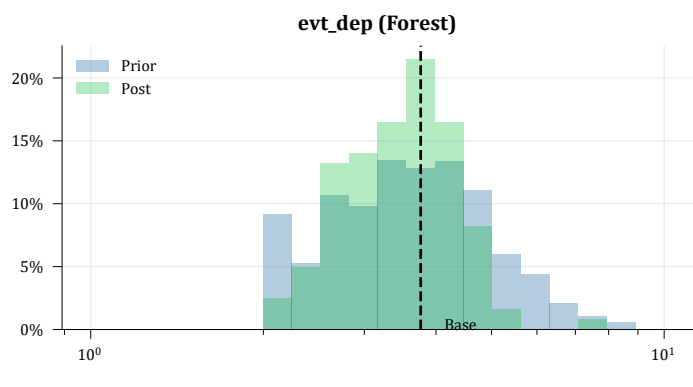
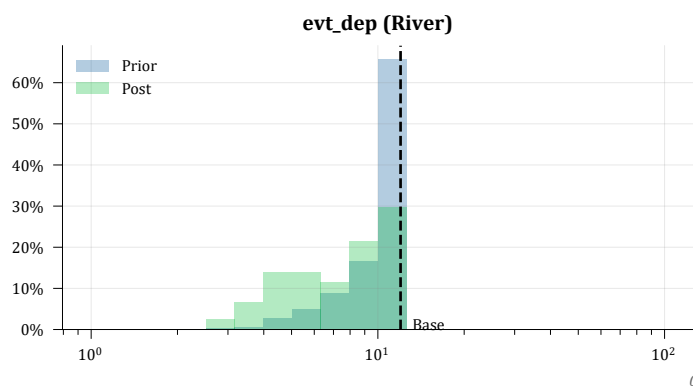
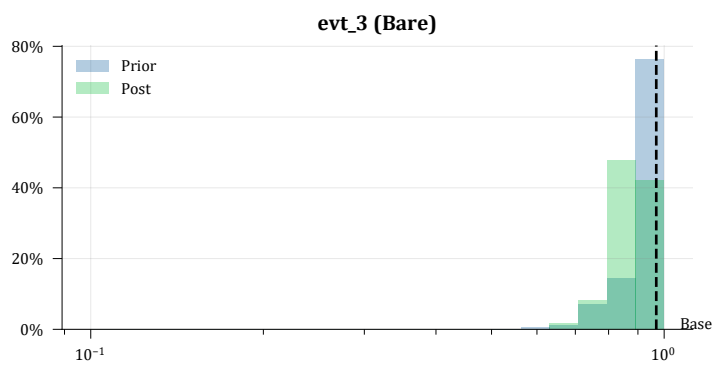
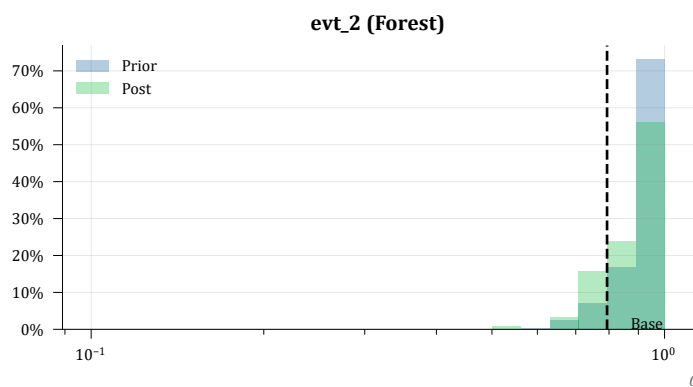
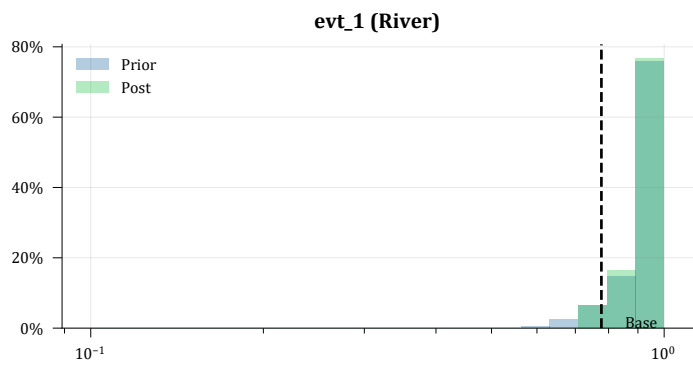
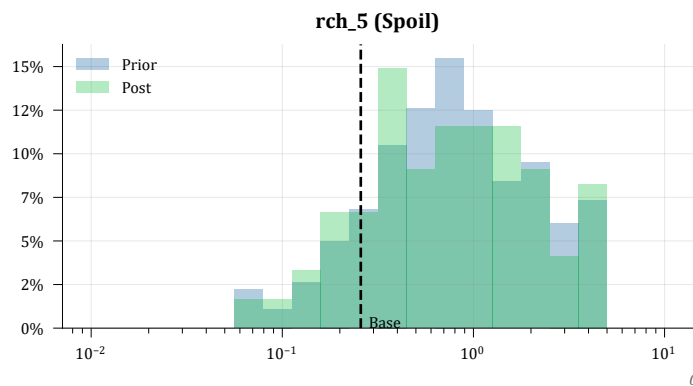
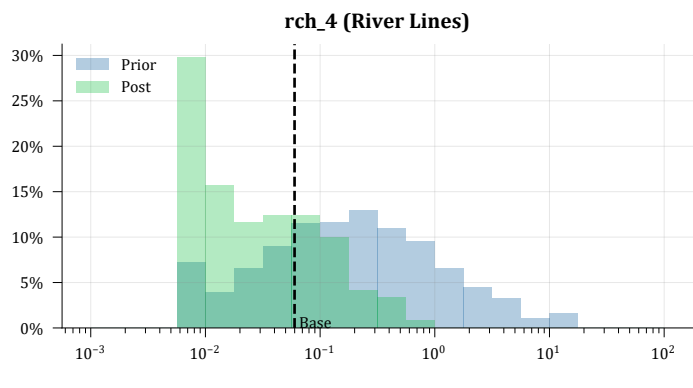
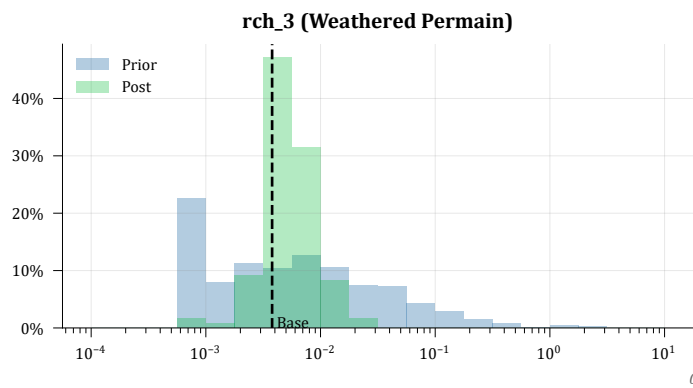


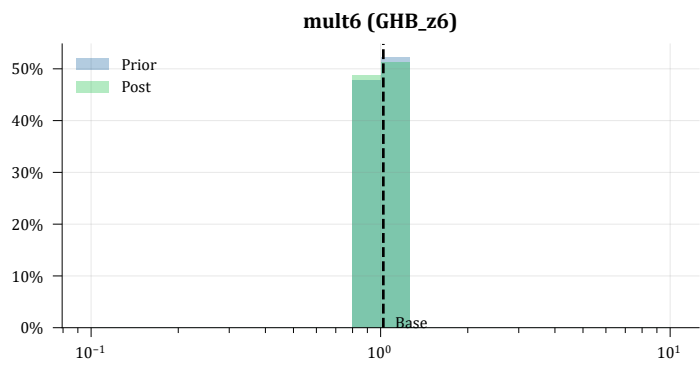
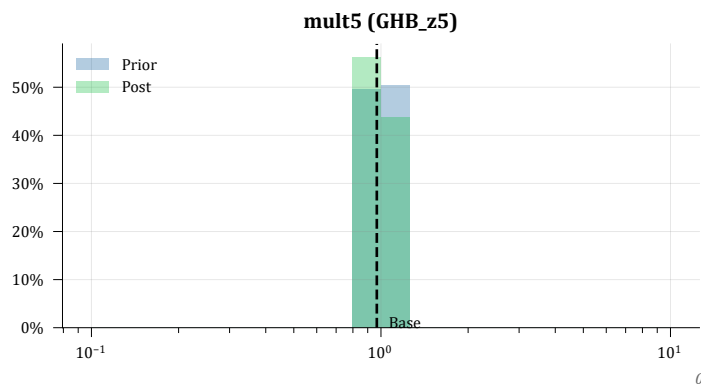
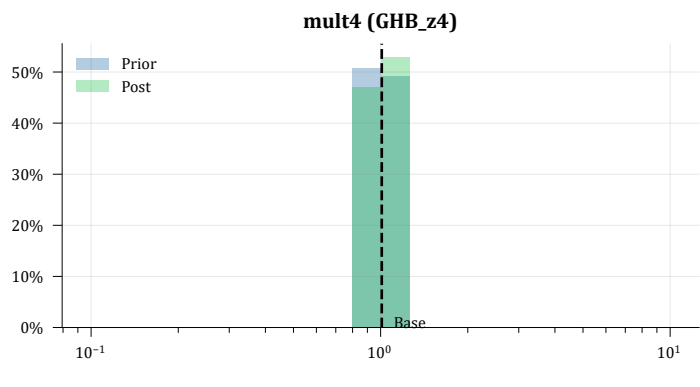
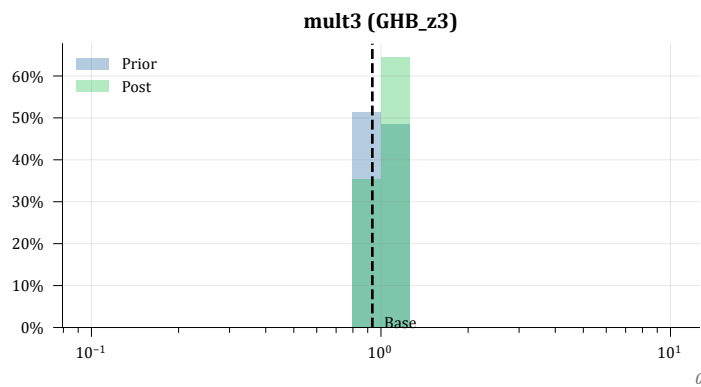
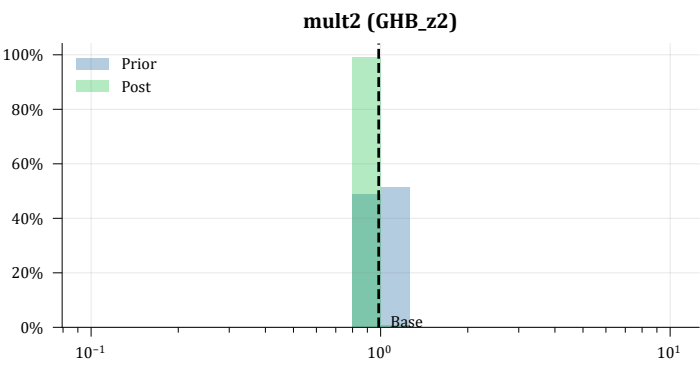
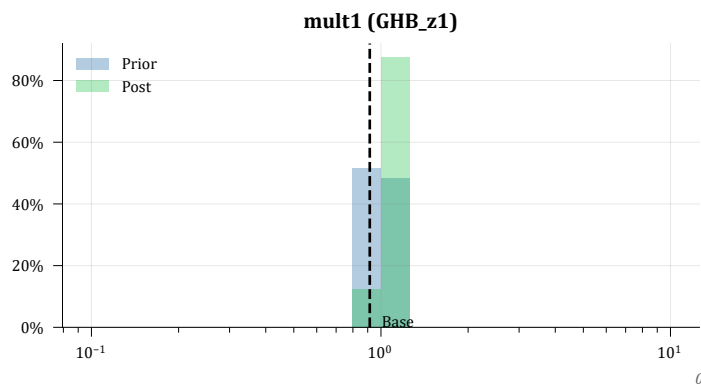
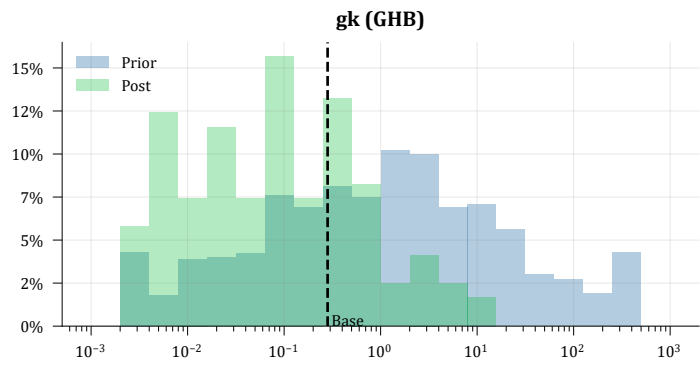
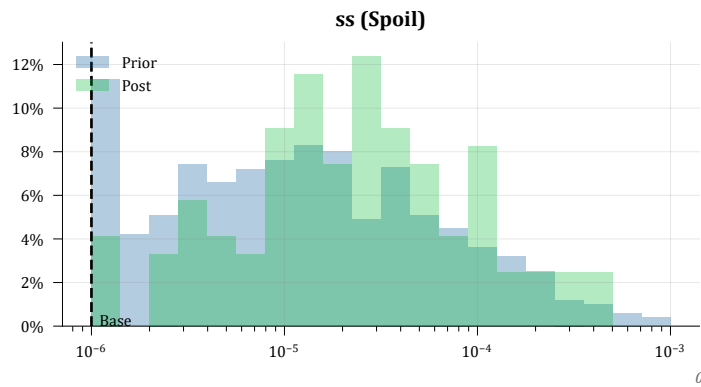
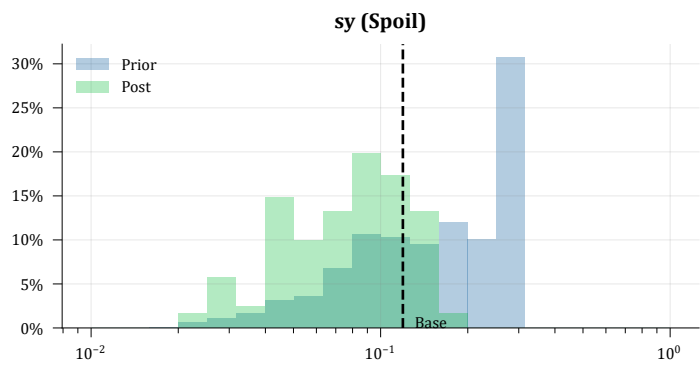
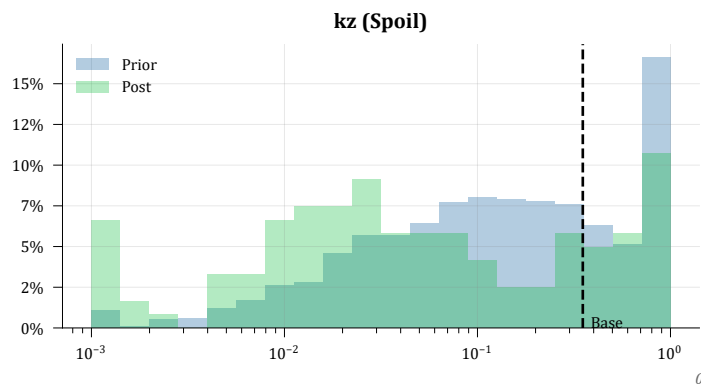


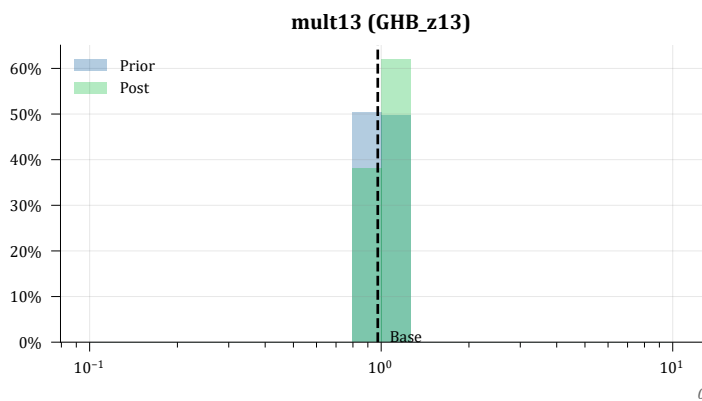
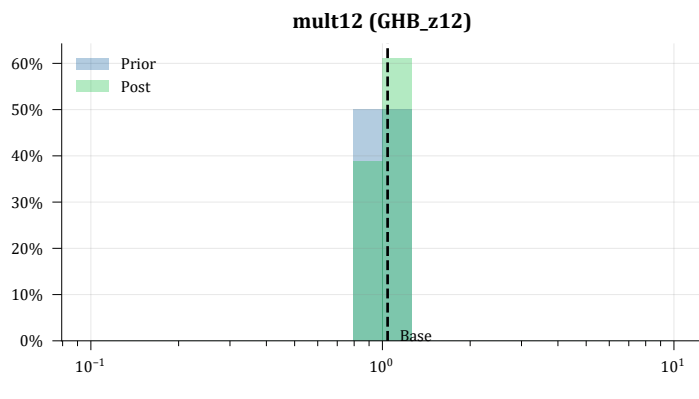
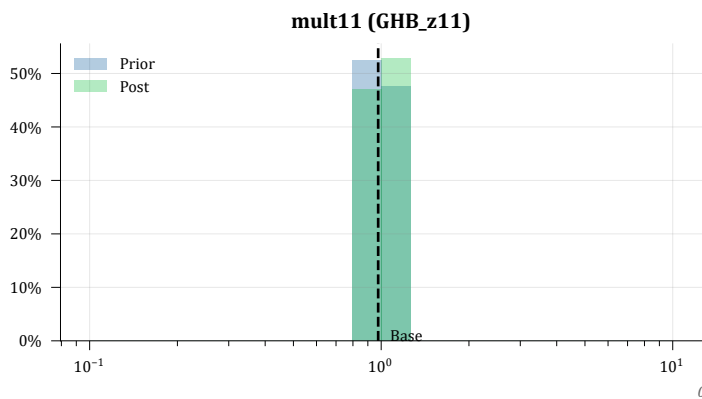
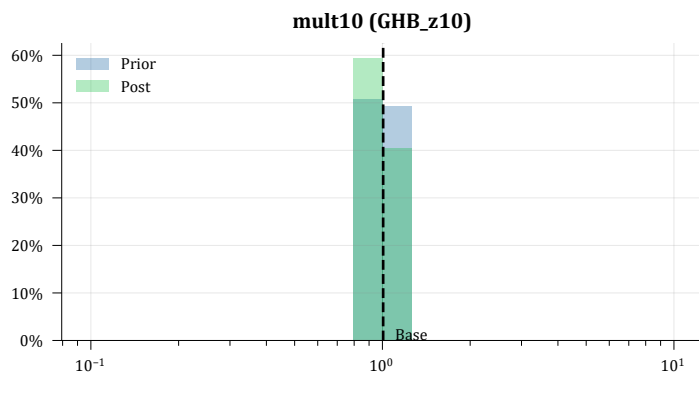
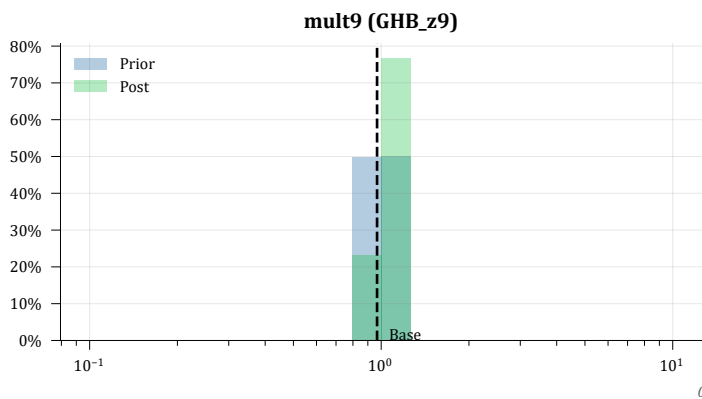
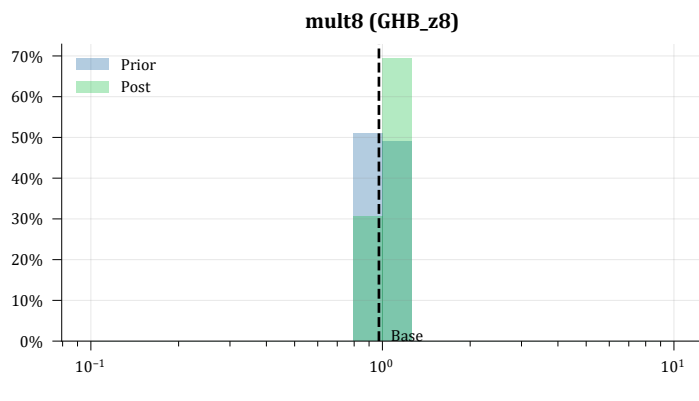
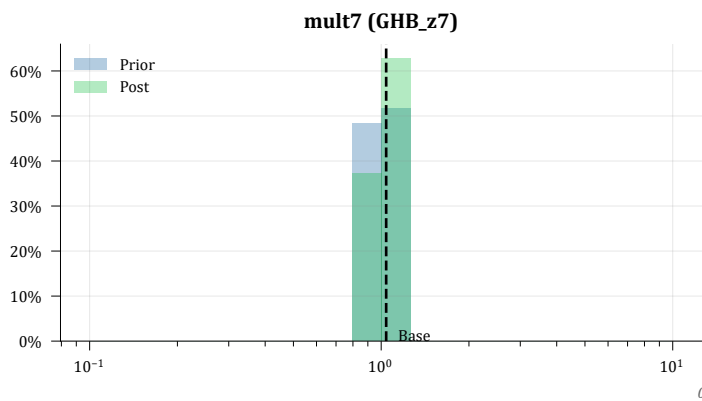


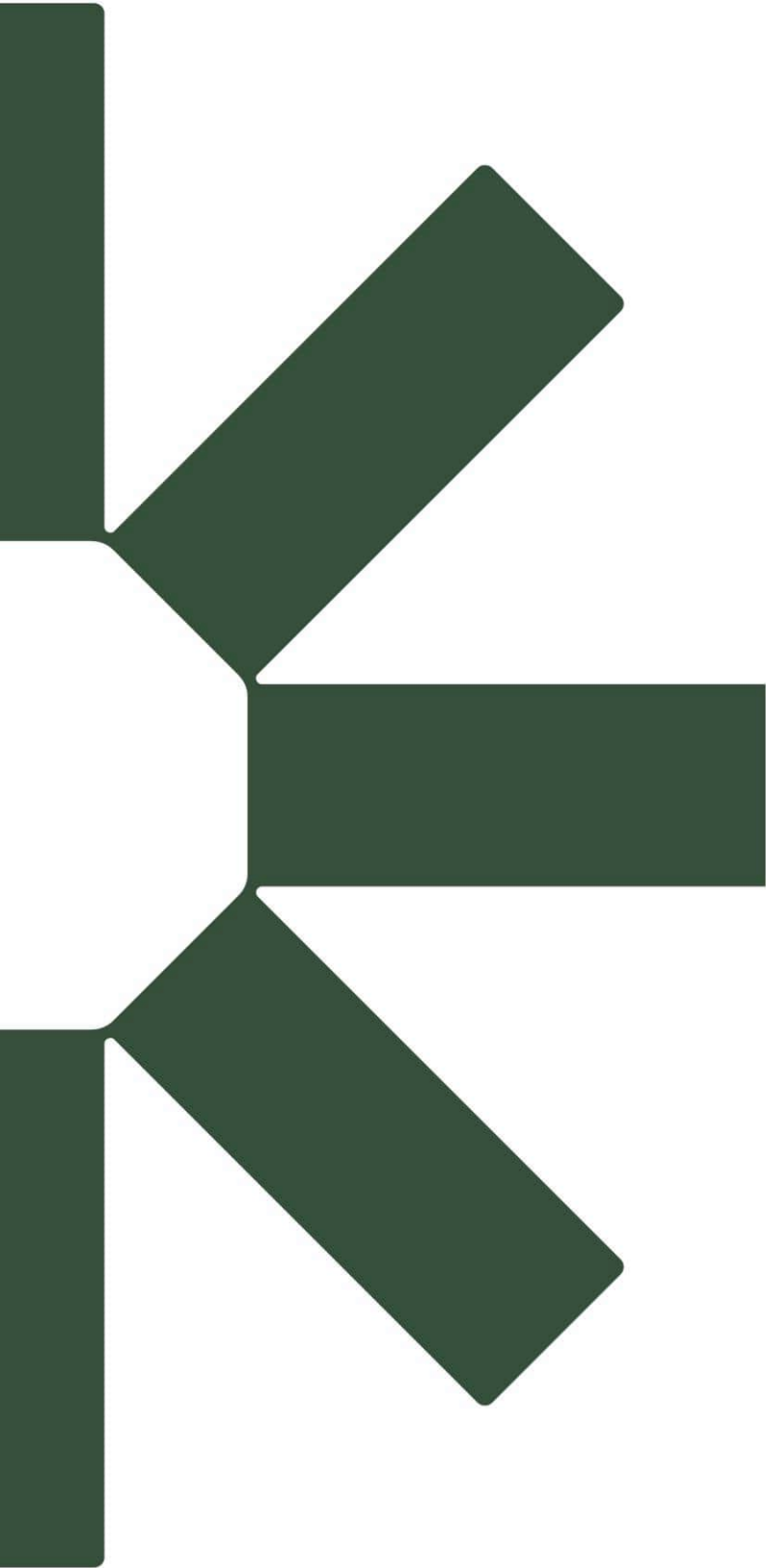
Parameters











Making Sustainability Happen

Spatial information

GIS data associated with this application is available upon request to the Department of Environment and Science.

Information on how to make a request is available at:

<https://www.qld.gov.au/environment/pollution/licences-permits/public-register>