Ensham

RESOURCES

Residual Void Project

Stage 5

Final

Residual Void Report

Version Control

Rev	Date	Status	Approved for release	Distribution
A	4/03/19	Draft for internal review	DY	
B	14/03/19	Draft for Pre-Lodgement DES	DY	DES
C	27/03/19	Final for lodgement with DES	DY	DES

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1 Introduction

1.1 Purpose

The purpose of this document is to present information for the Final Option from the Ensham Residual Void Project in support of the submitted Environmental Authority Amendment Application required under condition G24 of the Ensham Mine (Ensham) Environmental Authority EPML00732813. The Environmental Authority Amendment application is to populate Appendix 4: Rehabilitation Success Criteria of the Environmental Authority with criteria for voids.

This document is prepared in accordance with Condition G16 of the Ensham EA, which provides that the Residual Void Project must be completed and submitted to the administering authority for review and comment by 31 March 2019 and comprise:

a) Terms of Reference
b) Residual Void Study
c) Progress Reports
d) Rehabilitation Success Criteria for Voids.

The Residual Void Project has been completed in accordance with the approved Terms of Reference, pursuant to condition G19 of the EA.

This Residual Void Project report, including the Rehabilitation Management Plan is intended as a 'land outcome document' under the *Mineral and Energy Resource (Financial Provisioning) Act 2018*.

The Ensham Rehabilitation Management Plan Section 4, dated 20 June 2017 and approved by the Administering Authority, contains the landform design objectives. Section 4.1 of the approved Rehabilitation Management Plan describes the rehabilitation domains. **Table 4-1** identifies that the domain for voids (Mining Pit) as being domain 2. **Figure 1-1** (below) identifies domain 2 as the blue zones.

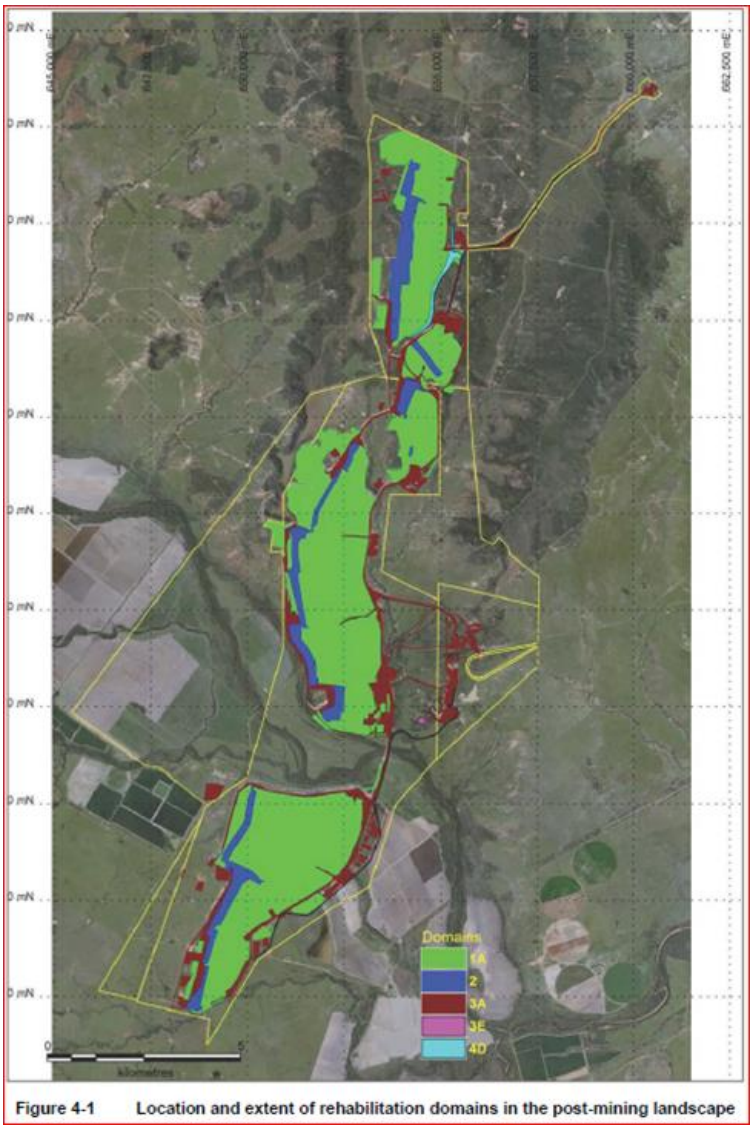


Figure 1-1 – Existing Rehabilitation Domains

Condition 24 of the Environmental Authority requires an Environmental Authority amendment application to be made prior to 31 March 2019 to populate Appendix 4 of the Environmental Authority with the rehabilitation success criteria for Domain 2, including the areas and volumes for this domain.

Furthermore, condition G6 requires an application to amend the environmental authority to update Appendix 4: Rehabilitations Success Criteria for all domains including voids to be made by 31 March 2019.

1.2 The Proponent

Ensham Mine is operated by Ensham Resources Pty Ltd (Ensham), a wholly owned subsidiary of Idemitsu Australia Resources Pty Ltd (Idemitsu), on behalf of the Ensham Mine joint venture (JV) partners.

The JV partners, and holders of the Environmental Authority, are:

- Bligh Coal Limited (47.5%),
- Idemitsu (37.5%), and
- Bowen Investment (Australia) Pty Ltd (15%).

Environmental Authority EPML00732813 (the EA), dated 09 August 2018, is the relevant environmental authority under which Ensham operates the mine. Note that Natural Resources Investment (Australia) Pty Ltd has changed its name to Bowen Investment (Australia) Pty Ltd.

2 Background

2.1 Ensham Mine Overview

Ensham Mine is an open cut and underground coal mine located 35 km east of Emerald along the Nogoa River in Central Queensland. The mine is a large-scale operation currently producing 5.2 million tonnes of coal per annum (Mtpa) from dragline/truck/shovel operations in the northern pits and underground bord and pillar operations under the Nogoa floodplain.

The EA covers seven mining leases (ML7459, ML7460, ML70049, ML70326, ML70365, ML70366 and ML70367) (see Error! Reference source not found.**2.2**). A summary of the ownership and sizes of the m ining leases is provided in **Table 2.1**. For the purposes of this report, the Project Area consists of the Ensham Mine MLs as contained in **Table 2.1.**

Table 2.1 Ensham Mine Tenure

Mining Tenement	Area (ha)	Lot on Plan	Owner
ML7459	6,154.00	Lot 31 CP864573 Lot 32 RP908643 Lot 30 CP864574 Lot 33 RP864576	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)
ML7460	774.34	Lot 31 CP911009 Lot 32 RP908643	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)
ML70049	1,648.00	Lot 3 CP911009 Lot 2 SP165518	• Private landowner
ML70326	25.66	Lot 31 CP864573	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)
ML70365	2,763.00	Lot 31 CP864573 Lot 32 RP908643	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)
ML70366	254.20	Lot 30 CP864574	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)

Mining Tenement	Area (ha)	Lot on Plan	Owner
ML70367	1,003.00	Lot 31 CP864573 Lot 32 RP908643	• Bligh Coal Ltd (47.5%) • Idemitsu Australia Resources Pty Ltd (37.5%) • Bowen Investment (Australia) Pty Ltd (15%)
Total	**12,622.20**		

The underground bord and pillar operation is located on ML 7459 and ML 70365. The location of Ensham Mine is shown in **Figure 2.1.**

In all, Ensham open-cut comprises 11 pits, being:

- A Pit South, A Pit Central and A Pit North
- B Pit
- C Pit
- D Pit
- E Pit
- F Pit South and F Pit North
- Y Pit South, Y pit Central, and Y Pit North

A Pits and B Pit lie south of the Nogoa River with B Pit lying partly in the Nogoa floodplain, protected by 0.1% AEP regulated structure levees. C Pit to Y Pit lie to the north of the river, with C Pit and D Pit occupying part of the floodplain and are also protected by 0.1% AEP regulated structure levees.

The Environmental Authority covers seven mining leases (ML7459, ML7460, ML70049, ML70326, ML70365, ML70366 and ML70367) **(Figure 2.2).** This amendment application will relates to the land bound by these seven Mining Leases.

Land over which ML 70049 sits is owned by Michael David Shaw, Margaret Eleanor Shaw, Edward Michael Shaw, John David Shaw, and Simone Margaret Shaw.

The land over which the remaining six mining leases sit, being ML7459, ML7460, ML70326, ML70365, ML70366 and ML70367, is owned by Ensham.

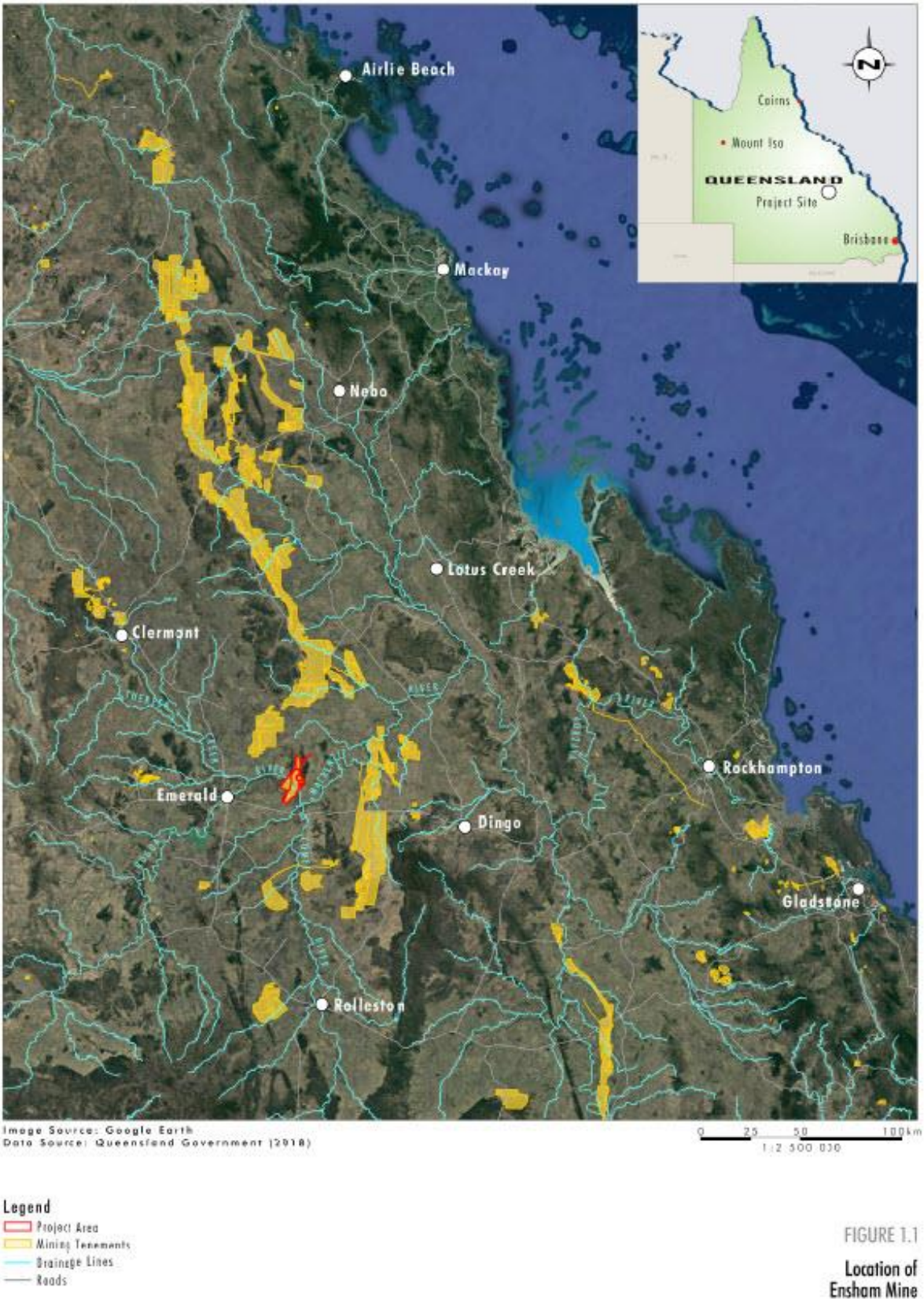


Figure 2.1 – Location of Ensham Mine

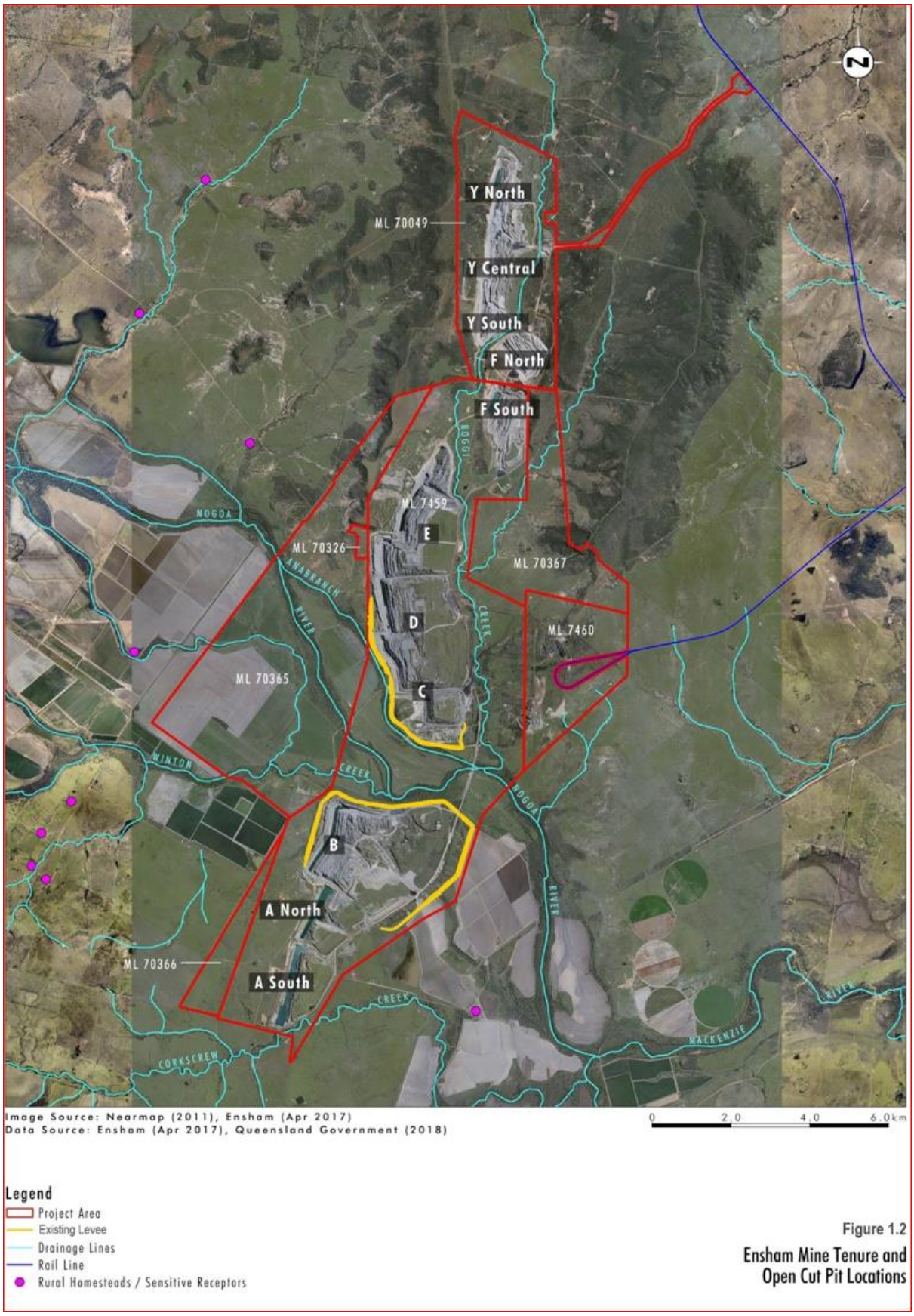


Figure 2.2 – Location of Open-cut pits and Mining Leases

2.2 Residual Void Project

Conditions G16-G20 of the EA require that the RVP must be completed in accordance with the approved Terms of Reference (ToR). The approved ToR divides the RVP into five separate stages:

Stage 1 – Project Definition and Options Identification;

Stage 2 – Preferred Options Technical Studies;

Stage 3 – Preferred Options Detail Design;

Stage 4 – Most Preferred Option Identification; and

Stage 5 – Regulatory Documentation.

Ensham have completed Stages 1 to 4 of the RVP. This report forms part of Stage 5 of the RVP. The ToR provides that Stage 5 is to provide details of how the selected Final Option will be implemented, managed and maintained for submission to the administering authority. As required by the ToR, this report includes:

a) All reports required in Stages 1, 2, 3 and 4, including peer review reports (refer Appendices 1, 2, 3, 4 and 5 respectively);
b) b. An updated Mine Rehabilitation Management Plan; and
c) c. Rehabilitation success criteria for voids as per Appendix 4: Rehabilitation Success Criteria.

The Final Option was determined in the Stage 4 Triple Bottom Line Assessment conducted on 22 January 2019 as being 'Option 2 Beneficial Use'.

3 Approvals

3.1 Approvals Process

The Ensham Coal Mine (Ensham) operates under Environmental Authority (EA) EPML00732813 which is administered under the *Environmental Protection Act 1994* (EP Act) by the Department of Environment and Science (the Administering Authority).

The EP Act s226 specifies certain requirements for an amendment application. These requirements are shown in **Table 3.1**. The table specifies where each of the elements is described in this report.

The RV project is required to include the elements detailed in Condition G20 of the EA. Conditions G16, G20 and G24 of EA EPML00732813 state the following requirements:

Condition G16:

A Residual Void Project must be completed and submitted to the administering authority for review and comment by 31 March 2019, and must be comprised of the following at a minimum:

a) Terms of Reference
b) Residual Void Study
c) Progress Reports; and
d) Rehabilitation success criteria for voids.

Progress Reports submitted to DES during the course of the project in Item c) above are attached in Appendix 5g. The Rehabilitation Success Criteria referred to in item d) are shown in Appendix 5c.

Condition G20:

The Residual Void Project required by Condition G16 must include, but not be limited to, the following:

a) options available for minimising final void area and volume
b) design objectives for rehabilitation of final voids
c) void hydrology, addressing the long-term water balance in the voids, connections to groundwater resources and water quality parameters in the long term
d) pit wall stability, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events;
e) options available for minimising risk of flood interaction for all flood events up to and including the Probable Maximum Flood level;
f) void capability to support native flora and fauna, and
g) void rehabilitation success criteria and final void areas and volumes to meet the outcomes in Condition G24

Table 3.2 describes where each of the elements described above is addressed in this document.

Condition G24:

Prior to 31 March 2019 the environmental authority holder must submit an Environmental Authority amendment application to populate Appendix 4: Rehabilitation Success Criteria with rehabilitation success criteria for voids and residual void areas and volumes.

Accordingly, an EA amendment application and supporting documentation including the required Rehabilitation Success Criteria have been prepared in accordance with s226 of the EP Act. The requirements required under this section are listed in Table 3.1. Supporting documentation for the project are listed in the **Appendices**.

Table 3.1.1 identifies how the Standard Criteria, as described in Schedule 4 of the Environmental Protection Act (1994), are addressed. The requirements for a site-specific application in regards to underground water rights and associated information, listed under Section 216 of the EP Act, are shown in **Table 3.1.2**.

Table 3.1 s226 EP Act Elements and Locations

	Element s226	Location
An amendment application must:		
a	be made to the administering authority; and	This EA Application has been lodged with the Administering Authority at Level 3, 400 George Street, Brisbane.
b	be made in the approved form; and	The approved form ESR/2015/1733 Version 13 00 Effective: 23 NOV 2018 has been used.
c	be accompanied by the fee prescribed under a regulation; and	The prescribed fee was paid on lodgement
d	describe the proposed amendment; and	The Stage 5 Residual Void Report (being this document), is appended to the EA Application and describes the proposed amendment.
e	describe the land that will be affected by the proposed amendment; and	Section 2.1 of the Stage 5 RV Report.
f	describe any development permits in effect under the Planning Act for the carrying out of the relevant activity for the authority; and	There are no Development Permits in effect under the Planning Act for the carrying out of the relevant activity for the EA.
g	state whether each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity; and	The relevant activity would not comply with the eligibility criteria for the activity.
h	if the application states that each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity - include a declaration that the statement is correct; and	Not applicable.
i	state whether the application seeks to change a condition identified in the authority as a standard condition; and	Table 3.1 identifies the proposed changes to the Ensham EA. The application does not seek to change a condition identified in the authority as a standard condition.
j	if the application relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit - state whether the applicant seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit; and	Not applicable.
k	include an assessment of the likely impact of the proposed amendment on the environmental values, including-	
	(i) a description of the environmental values likely to be affected by the proposed amendment; and	Stage 5 RV Report, Section 6.
	(ii) details of any emissions or releases likely to be generated by the proposed amendment; and	Stage 5 RV Report, Section 6, including Table 6.1, 6.8 and 6.9.
	(iii) a description of the risk and likely magnitude of impacts on the environmental values; and	Stage 5 RV Report, Section 6, Impact Assessment and Appendix 3iRisk Assessment
	(iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts; and	Stage 5 RV Report, Section 6

	Element s226	Location
An amendment application must:		
	(v) details of how the land the subject of the application will be rehabilitated after each relevant activity ceases; and	Rehabilitation Management Plan, Section 7.1
l	include a description of the proposed measures for minimising and managing waste generated by any amendments to the relevant activity; and	Stage 5 RV Report, Section 6.10 Waste Management.
m	include details of any site management plan or environmental protection order that relates to the land the subject of the application; and	There is no site management plan or environmental protection order that relates to the land the subject of the application.
n	include any other document relating to the application	Refer to Table 3.1.1

Table 3.1.1 Schedule 4, Environmental Protection Act (1994): Standard Criteria

No:	Standard Criteria	Supporting material
1	The following principles of environmental policy as set out in the "Intergovernmental Agreement on the Environment": - the precautionary principle; - intergenerational equity; and - conservation of biological diversity and ecological integrity.	<u>Precautionary Principle:</u> The individual RVP studies have assessed the impact on EV's that were identified in the Stage 2 EV Workshop as having the potential to be impacted by the proposed rehabilitation. The impact assessment undertaken in Stage 3 was completed by competent and suitably qualified consultants, who identified that there will be no significant harm on any of the EV's as a result of the proposed rehabilitation. Relevant aspects of the impact assessment were updated to address the final form of Option 2 Beneficial Use. The impact assessments have been peer reviewed by independent suitably qualified third parties, being person's whose professional training or experience is relevant to the matters being considered. The results of these studies are summarised in the Stage 3 Environmental Assessment Report, which has also been peer reviewed by an independent suitably qualified third party. The impact assessment demonstrates that there is no threat of serious or irreversible environmental damage expected to arise from the proposed rehabilitation. . <u>Intergenerational Equity:</u> The risk assessment conducted in Stage 3 of the RVP did not identify any significant negative impacts on the health, diversity or productivity of the

		environment for future generations[1]. In addition, completion of the rehabilitation will: • return 4,658 ha of land to sustainable grazing, • improve the post mining land carrying capacity of F&Y pit areas, • not result in any actual or potential adverse effect on groundwater from the rehabilitation. Refer section 6.5.5 and • the design of the rehabilitated landform at 1% AEP means that the risk of water from within the rehabilitated areas being released to the receiving environment is extremely improbable. Based on the RVP reports and associated findings, the approval of this EA amendment application will not result in any significant negative impact on future generations <u>Conservation of biological diversity and ecological integrity:</u> As described in Section 6 of this report, the rehabilitation has been designed in a way that does not impact on the environmental values of air, waters, wetlands, acoustic environment, groundwater and any associated surface ecological systems and land. Waste generated in the rehabilitation phase will continue to be managed in accordance with the Ensham Waste Management and Minimisation Plan – refer to section 6.10 of this report. In addition, the design of the rehabilitation incorporates two native bushland corridors on the western side of the rehabilitation to establish better connectivity between existing mapped regional biodiversity corridors.
2	Any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development.	The Stage 2 Environmental Values Workshop Report identified the relevant Queensland and Federal legislation, policies and guidelines for determining the EVs for the RV Project. These are set out in Section Table 2 and Section 4.1 of that Report, and includes: • Environmental Protection (Water) Policy 2009; • Environmental Protection (Air) Policy 2008; • Environmental Protection (Noise) Policy 2008; • Healthy waters for Queensland: Environmental values, management goal and water quality objectives – FAQ; • Nogoa River Sub-basin Environmental Values and Water Quality Objectives; • WQ1302 – Upper Nogoa River Sub-basin – Map; • WQ1303 – Lower Nogoa River/Theresa Creek Sub-basin – Map; and

[1] Pages 14, 23 and 23 of the Stage 3 Risk Assessment

		• WQ1310 – Fitzroy Basin Groundwater Zones– Map. The independent peer reviewer for the Stage 2 Environmental Values Workshop, notes that the EVs in the Report were cross-referenced against the legislation[2], policies and guidelines as part of the review process. Additional documents considered in individual Study Reports completed as part of the RV Project include, but are not limited to: • the Queensland State Planning Policy, • the Central Queensland Regional Plan • the Central Highlands Regional Council Planning Scheme 2016 • the Mined Land Rehabilitation Policy A full list of references is contained in each report provided in the Appendices.
3	Any relevant environmental impact study, assessment or report.	In submitting the rehabilitation option for approval all relevant findings and recommendations that arose from the RV Project Study Reports were considered, including but not limited to: - The findings of each individual report and the actions to manage or mitigate any negative impacts on EV's (including commitments in this document), - The feedback provided by the Community Reference Group, - Feedback provided by the administering authority throughout all Stages of the RVP. In undertaking the RV Project studies individual consultants have had access to and considered prior studies conducted at Ensham Mine.
4	The character, resilience and values of the receiving environment.	The RV Project studies identified relevant EVs, assessed the potential for environmental impacts to the EVs and applied the Hierarchy of Controls to manage and or mitigate potential harm to each EV. The Rehabilitation Success Criteria have been developed from the RVP Studies and build upon the current successful rehabilitation experiences at Ensham. The Environmental Assessment Report, the Social Impact Assessment Report and Economic Assessment Report together represent a holistic approach to achieving best practice environment management for Ensham Mine.

[2] Page 2 of the Stage 2 – Environmental Values Workshop Report IPR letter.

5	All submissions made by the applicant and submitters.	In the delivery of the RV Project Ensham has undertaken significant consultation with nearby neighbours, mining area landholders, the Central Highlands Council, CHRRUP, Fitzroy Partnership for River Health, Sunwater, Cotton Growers and Irrigators Association, the broader community and the administering authority. Consultation that has been undertaken is discussed in detail in the Social Impact Assessment and as set out in section 7 of this report. Figure 4.1 of the SIA identifies Stakeholders relevant to the RV Project. Table 4.3 provides an overview of the number of stakeholders consulted across each stakeholder group category. In summary, across the two engagement rounds (three weeks of consultation) in Emerald and Comet, a total of 48 individuals were engaged, through 45 face to face interviews, five workshops and two telephone interviews. In addition, stakeholder engagement included consultation with the following: - 4 x State Ministerial Offices - 1 x State Minister, and - 1 x Federal Minister. In the early phases of the Project, a Community Reference Group (CRG) was established to work with the company and its relevant consultants in relation to the Project. Over the period from October 2017 to February 2019 a total of 7 CRG meetings were held. The Charter for the CRG, Participants and minutes of all CRG meetings held can be accessed at: https://www.idemitsu.com.au/mining/projects/ensham-rv-community-reference-group/ Detailed feedback provided by the administering authority for Stage 2, 3 and 4 studies has been used during the RV Project to refine the final proposed option for rehabilitation of the voids. Specific improvements and commitments provided in this document based on Stage 3 feedback from the administering authority have been footnoted in this report to assist with identification.

6	The best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows: - an environmental authority; - a transitional environmental program; - an environmental protection order; - a disposal permit; and - a development approval.	The Stage 3 Environmental Assessment Report has assessed the environmental impacts to each EV for this Option. The Stage 3 reports include examples of best practice environmental management including: • the Factor of Safety greater than 1.5, • the inclusion of the 2 native bushland corridors, • isolation of the water in the rehabilitated areas from the receiving environment, and • returning of 4,658ha or 76.7% of mine disturbed land to sustainable grazing. In the development of the Landform Design Criteria, provided in Table 6.2.2.2 of this document, expert consultation has been undertaken to address best practice environmental management for the proposed rehabilitation. In developing a safe, stable and non-polluting landform design which would accommodate high value post mining land uses, regard was given to best practice rehabilitation strategies, including: - Table 1 of the "Rehabilitation requirements for mining resource activities" Guideline; and - Appendix 1 of the Better Mine Rehabilitation in Queensland Discussion Paper.
7	The financial implications of the requirements under an instrument, or proposed instrument, mentioned [at item 6 above] as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument.	The Economic Impact Assessment Report assesses the financial benefits and the financial cost for the proposed rehabilitation through a cost benefit analysis and CGE economic modelling. The TBLA assessed each option from an environmental, economic and social perspective. The outcome of the TBLA was that Option 2, without a reservoir as a PMLU, would move forward to Stage 5 of the RV Project. The TBLA was independently peer reviewed by the University of Queensland Sustainable Minerals Institute, a world leading research institute committed to developing knowledge based solutions to the sustainability challenges facing the global mining and resource industry. In conducting the peer review UQ SMI opined that "*the assessment process was in accordance with best practice for TBLA's*." Based on the RV Project study's findings and the outcomes from the TBLA the associated monitoring and management measures detailed in this application are reasonable and appropriate.
8	The public interest.	In the performance of the RV Project it has been demonstrated that the proposed rehabilitation is in the interest of the community, in that: - the rehabilitation outcome has environmental, economic and social benefits or advantages for the whole community including: • monetised economic benefits of $12.30M (NPV), and • 40 FTE employment opportunities to the local Central Highlands region

		• the land design remains largely unchanged, and • the design criteria deliver sufficient storage volume for a future potential benefit of a reservoir. - extensive consultation has occurred with the local and regional community, as detailed in the SIA Report and the CRG Website, to understand and respond to the concerns of the local community. In summary, the TBL Assessment has considered the environmental, social and economic value of future activities, and assesses this value and its net benefits to the broader community.
9	Any relevant Site Management Plan.	Not applicable.
10	Any relevant integrated environmental management system or proposed integrated environmental management system.	The delivery of the rehabilitation prior to relinquishment will be undertaken under the existing environmental management systems of the Ensham Mine to meet the requirements of the environmental authority. Consideration has also been given to the relevant management systems in place at Ensham Mine in the conduct of the RV Project studies and the development of the Design Criteria in order to reduce the risk of environmental harm. Examples include the current approved Rehabilitation Management Plan (including successful rehabilitation done to date) and environmental data gathered to date.
11	Any other matter prescribed under a regulation.	In undertaking the RV Project studies, including the development of the Landform Design Criteria for the proposed rehabilitation, an objective assessment has been completed under Schedule 5, Part 3, Table 1 of the EP Regulation. This assessment is incorporated in to Section 6 using footnotes to identify specific compliance requirements. Measurable performance outcomes for rehabilitation domains are contained in the Rehabilitation Management Plan and proposed draft changes to the Ensham EA (Appendix 5c).

Table 3.1.2 s126A Requirements for Site-specific Applications—Particular Resource Projects and Resource Activities

	Element s126A	Location
The application must state the following—		
a	any proposed exercise of underground water rights during the period in which resource activities will be carried out under the relevant tenure;	There is no change to the exercise of underground water rights during the period that the resource activities will be carried out on the tenure. There will be no direct or indirect release of contaminants to groundwater from this option and there will be no actual or potential adverse effect on groundwater from the option. Refer section 6.5.5 of this document. As such there are no changes to the existing groundwater conditions in the Ensham EA.
b	the areas in which underground water rights are proposed to be exercised;	Figure 2.2 of this document identifies the area in which underground water rights are currently exercised. There are no changes to the existing underground water interference proposed by the EA amendment application.
c	for each aquifer affected, or likely to be affected, by the exercise of underground water rights	
(i)	a description of the aquifer; and	There is no change to the exercise of underground water rights during the period that the resource activities will be carried out on the tenure. Aquifers that are relevant to Ensham Mine are described in the Stage 3 Groundwater Report (Appendix 3b) and Section 6.5 of this report.
(ii)	an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water; and	Refer to the Stage 3 Groundwater Report (Appendix 3b) and Section 6.5 of this report.
(iii)	a description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and	There is no change to the exercise of underground water rights during the period that the resource activities will be carried out on the tenure. Refer to the Stage 3 Groundwater Report (Appendix 3b) and Section 6.5 of this report. Of note: there is no predicted long-term decline in groundwater levels post mining.
(iv)	the predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out;	There are no changes to the existing underground water interference during the period of the tenure.

	Element s126A	Location
The application must state the following—		
d	the environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values;	Refer to the Stage 3 Groundwater Report (Appendix 3b), The Stage 3 Environmental Assessment Report Section 6.5 (Appendix 3l) and Section 6.5 of this report.
e	any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the period in which resource activities are carried out;	Refer to the Stage 3 Water Solute and Balance Report (Appendix 3d), Model Run 8 Report (Appendix 5b) and Section 6.3.2.1 of this report.
f	strategies for avoiding, mitigating or managing the predicted impacts on the environmental values stated for paragraph (d) or the impacts on the quality of groundwater mentioned in paragraph (e).	Refer to Sections 6.3.1 and 6.5.5 of this report.

Table 3.2 G20 Elements and Locations

	Condition G20 Criteria	Information Location
The Residual Void Project required by Condition G16 must include, but not be limited to, the following:		
a)	options available for minimising final void area and volume	Options to minimise final void area and volume are contained in the Stage 1 Options Workshop located as Appendix 1 and the Landform design criteria in the Rehabilitation Management Plan Section 5.5 Landform Design Criteria – General.
b)	design objectives for rehabilitation of final voids	Contained in the submitted Rehabilitation Management Plan, Section 5.
c)	void hydrology, addressing the long-term water balance in the voids, connections to groundwater resources and water quality parameters in the long term	Contained in Section 6.3, 6.4 and 6.5 of this report. Plus Appendix 5b: Model Run 8
d)	pit wall stability, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events;	Contained in Section 6.2 of this report.
e)	options available for minimising risk of flood interaction for all flood events up to and including the Probable Maximum Flood level;	Contained in Section 6.4 of this report.
f)	void capability to support native flora and fauna, and	Contained in Section 6.6 and 6.7 of this report.
g)	void rehabilitation success criteria and final void areas and volumes to meet the outcomes in Condition G24	Rehabilitation Management Plan, Section 10 and Table 2.1

3.2 Approvals Flowchart

An approvals flowchart has been prepared to identify approvals required for Option 2. The flowchart has been prepared on the basis of constructing a landform to replace the existing levees. The Approvals Flowchart is located in **Appendix 3j**.

3.3 EA Amendment Application Supporting Information

3.3.1 Key documents

An EA amendment application has been prepared to incorporate the inclusion of the Rehabilitation Success Criteria for the final voids as required under conditions G16, G20, and G24.

This Environmental Authority Amendment Application package includes the following documents prepared for the Residual Void Project:

1) EA Amendment Application
2) Stage 5 Residual Void Report, including all reports required in stages 1, 2, 3 and 4 of the Residual Void Project including corresponding peer review reports;
3) An updated Mine Rehabilitation Management Plan

All documentation has been provided both electronically on a USB device and in hard copy to the Department of Environment and Science (the administrating authority).

3.3.2 Supporting Information for EA Amendment Application

Supporting information to address Sections 11 (Amend Conditions) and Section 13 (Describe the proposed amendment including an assessment of the Minor Amendment triggers) of the EA Amendment Application have been prepared and provided below.

3.3.3 Section 11 – Amend Conditions

- *Do you wish to amend the condition(s) of the environmental authority?*
- *Provide details of: (a) condition number(s); (b) proposed change; and (c) justification for the change.*

A summary of proposed amendments to the EA conditions is provided in **Table 3.3.** A draft set of EA conditions plus Appendix 4 are attached as Appendix 5c. The amended conditions all relate to proposed changes for the Residual Void Project in Section G – Land and Appendix 4 – Rehabilitation Success Criteria.

Table 3.3 Proposed Amendments to EA Conditions

Condition Number	Proposed Amendment	Justification for proposed amendment
G5	Delete condition	This condition has been superseded
G8	Delete condition	Condition has been completed as the rehabilitation required by the condition has been completed.
G9	Delete condition	Condition is superseded
G10	Delete condition	Condition has been completed. The rehabilitation report required by the condition has been submitted.
G12	Proposed Amendments	Minor changes to reflect evolution of the Rehabilitation Management Plan
G25	Proposed Amendments	Amend condition to require annual reporting of rehabilitation activities and monitoring outcomes. Proposed amendments are described in Appendix 5c.
G34	Proposed Amendments	Amendments to reflect that infrastructure may remain on land owned by any of the environmental authority holders, where agreed with the administering authority.
Appendix 4: Rehabilitation Success Criteria	Proposed Amendments	Appendix 4 to be updated to include final landform rehabilitation success criteria as required under G24. Proposed amendments are described in Appendix 5c.
Appendix 5: Progressive Rehabilitation Plans	Deletion condition	Outdated map has been removed. New rehabilitation program is set out in the Rehabilitation Management Plan.

3.3.4 Section 13 – Describe the proposed amendment

Provide a detailed description of your proposed amendment. Include justification of how your proposed amendment meets the criteria for a major or minor amendment and attach any supporting information to this application. If the amendment is to add or delete a location, tenure or activity, or to change the threshold of an activity, provide details below.

The amendment involves the amendment to the rehabilitation success criteria contained in the Ensham EA as required under Conditions G6. The proposed amendments are supported by the studies undertaken as part of the Residual Void Project. In addition, a number of related EA conditions are now superseded and administrative changes are proposed to delete those conditions.

To assess whether the RVP is a minor (threshold) amendment or major amendment, an assessment against the minor criteria listed in Section 3.1 of Guideline ESR/2015/1684 version 7.02 has been undertaken. Responses to these criteria are shown in **Table 3.3.4**.

Based upon the responses to the Minor Threshold Criteria in Table 3.2, it is considered that the amendment can be assessed as a minor amendment as none of the amendment criteria for a major amendment are triggered under the proposed amendment.

Table 3.3.4 Assessment of Minor Amendment (threshold) Criteria

Minor Amendment (threshold) Criteria	Response
(a) Is not a change to a standard condition identified in the EA as a standard condition, other than a condition conversion or replacing a standard condition with a standard condition for the ERA; and	Proposed changes to environmental authority conditions identified in Table 2.1 (above) are due to modifications required to include the final void rehabilitation success criteria in Appendix 4 of the EA. These conditions are not standard conditions.
(b) Does not significantly increase the level of environmental harm caused by the relevant activity; and	The proposed amendment relates to the rehabilitation of already disturbed areas and does not propose to authorise any activities that will result in a significant increase in the level of environmental harm. Impact assessments conducted by specialist consultants and independently peer reviewed, identify that the rehabilitation outcome in the proposed EA amendment will not result in significant environmental harm and results in landforms that are designed to be safe, stable and non-polluting. The assessment of impacts on environmental values for the proposed rehabilitation outcome is described shown in Appendix 4c.
(c) Does not change any rehabilitation objectives in the EA in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the EA; and	The proposed amendment does not change any rehabilitation objectives in the EA in a way likely to result in impacts on environmental values that are significantly different to those currently permitted under the EA. In particular: • The existing EA contemplates that the rehabilitation success criteria be changed. The proposed EA amendment is to update

Minor Amendment (threshold) Criteria	Response

	Appendix 4: Rehabilitation success criteria as is required under Condition G6 of the existing EA;
	• The rehabilitation objectives for domains where the PMLU is sustainable grazing, landholder retained infrastructure and Boggy Creek diversion remain the same as set out in Appendix 4 of the existing EA. While there are some slight changes to the completion criteria proposed in this EA amendment, these are not significant and have been based on site historical data reported annually in WaTers. Groundwater trigger levels remain as in the existing EA Table C9.
	• The EA amendment proposes a PMLU and objectives for rehabilitation of the voids. These however do not result in significantly different impacts to that previously permitted under the EA as:
	  ○ the rehabilitation objectives in proposed new domains provide for each rehabilitation to be safe, non-polluting, geotechnically and erosionally stable and with a self-sustaining vegetation cover upon relinquishment. This is what is currently required under the existing EA condition G4, which provides
	
	"All surface areas significantly disturbed by mining activities must be rehabilitated to a safe, stable and non-polluting landform, with self-sustaining vegetation cover in accordance with Appendix 4: Rehabilitation Success Criteria (condition G4)"
	  ○ The proposed completion criteria are consistent with the completion criteria for sustainable grazing for all criteria except slope gradient and vegetation cover, which have been assessed as

Minor Amendment (threshold) Criteria	Response
	suitable for the proposed PMLU for these domains. ○ The proposed rehabilitation objectives also meet the requirements of Condition G15 where *"residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself"* For the 153.2ha of land involved in the Water Area PMLU groundwater will emerge ~50-55 years after mining ceases and is modelled to reach equilibrium between 2140 and 2220. This area is only 2.57% of the total area disturbed and will function as an aquatic habitat. Table 4.2 of the Stage 4 TBL Assessment Report summarises the Stage 3 EV impact assessments conducted by suitable experienced and competent consultants which was then confirmed by the Independent Peer Review process. The are no negative impacts to any EV for the proposed rehabilitation greater than insignificant and as such this proposed rehabilitation will not cause any serious environment harm.[3] This said the groundwater daylighting is a result of the void in of itself as contemplated by condition G15. ○ The environmental assessments attached have identified that the rehabilitated residual voids will not cause any serious environmental harm

[3] Refer to page 28 Table 4.2 of the Stage 4 TBL Assessment Report

Minor Amendment (threshold) Criteria	Response
	to land, surface waters or any recognised groundwater aquifer. In summary, it cannot be said that the change results in significantly different impacts to that authorised under the current EA.
(d) Does not significantly increase the scale or intensity of the relevant activity; and	The proposed EA amendment seeks to include the residual void rehabilitation success criteria in Appendix 4 of the EA. All rehabilitation works will be conducted in previously disturbed land within the Project area will not significantly increase the scale or intensity of the currently approved mining activity.
(e) Does not relate to a new relevant resource tenure for the EA that is—	
(i) a new mining lease; or	Not applicable – the proposed amendment does not relate to a new mining lease
(ii) a new petroleum lease; or	Not applicable – the proposed amendment does not relate to a new petroleum lease
(iii) a new geothermal lease under the *Geothermal Energy Act 2010*; or	Not applicable – the proposed amendment does not relate to a new geothermal lease
(iv) a new greenhouse gas injection and storage lease under the *Greenhouse Gas Storage Act 2009*; and	Not applicable – the proposed amendment does not relate to a new greenhouse gas injection and storage lease
(f) Increases the existing surface area for the relevant activity by 10% or less; and	The proposed EA amendment does not increase the existing surface area of the Ensham Mine by more than 10%. To proposed amendment involves the inclusion of the residual void completion criteria related to the rehabilitation of already disturbed areas. The additional 58ha required for the increased footprint of the rehabilitated landform is proposed to be located within an area of already disturbed land in the Project area. The additional 58ha

Minor Amendment (threshold) Criteria	Response
	represents only 0.9% of the total area disturbed at Ensham Mine.
(g) For an EA for a petroleum activity: (i) involves constructing a new pipeline that does not exceed 150km in length; and (ii) involves extending an existing pipeline by no more than 10% of the existing length of the pipeline; and	Not applicable – the EA is not a for petroleum activity
(h) Is for a new relevant resource tenure for the authority that is an exploration permit or greenhouse gas permit— where the amendment application seeks an EA that is subject to the standard conditions for the relevant activity, to the extent it relates to the permit.	Not applicable. The proposed EA amendment application is not for a new resource tenure for an authority that is an exploration permit or greenhouse gas permit.

4 Option Selection Process

4.1 Process Overview

A triple bottom line assessment (TBLA) was conducted to include a comparative assessment of the residual void options having regard to the environmental, social and economic impacts of this option. The development of the TBLA addresses the key findings of the RVP studies, which have been undertaken by suitably qualified and experienced consultants and independently peer reviewed.

An agreed rating system to quantify any impact on Environmental Values (EV) is contained in each study report and provides a quantitative assessment of the impacts on EV for each Preferred Option. The EV assessment and subsequent risk assessment was designed to assess the options against the EA requirement that residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself, in accordance with Condition G15 of EA EPML00732813. Condition G4 of the EA also requires that all surface areas significantly disturbed by mining activities be rehabilitated to a safe, stable and non-polluting landform, with a self-sustaining vegetation cover. Impacts for identified EV's have been assessed in accordance with the agreed outcomes of the Stage 2 EV's workshop. The rating system adopted for the assessment is consistent with the outcomes of the Stage 2 EVs workshop and involves an assessment range of -3 to +3 (The scoring system is further detailed in Section 2.2 of the TBLA).

This TBLA also considered the financial implications of each option. Costs must be reasonable in the circumstances having regard to the costs of each Preferred Option, the capacity of Ensham Mine to manage the costs and any gain for improved environmental outcomes. Essentially, if the cost of one Option is greater than that of an alternative, and only achieves a marginal reduction in environmental harm, the marginal environmental gain may not justify the additional expenditure. This is consistent with the DES guideline in the Assessment requirements for making a decision for an Environmental Authority for an Environmentally relevant activity (24 March 2015).

The development of the TBLA assessment tool provides a comparative assessment method analysis of the three preferred options. The TBLA tool, including the methodology and the stage gate questions, has been independently peer reviewed by the University of Queensland Sustainable Minerals Institute (the suitably qualified third party) prior to the assessment being undertaken. The IPR attended the TBLA workshop as an independent observer to verify the transparency process and that information discussed and concluded at the workshop is accurately reflected in the TBL Report. All RVP study reports for each Preferred Option have been independently peer reviewed by a suitably qualified third party and form the basis of the TBLA. A Risk Assessment has been completed to identify and quantify risks associated with each Preferred Option. The detailed design for each option was of sufficient quality and specification to inform the risk assessment, a Hazard Operability Risk Assessment, as supported by the participants in the risk assessment. The experience of the risk assessment team members, which informs their suitability to participate in the risk assessment, is documented in the risk assessment report.

An Economic Impact Assessment (EIA) was undertaken by Deloitte Access Economics and independently peer reviewed by a suitably qualified third party. The EIA was completed consistent with the requirements of the Economic Impact Assessment Guideline (2017) published by the Queensland Department of State Development, Manufacturing, Infrastructure and Planning. The monetised benefits and employment generated for each Preferred Option, for both direct and economy wide contributions, is included in the TBLA.

A Social Impact Assessment (SIA) was undertaken by Umwelt (Australia) Pty Limited and independently peer reviewed by a suitably qualified third party. The SIA was completed consistent with the requirements of the Social Impact Assessment Guideline (2018) published by the Queensland Department of State Development, Manufacturing, Infrastructure and Planning. The outcomes of the SIA have been included in the TBLA.

All Stage 1, 2, 3 and 4 reports were submitted to the administrating authority for their review and comment prior to being finalised. Ensham has considered the feedback received by the administrating authority continuously throughout the RVP, including the letter correspondence on 10 and 14 January 2019 and feedback on Stage 3 Reports, Economic Impact Assessment and Social Impact Assessment received on 6 and 11 February 2019.

The Option 2 design has evolved from consultation with the administering authority, to the delivery of a rehabilitated landform that allows Ensham Mine to meet rehabilitation obligations whilst preserving the optionality into the future of a water storage facility subject to a future application. These changes have been presented and discussed with the Community Reference Group members, the Central Highlands Regional Council and the administering authority. Both the CRG and Central Highlands Regional Council have provided feedback that in light of the future reservoir opportunity created by the retention of the design criteria that they support Option 2 as the final preferred option. There have been clear discussions that any future reservoir would be subject to a separate approval process to this option.

Notwithstanding that the Stage 3 Reports, with the economic and social assessments were based on the original Option 2 design and PMLU of a reservoir, the TBLA assessed the revised Option 2 as discussed in Section 1.7.

The economic section of the TBLA has not relied on the Economic benefits of the reservoir, rather the TBLA has considered the value of a PMLU of grazing, drawn from Option 1. This said, it is appropriate to recognise the future potential benefit in terms of benefit to the community of a potential future reservoir in the social section of the TBLA.

The TBLA uses the values scores drawn from the Stage 3 Reports to identify the environmental impacts on Environmental Values, Social Impact and Economic Impacts as part of the RVP. The TBLA then considered 14 stage gate questions for each Option which cover key aspects of environment, economic and social considerations. Regulatory approval flowcharts were prepared prior to TBLA for each Preferred Option (refer to Appendix 3j). If any Preferred Option did not return a positive response to any of the 14 stage gate questions, that Preferred Option is deemed to be not suitable as the Final Option. For full details of the TBLA refer to Appendix 4c: Stage 4 Triple Bottom Line Report.

4.2 TBL Findings

The TBLA was held on Tuesday 22 January 2019. Appendix 4c provides a list of all attendees. A summary of the TBLA is provided in **Figure 4.2** below:

	Environmental	Economic	Social
Option 1 - Landform Levee			
Option 2 - Flood Mitigation and Beneficial Use			
Option 3 - Backfill to PMF			

Figure 4.2 Triple Bottom Line Assessment Summary

Key summary of the results:

- All Preferred Options have been assessed as not causing any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself.

- Whilst Option 3 may not cause any serious environmental harm, the option does not represent best practice environmental management for treatment/mitigation of negative impacts. This is the reason for the negative Environment outcome for Option 3. This is detailed in the response to stage gate Question 4 in **Appendix 4c**.

- Option 2 is the only Preferred Option which passes all 14 stage gate questions for Environment, Social and Economic.

- Both Option 1 and Option 3 do not pass the Economic and Social areas. Both options have significantly increased capital costs with limited additional benefits to environment, social or economic outcomes when compared to Option 2.

- Option 3 main concerns include, but are not limited to: SIA Report -"Therefore, in summary, Option 3 will result in only small/MINOR economic benefit to the community as there are a small number of local employment opportunities and an increase in useable land for landholders." (pg. 103); EIA Report - "Option 3 has the lowest source of benefit from residual value of land, valued at $1.8 million, due to be backfilling of the voids. However, benefit from backfilling is offset by increase in greenhouse gas emissions, and to a lesser extent, a small increase in flooding risk given a large magnitude event (i.e. 1% annual exceedance probability) (Hydro Engineering & Consulting Pty Ltd, 2018)." (page 48); and environment concerns of landform erosion from extreme flood levels which are likely to cause disposition of sediment into the receiving environment (Nogoa River and subsequent downstream water courses), this is further detailed in section 4.1.

- Option 3 is the least Preferred Option.

Based upon the above findings, and in full compliance with the ToR, the TBLA concluded the preferred Final Option to be **Option 2: Beneficial Use (with a post mining land use of grazing and native bushland corridor).**

Initially it was proposed that Option 2 would include a water reservoir as a PMLU. Following feedback from DES and DNRME, Option 2 has been revised and no longer has a water reservoir as a PMLU. The following changes have been incorporated into this option:

1) Removal of the reservoir as a PMLU,
2) Removal of civil works required to support the water reservoir PMLU;
3) Conversion of the existing 0.1% AEP levee to a 0.1% AEP Landform, recognising that there would be no reservoir operator under this Option to manage the Regulated Structure obligations of the existing levee. This landform will be as described for Option 1; and
4) Topsoiling and seeding of the inward facing slopes which were previously under the modelled reservoir Full Supply Level, as these areas will no longer be inundated in this Option.

Otherwise this Option landform design remains the same as previously proposed for Option 2.

5 Description of this Option

5.1 Landform Description

This Option involves partial backfilling of the residual voids to create a rehabilitated landform consistent with the regional topography protected by permanent landforms. These landforms have been designed and independently peer reviewed by RPEQ certified engineers and would be along the existing levee alignment to provide flood immunity and exclude the rehabilitated areas from flood interactions up to and including a 0.1% Annual Exceedance Probability (AEP) event.

It is proposed to incorporate the existing levees into the landform design, with overburden emplacement areas behind the levee being reshaped in a manner that achieves a stable landform. All slopes have been designed to exceed a Factor of Safety (FoS) of 1.5. In doing so the design of this Option delivers long-term safe and stable slopes with Post Mining Land Uses (PMLUs) of:

- Sustainable Grazing/ Water Body
- Self-Sustaining Vegetated Cover
- Native Bushland Corridor
- Mining Infrastructure Retained, and
- Boggy Creek Diversion.

Figures 5.1. and 5.2 provide a visual representation of the landform cross sections for this Option. Actual cross sections for the final landform are contained in the Rehabilitation Management Plan.

The inward facing slopes of the rehabilitated void would be at a maximum of 25% and would likely include rock mulching or other suitable treatment to further reduce erosion risk potential. Overburden slope grades remain as currently approved in the Ensham Environmental Authority and as such do not require approval as part of this application. The PMLU for the low wall rehabilitated areas would remain as grazing, which is the current approved PMLU for this area. Cattle would be able to move across and between all slopes up to 25% freely to forage for feed

Slope angles greater than 33% are not suitable for cross grade traffic of machinery however these slopes will support grazing activities. Similarly slope angles up to 100% with self-sustaining vegetated cover will support grazing activities, albeit with a lower preference from stock and capacity to carry the same stock.

Self-sustaining vegetative cover which would be applied to the steeper slopes such as high wall slopes at 100% and would occupy 205 ha or 3.4% of the total rehabilitated area. All of this 205 ha sits within land owned by Ensham.

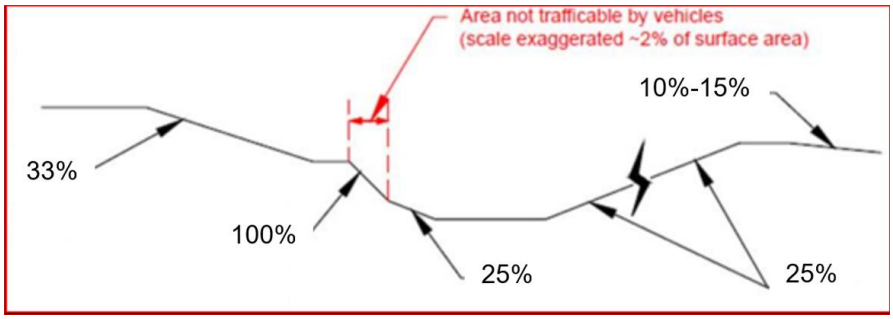


Figure 5.1 Diagrammatic Cross Section of A, B, C, D and E Landforms

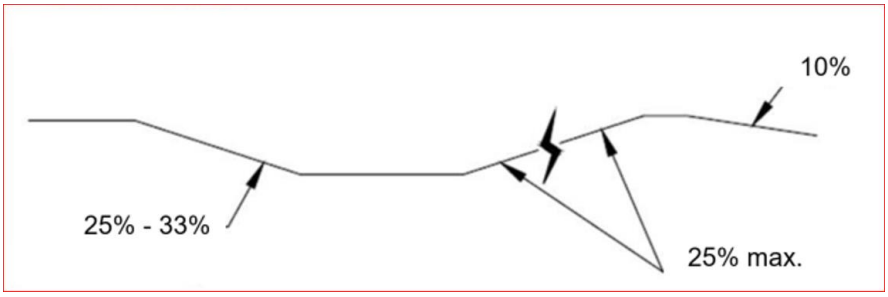


Figure 5.2 Diagrammatic Cross Section of F and Y Landforms

The existing 0.1% AEP levees adjoining A, B, C and D pits will be upgraded to 0.1% AEP landforms that exceed a FoS of 1.5 to ensure that these areas safe and stable into perpetuity.

Important additional information:

- Groundwater has been modelled and indicates that groundwater would daylight in a number of the rehabilitated land forms over the modelled 240 year period post mining. Ground water salinity levels over the same period are modelled to climb to ~26,000 EC over this same period. Further information on groundwater levels, volumes and hectares involved can be located in the Ensham Coal Mine Residual Void Project: Stage 3 Void Water Quantity and Quality Balance Modelling Report, Table 10, page 26.

  It is important to note that the modelled salinity does not represent hypersaline water, which is generally accepted as being water that exceeds seawater salt quality.

- F and Y rehabilitated areas are designed such that groundwater would never daylight.[4]

- A native bushland corridor has been designed adjacent to the highwall between Corkscrew Creek and the Nogoa River, which would reduce any visual impacts that may be associated with the rehabilitated landforms, and

- The rehabilitated areas are designed to be consistent with and blend with the regional escarpment landscape. As such this Option is not expected to have any significant impact on the visual amenity of the area.

To understand how the overall rehabilitation of Ensham fits into the regional context, **Table 5.1** shows the total hectares for each slope angle and percentage total of the slope grade.

Slope gradients equal to or less than 15% are suitable for grazing purposes and total some 4,658 ha out of a total available area of 5995 ha, or in percentage terms 77.6%, of the total rehabilitated area. A further 420 ha, or in percentage terms 31.4%, of the remaining 1,337 ha's rehabilitation will be dedicated to regional biodiversity connectivity through the provision of the native bushland corridor and Boggy Creek rehabilitation.

[4] Section provided in response to line 92 of the Stage 3 DES feedback sheet.

Table 5.1 Hectares for Each Slope Angle

Slope	Domain	AB	CDE	FY	Total	%
0 - 10%	Grazing	1,358	1,396	1,218	3,972	66.26%
11 - 15%		212	280	194	686	11.44%
16 - 25%	Self-sustaining vegetation	175	254	214	643	10.73%
26 – 33%		98	322	68	488	8.14%
34 – 100%		52	81	73	206	3.44%
>100%		0	0	0	0	0.00%
Total		*1,895*	*2,333*	*1,767*	*5,995*	*100%*

Note:

1. The 73ha shown in the table above are not from mine rehabilitation slopes. Rather this 73ha area is immediate to the rehabilitation area and has been included in the modelled area due to limitations in the modelling tool. There are no 34-100% slopes in F&Y rehabilitation areas.

2. The Native Bushland Corridor covers all angles on the high wall from 0-33%. The Native Bushland Corridor does not extend down into >33% slopes on the high wall.

6 Summary of Impact Assessment

The environmental values that could be affected by this proposed amendment were identified and reported in the Stage 2 Environmental Values Workshop. Detailed information on the impacts for each EV are detailed in the Stage 3 environment specific studies, the Stage 3 Environment Assessment Report, the Social Impact Assessment Report and the Economic Impact Assessment Report.[5]

An assessment of impacts on EV of each Preferred Option was undertaken by each consultant in Stage 3 with the assessed impact on each EV independently peer reviewed by a suitably qualified and experienced consultant. A quantitative assessment of the impacts on each EV for this Option was undertaken using the rating system described below.

In summary, the technical studies assessed the environmental impact of this Option against each EV, using the scoring ranking range from -3 to +3, further explained in the following two tables.

Scoring Criteria	Ranking
Significant negative impact for this consideration	-3
Medium negative impact for this consideration	-2
Minor negative impact for this consideration	-1
No impact/benefit for this consideration	0
Minor benefit for this consideration	+1
Medium benefit for this consideration	+2
Significant benefit for this consideration	+3

Description of Scoring criteria
Significant impact/benefit – results in a change which is important, notable or of consequence to the EV having regard to its intensity/frequency. For an impact the change will result in not being able to meet published standards (if there are any). For a benefit the change should meet best practice standards (if there are any published)
Medium impact/benefit – results in a change which is potentially important, notable or of consequence to the EV having regard to its intensity/frequency. For an impact, the change will result in occasions where the criterion will not meet published standards (if there are any). For a benefit the change should meet good practice standards (if there are any published)
Minor impact/benefit – results in a change which is identifiable but is not important, notable or of consequence to the EV having regard to its intensity
No impact/benefit – results in no discernible change, or is of no consequence to the EV

The following section of this report summarises the EV impact assessment, documented in Stage 3 of the RVP. The following summary assessments include an objective assessment under Schedule 5, Part 3, Table 1 of the EP Regulation for each EV.

[5] Section provided in response to line 48 and 69 of the Stage 3 DES feedback sheet.

The Stage 3 studies have been guided by the management hierarchy which aims to eliminate impacts wherever possible, then use engineering design controls, and then administrative controls as a final resort.

Feedback from various stakeholders, in particular, the Community Reference Group and the administering authority have been considered as part of the RVP. Footnotes are provided to reference where DES Stage 3 feedback has been specifically addressed.

6.1 Climate

6.1.1 Description of Environmental Values (EV)

The EVs that are relevant to the aspect of Climate are shown in **Table 6.1.1,** with a summary of assessment following. The detailed impact assessment on this aspect is contained in Section 6.2 of the Stage 3 Environmental Assessment Report.

Table 6.1.1 Climate Environmental Values

Environmental Aspect	Environmental Value	Assessment Considerations
Climate	Increased vulnerability of other EVs	Covered in individual EV assessments
	Air quality degradation - emissions	Dust
		Odour
		Fuel usage
Hazards & safety	EV vulnerability due to climate change	Covered in individual EV assessments

6.1.2 Current Climate

The project site is located in Central Queensland Region and has a sub-tropical climate, characterised by hot, moist summer and warm, dry winters.

The closest Bureau of Meteorology (BoM) station to the site is the Emerald Airport station (035264) with data collection starting in 1992. Mean annual rainfall recorded at this station is 561 millimetres (mm), which occurs predominantly in the wet season between October and March. Rainfall is highly variable, with the lowest being 284.1 mm in 2001 and highest recorded rain being 1099.2 mm in 2010. The warmest months are December and January, with a mean maximum temperature of 34.2°C and 34.5°C, respectively. Historical mean rainfall and temperatures for this weather station are provided in **Figure 6.1.1.**

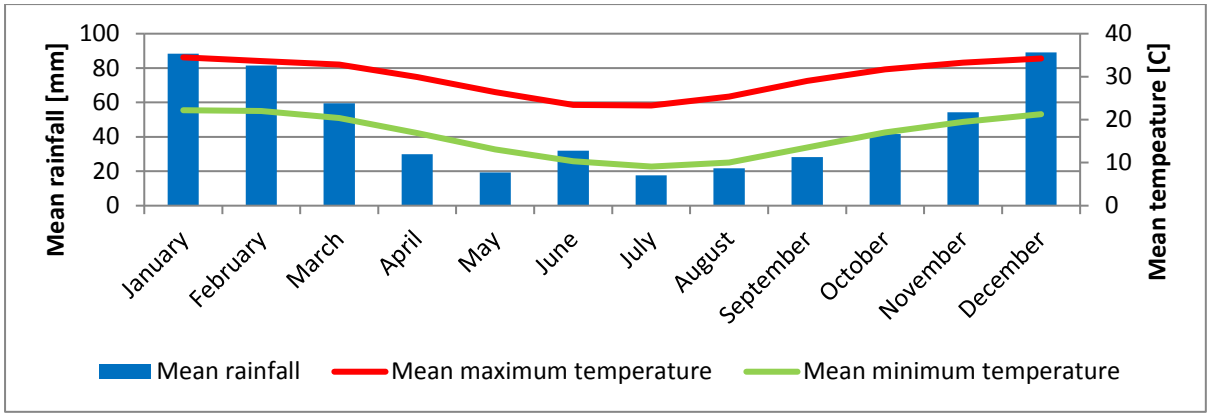


Figure 6.1.1 Mean Rainfall and Temperatures for BoM Station 035264

(Source: BoM, 2018a)

BoM assessed the average areal potential evapotranspiration for the area as 1,600-1,700 mm per year, whereas the average areal actual evapotranspiration is estimated by BoM to be between 500-600 mm per year. The sizeable difference between potential and actual evapotranspiration is due to the limitations of soil moisture being available for vegetation. Due to the large scale of the assessment undertaken by BoM, local differences to the values reported are to be expected.

6.1.3 Impacts to Environmental Values

Any potential impacts of this Option on EVs relevant to climate would be due to impacts from climate change. The Final Option is not expected to have any measurable impact on climate change.

6.1.4 Mitigation and management

No specific management and mitigation measures are proposed for climate. Where climate change predictions influence other EVs and management and mitigation measures are required, these are noted where relevant below[6].

Based upon the identified impacts and mitigation/management measures discussed above, the impacts to the Climate values have been provided in **Table 6.1.4**.

Table 6.1.4 Impacts on Climate Environmental Values

Environmental Aspect	Environmental Value	Assessment Considerations	Ranking	Evidence
Climate	Increased vulnerability of other EVs	Covered in individual EV assessments		
	Air quality degradation - emissions	Dust	0	
		Odour	0	
		Fuel usage	0	
Hazards & safety	EV vulnerability due to climate change	Covered in individual EV assessments		

[6] Refer to page 100 of the Stage 3 Environmental Assessment Report

6.1.5 Commitments

There are nil additional commitments for this EV.

6.2 Land

6.2.1 Description of Environmental Values (EV)

The EVs that are relevant to the aspect of Land are shown in **Table 6.2.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.3 of the Stage 3 Environmental Assessment Report.

Table 6.2.1 Land Environmental Values

Environmental Aspect	Environmental Value	Assessment Considerations
Land	Visual amenity	Visual impact
	Landform stability	Slope failure
		Erosion
	Incompatible land uses	Land capability class
	Agricultural potential	Long term available area
Contaminated Land Potential	The scoring of this EV is addressed by the Waste Generation & Environmental Dispersal EV	

6.2.1.1 Land Setting

Topography

The Project Area is located in a landscape with alluvial floodplains and rolling hills, with Tertiary plateaus situated in the north of the mine. The Nogoa River and its anabranch flow through the Project Area in a south-easterly direction. The southern floodplain of the Nogoa River gently slopes to the south-west towards a low rise derived from Tertiary material. The rise has an elevation of 170m AHD while the floodplain has a height of approximately 150 m AHD. Portions of Pit B and Pit C are located in the floodplain, whereas Pit A is situated in the rise which is formed by highly weathered Tertiary hills.

Pits D, E, F and Y are located between undulating hills and Tertiary plateaus. These plateaus are running in a south westerly direction. The plateau slopes generally have a gentler decline towards the pits and steeper slopes towards unmined land. Maximum elevation in the west is approximately 270 m AHD, and approximately 300 m AHD in the east.

6.2.1.2 Geology

Table 6.2.1.2 provides a summary of the stratigraphy encountered within the Project Area (AGE, 2017a).

Table 6.2.1.2 Summary of Project Area Stratigraphy

Age	Unit	Description
Quaternary	-	Alluvium – comprising soil, silt, clay, sand and gravel.
Tertiary	Emerald Formation	Mudstone, sandstone, conglomerate, siltstone sediments, weekly consolidated in parts. Tertiary volcanics (basalt) are also mapped as being present over 10km west of the site.
Triassic	Rewan Group	Mudstone with lithic sandstone interbeds.
Permian	Rangal Coal Measures	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Coal seams include the Aries, Castor, Pollux and Orion seams. The main economic seams at Ensham are the Aries 2 and Castor seams.
	Burngrove Formation	Sandstones, siltstones and mudstones, and banded coal seams frequently interbedded with tuff and tuffaceous mudstones - coal seams include the Virgo and Leo seams.
	Fair Hill Formation	Lithic and feldspathic labile sandstone, siltstone, mudstone and conglomerate.
	Macmillan Formation	Lithic and feldspathic sublabile mudstone, siltstone and sandstone.

6.2.1.3 Soils

Regional Context

In the Nogoa River floodplain, the Comet and Humboldt land systems are the dominant land systems, which have no or few limitations to agriculture. Further, Monteagle (texture contrast soil, Agricultural Land Class C), Junee (red and yellow earths, Agricultural Land Class C) and Durrandella (shallow, rocky soils, Agricultural Land Class C to Class D), amongst others, can be found in the region (Story *et al.*, 1967).

The site is located between two Important Agricultural Areas, namely The Golden Mile to the east and Central Highlands to the west. The Golden Mile is characterised as high-quality soils leading to areas of high quality grazing and cropping land. Cattle growth rates are high in the area and the Golden Mile is an important beef supply area (DAF, 2013).

The Central Highlands area is defined by extensive cropping, high productivity grazing land in addition to current and potential horticultural use. Cropping from the Central Highlands area contributes significantly to the supply of grains and cereals to domestic and international markets. The area is an important contributor for the consistent supply of these goods to the market. More regionally, the Emerald irrigation area supports large citrus orchards and grape vines (DAF, 2013).

Soils of the Project Area

Soils of the Project Area range from high quality agricultural soils in the floodplains to poorer quality soils in the hilly areas.

The majority of the existing B Pit levee and most of C Pit levee are located in or adjacent to the Comet land system, which are alluvial plains and cracking clay soils. The northern extent of the C Pit levee and the southern extents of B Pit levee are in the Humboldt land system, which is a mixture of cracking clays and texture contrast soils (Story et al., 1967). The Comet land system has been classed as Crop Land – Broadacre and Horticulture (Agricultural Land Class A). The Humboldt land system has slightly more limitations to agriculture (Agricultural Land Class B with occurrence of Class C) (Hansen Consulting, 2006).

The land system around Pit A is the Monteagle land system, where erosion, salinity or alkalinity are the main limitations to agriculture. The land system to the north-east of Pit C is the Blackwater land system, which is defined as cracking clays with some texture contrast soils. Due to limitations including erosion, salinity and/or alkalinity this system has been classed as capable for undertaking cultivation with moderate limitations (Pasture Land – Sown pastures, and native pastures on high fertility soils) (Story et al., 1967; Hansen Consulting, 2006). Details can be found in Figure 5.3 of the Environmental Assessment Report.

The detailed soil survey undertaken for the 2006 EIS showed that the soils adjacent to the northern part of the B Pit levee and to the south-western, southern and south-eastern part of C Pit levees are cracking clay soils (Vertosol) and non-cracking clay soils (Dermosol). The soils in the western extent of the Nogoa River, Nogoa Anabranch and Winton Creek have all been mapped as predominantly Vertosols with interspersed Dermosols. These areas have been identified to be cropping land with nil to moderate limitations (Agricultural Land Class A). The Winton Creek floodplain and creeks feeding to this creek as well as to the Nogoa Anabranch are classed as pasture land for improved or native pastures (Agricultural Land Class C). This is due to a combination of factors including flooding risk, increased salinity and sodicity, some rooting restrictions in the subsoil and steepness of slope. The creeks and creek benches themselves are classified as non-agricultural land (Agricultural Land D), due to steep slopes, rocky soils or poor drainage (Hansen Consulting, 2006).

The soils along the northern part of the C Pit levee are predominantly non-cracking clay soils with a slight potential of the occurrence of some texture contrasts soils (Sodosol) together with sodic Dermosols. They have been assessed as Agricultural Land Class B (limited crop land). The southern part of B Pit levee is adjacent to Dermosols mixed with Kandosols and Tenosols. The former are Agricultural Land Class B and the latter Agricultural Land Class C. For the Class C land, the main limitations are hard setting surface, elevated sodicity and salinity and slope (Hansen Consulting, 2006).

In the 1990 EIS (Hollingsworth, Dames and Moore), the soils adjacent to the A Pit levee were mapped as Rudosols and Sodosols. These soils have an Agricultural Land Class B to Agricultural Land Class C. Soils to the north-eastern part of the C Pit levee are mapped as Vertosols with an Agricultural Land Class B.

6.2.1.4 Overburden Characteristics

The existing hydrogeochemistry of the coal and mine waste has been characterised by RGS (2018). The assessment found that the coal and mine waste materials generated at Ensham, and which will be used in backfilling of the residual voids, can generally be described as having a low sulfur content and excess acid buffering capacity. Most materials are classified as non-acid forming (NAF) and have a high factor of safety with respect to potential for acid generation. As such there is very low potential

to produce acidic drainage due to the low sulfide content.[7] The total metal/metalloid concentrations measured in coal and mine waste samples were found to be typically low, and only elevated in a small number of samples. The kinetic leach test data demonstrated that most metal/metalloids were sparingly soluble in leachate, and concentrations are low. RGS concluded that, based on available information, it is expected that the risk of any acid issues or elevated concentrations of metals/metalloids in surface water and groundwater resources is expected to be low. This finding was supported by the Independent Peer Reviewer.[8]

The static and kinetic geochemical test work on drill core and in pit spoil samples showed that the salinity in the Quaternary sediments was generally elevated and quite variable, whereas the salinity in the Tertiary and Permian materials was lower and more consistent. Again, this finding was supported by the Independent Peer Reviewer.[9]

It should be noted that the salinity of regional groundwater in the Project Area is elevated under natural (pre-mine) conditions (RGS, 2018). In particular, elevated salinity in groundwater associated with the shallow groundwater system and Quaternary alluvium, and to a lesser extent with the deeper groundwater systems in the Tertiary and Permian strata, is already apparent (groundwater quality is discussed further in the Material characterisation and source term development for the Stage 3 Geochemisty Report (RGS, 2018). Based on available information, the risk of the development of saline drainage from spoil is expected to be low to moderate (RGS, 2018).

6.2.2 Impacts to Environmental Values

6.2.2.1 Visual Amenity

Figure 6.2.2.1 provides a conceptual visualisation of the rehabilitated final landform. The visual setting would be similar to the regional landscape, with the landforms and slopes rehabilitated to be visually consistent with the surrounding environment.

A native bushland corridor would be established along the highwall between Corkscrew Creek and Nogoa River and up to the escarpment west of D Pit, which would reduce any visual impacts that may be associated with the final landform. However, the landform is not expected to have any material impact on the visual amenity of the area[10].

[7] Section provided in response to line 13 of the Stage 3 DES feedback sheet and Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Water.
[8] Section provided in response to line 36 of the Stage 3 DES feedback sheet.
[9] Section provided in response to line 12 and 14 of the Stage 3 DES feedback sheet.
[10] Refer to page 100 of the Stage 3 Environmental Assessment Report

Figure 6.2.2.1 Visualisation of the Final Landform

The full design criteria for the above landform is contained in Table 6.2.2.2 (below). The process for rehabilitation of each domain is detailed in Table 7.1 of the Rehabilitation Management Plan.[11]

6.2.2.2 Landform Stability

The landform design was based on achieving key rehabilitation goals including the landform being safe, stable and non-polluting, with a self-sustaining vegetation cover in accordance with condition G4 and the EA.

The landform assessment identified that in order to achieve a safe and stable landform regrading of the residual voids would be required, including the highwalls, endwalls and spoil dumps. This has been done to achieve geotechnical stability and reduce erosion. Details of the landform design criteria adopted for rehabilitated landform are listed in **Table 6.2.2.2**.

Table 6.2.2.2 Landform Design Criteria

Domain	Design Treatment
General	• Final landform to be water-shedding with no ponding shapes – minimum slopes of 1% to be adopted draining to voids or to watercourses. • Final landforms to be generally free-draining other than landform regraded towards the residual voids. • F & Y pit rehabilitated areas are designed to not retain rain run off (lowest points are to be downward draining to groundwater) • Regrading to provide a materials balance between cut and fill. • Regrading to provide a balance between backfilling of the pits and volume of space required to support the option of a viable reservoir into the future. • Minimum volumetric movement to achieve landform objectives.

[11] Section provided in response to line 28 of the Stage 3 DES feedback sheet.

Outward slope of spoil	• Regrade to a slope of 10% for Tertiary spoil rehabilitation in line with current site practices, with slope length up to a maximum of 200m between benches. • Regrade to a slope of 15% for Permian spoil rehabilitation in line with current successful site practices, with slope length up to a maximum of 100m between benches. • No permanent drainage structures to be incorporated in the landform. • 10 m wide non-drainage bench at the frequency described above to break runoff velocity down slopes. • Slopes to be topsoiled (or ameliated) with self-sustaining vegetation cover, benches to be seeded with trees.
Inward slope of spoil	• Maximum of 25% for all spoil with durable rock mulching or other suitable controls.
Highwalls and endwalls	To achieve long-term stability, highwalls must be regraded as follows: • Tertiary material – maximum slope 33%. • Weathered Permian – maximum slope 33% – for the purposes of landform design weathered Permian to be regarded as Tertiary material due to lack of information on the interface between these two materials, which aligns with current rehabilitation practices on site. • Fresh Permian – maximum slope of 100%. • Minimum 5 m wide bench to be provided between weathered and fresh Permian layers. • Buttressing of highwalls from pushed or blasted material from the highwall side to be sloped inward at a maximum slope of 25%. • A 100m wide native bushland corridor to be provided down to the 33%/ 100% interface. Trees species to be native species evidenced to thrive within the project area.
Land bridges	• No treatment required – access to land bridges to be cut off by earth bunds.
Ramps	• All ramps are to be partially infilled to create slopes that comply with spoil regrade requirements stipulated elsewhere in this table. • Ramp embankments to be battered back at 25%.
Landform (current levee)	• 0.1% AEP Landforms to replace the existing approved Regulated Structure 0.1% AEP levees at B & C/D Pits • 0.1% AEP Landforms on both sides of the river to have 0.1% AEP overtopping design points. • Outward facing slopes are no greater than 16%. • Top of landform levee is a minimum of 10m. • Landforms are design to minimise erosion

The landform has been designed to exclude rehabilitated areas from the floodplain up to and including 0.1% AEP event. Rain runoff on inward facing slopes of the rehabilitated land would have low salinity

and would collect in the lower areas of the rehabilitated land separate from the receiving environment[12].

Water draining from outward facing slopes to the receiving environment would have low salinity and present minimal risk to the environment. There is no risk of water within the rehabilitated landform (inward facing slopes) flowing to the receiving environment[13] unless an extreme flood event occurs (e.g. greater than a 0.1% AEP event for this catchment) which is considered low probability based upon historical data.

Depending on the nature of spoil material adjacent to the residual void, the inward facing spoil would be regraded to a maximum slope of 25%. Outward facing spoil would be regraded to no greater than 15%. The regraded slopes on spoil dumps would have self-sustaining vegetation (e.g. grass), and benches would be seeded with tree species currently proven with existing rehabilitation.

The proposed landforms, replacing the existing levees, would be constructed from spoil material that complies with technical requirements for levee construction materials in terms of clay content, linear shrinkage and dispersivity. Compaction of this material to an engineering standard would be undertaken to prevent excess settlement, and development of localised preferential drainage paths that could lead to piping failure in these embankments over time.[14] The levee structures would be topsoiled and grassed to reduce erosion potential.

A geotechnical assessment was undertaken by WSP (2018) to evaluate the stability and erosion potential of the final landforms. A Factor of Safety (FOS) of 1.5 has been adopted for the assessment as the minimum required to ensure the long-term stability of the final landforms. Appendix 5d contains a letter from WSP confirming the suitability of applying the Option 1 Landform to Option 2, along with a letter from the IPR confirming the same.

For this landform, highwalls and low wall spoil piles would be regraded and left as long-term stable structures. Permanent landforms would be constructed with batter slopes to minimise erosion potential.

The final rehabilitated areas will have considerably improved batter slopes for highwall, endwall and spoil in terms of erosion potential, compared with the existing un-rehabilitated landform. Low wall spoil slopes would be topsoiled and/or ameliorated to promote and sustain vegetation growth. Inward facing slopes would be regraded to a maximum of 25% as shown in **Figures 5.1 and 5.2**. The inward facing slopes of the low wall spoil at a maximum of 25% would likely include rock mulching or other suitable treatment to further reduce erosion risk potential. The need for additional site trials of 25% slopes has been identified in the landform report. This recognises that a safe and stable 25% slope exists at site already however further trials are intended to improve the erosion performance of these slopes which currently exceed a FOS of 1.5.[15] The Post Mining Land Use (PMLU) for the low wall rehabilitated areas incorporating slopes up to 15% would remain as grazing, which is the current approved PMLU for this area.

[12] Refer to page 101 of the Stage 3 Environmental Assessment Report
[13] Refer to page 101 of the Stage 3 Environmental Assessment Report
[14] Section provided in response to line 34 of the Stage 3 DES feedback sheet.
[15] Section provided in response to line 29 of the Stage 3 DES feedback sheet.

Based on the output of the studies and site experience in rehabilitation it is expected that all slopes discussed above, once self-sustaining vegetative cover is achieved, would perform well with respect to erosion caused by water moving through the landform.[16] Table 3.1 of the Rehabilitation Management Plan contains a period of approximately 10 years post rehabilitation to achieve the self-sustaining vegetation cover.

Highwall and endwall batters would be regraded to reduce erosion potential. Scour protection would also be installed on sections of the outward-facing landforms to reduce erosion potential where required. Alternatively, buttressing may be adopted where regrading is not economically or spatially viable. The regraded slope configuration for highwalls and endwalls were analysed using SLOPE/W identifying that all highwall and endwall slopes exceed a FOS of 1.5 into the longterm.[17]

Section 5 of the Stage 3 Geotechnical Report clearly identifies recommendations that should be scheduled prior to construction of this option commencing.[18]

The above factors, incorporating the adopted Landform Design Criteria outlined in **Table 6.5**, would result in a safe and stable landform[19].

6.2.2.3 Post Mining Land Use

The PMLUs for this option include:

- Sustainable Grazing / Water Body;
- Self-Sustaining Vegetated Cover;
- Native bushland Corridor;
- Landholder Retained Infrastructure; and
- Boggy Creek Diversion.

To understand how the overall rehabilitation of Ensham fits into the regional context, **Table 6.2.2.3** shows the total hectares for each slope angle and percentage total for each slope gradient. Slope gradients equal to or less than 15% are suitable for grazing purposes and total some 4,658 ha out of a total available area of 5995 ha, or in percentage terms 77.6%, of the total rehabilitated area. A further 420 ha, or in percentage terms 31.4% of the remaining 1,337 has rehabilitation will be dedicated to regional biodiversity connectivity through the provision of the native bushland corridor and Boggy Creek rehabilitation.

[16] Section provided **in** response to line 26 and 27 of the Stage 3 DES feedback sheet.
[17] Section provided in response to line 4 of the Stage 3 DES feedback sheet.
[18] Section provided in response to line 6 of the Stage 3 DES feedback sheet.
[19] Refer to page 102 of the Stage 3 Environmental Assessment Report and page 61 of the Stage 3 Geotechnical Report

Table 6.2.2.3 Option 2 -Hectares for Each Slope Angle

Slope	Domain	AB	CDE	FY	Total	%
0 - 10%	Grazing	1,358	1,396	1,218	3,972	66.26%
11 - 15%		212	280	194	686	11.44%
16 - 25%	Self-sustaining vegetation	175	254	214	643	10.73%
26 - 33%		98	322	68	488	8.14%
34 - 100%		52	81	73	206	3.44%
>100%		0	0	0	0	0.00%
Total		1,895	2,333	1,767	5,995	100%

Note:

1. The 73ha shown in the table above are not from mine rehabilitation slopes. Rather this 73ha area is immediate to the rehabilitation area and has been included in the modelled area due to limitations in the modelling tool. There are no 34-100% slopes in F&Y rehabilitation areas, and

2. The Native Bushland Corridor covers all angles on the high wall from 0-33%. The Native Bushland Corridor does not extend down into >33% slopes on the high wall.

Slope angles greater than 33% are not suitable for cross grade traffic of machinery however these slopes could support lower intensity grazing activities. Similarly slope angles up to 100% with self-sustaining vegetated cover will support grazing activities, albeit with a lower preference than gentler slopes (e.g. 10% or 15%). Self-sustaining vegetative cover, applied to the steeper slopes such as high wall slopes at 100%, would occupy 205 ha or 3.4% of the total rehabilitated area. All of this 205 ha sits within land owned by Ensham.

Despite backfilling approximately 40m vertically in most pits, it is predicted that groundwater would daylight in A, B, C, D and E rehabilitated land forms, over the modelled 240 year period post mining. Ground water salinity levels over the same period are modelled to climb to approximately 26,000 – 40,000 $uScm^{-1}$ depending on the respective rehabilitated landforms[20]. It is important to note that increased backfilling of the pits does not stop groundwater daylighting, rather the groundwater equilibrium level increases and the area involved with groundwater expands[21]. Further information on groundwater levels can be found in Figures 34–36 of the Stage 3 Groundwater Assessment Report.

Water volumes and hectares for each pit by m AHD is described in the Stage 3 Void Water Quantity and Quality Balance Modelling Report, Table 10, page 26.

Once ground water appears in the A – E landscapes (daylights) then the area effected by groundwater will transition from the Grazing PMLU to the Water Body PMLU and will be fenced either prior to relinquishment or once the groundwater daylights (whichever is the sooner) to prevent cattle from accessing groundwater. The maintenance of these stock fences will be the responsibility of the land

[20] Refer to Figures 1 to 4 of the Run 8 Modelling Report
[21] Refer to Table 7 of the Stage 3 Void Water Quantity and Quality Balance Modelling Report

owner, currently the proponent. Should title transfer to another land owner then maintenance of the fencing will become the responsibility of the new land owner.

Figures 6.2.2.3.1, 6.2.2.3.2 and 6.2.2.3.3 show where PMLU's are situated in the rehabilitated landforms[22]. **Figures 6.2.2.3.4 and 6.2.2.3.5** identify the Water Area PMLU and fencing.

In terms of the native bushland corridor, this improves connectivity within the network of existing biodiversity corridors regionally and works to improve areas of high conservation value and special significance and sensitive land uses adjacent to the project area (e.g riparian areas).

The PMLU's proposed do not involve the storage, production, treatment or release of hazardous contaminants, or involve a regulated structure.

[22] Section provided in response to line16 of the Stage 3 DES feedback sheet.

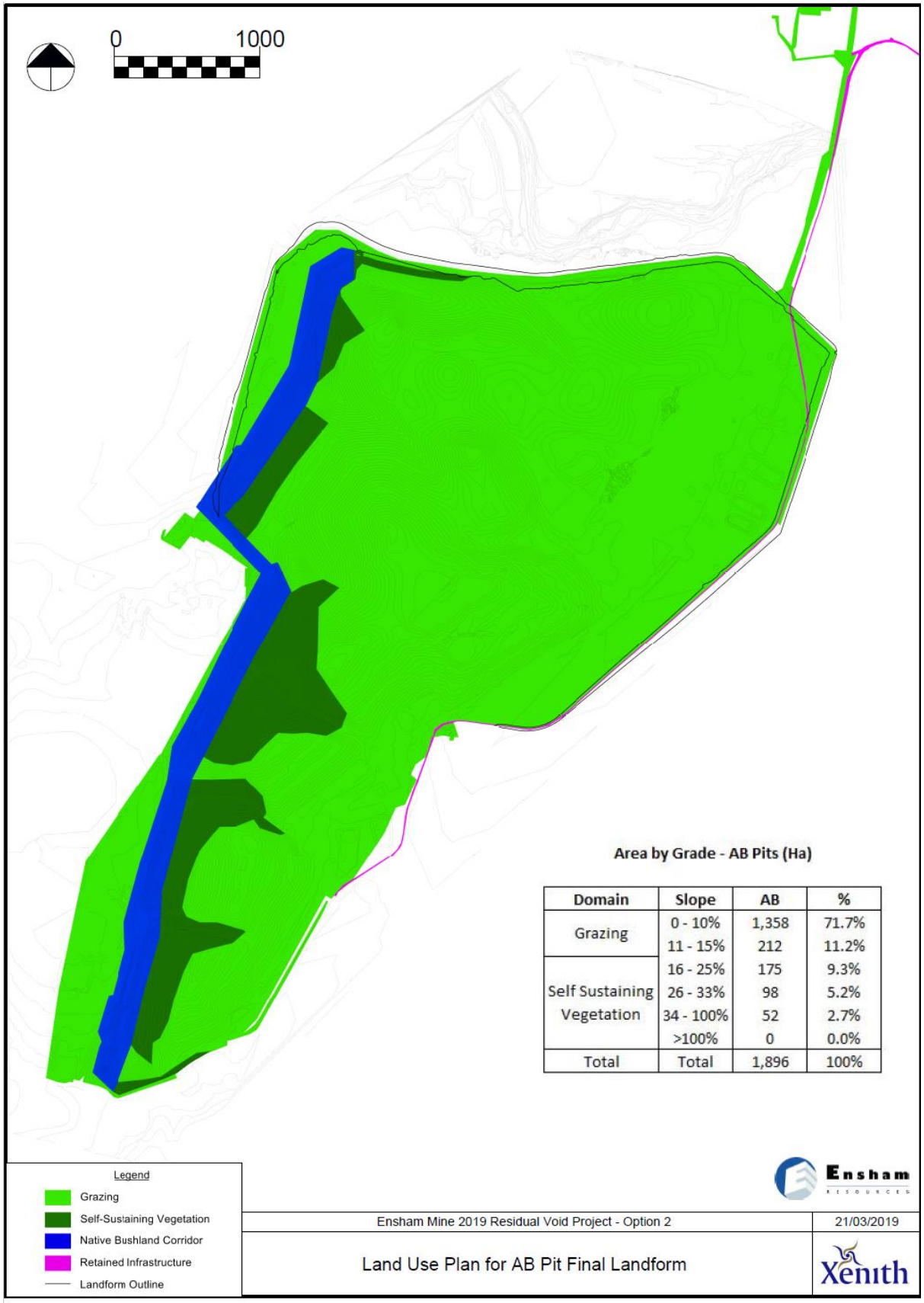


Figure 6.2.2.3.1 Landform A/B Land Use Mapping

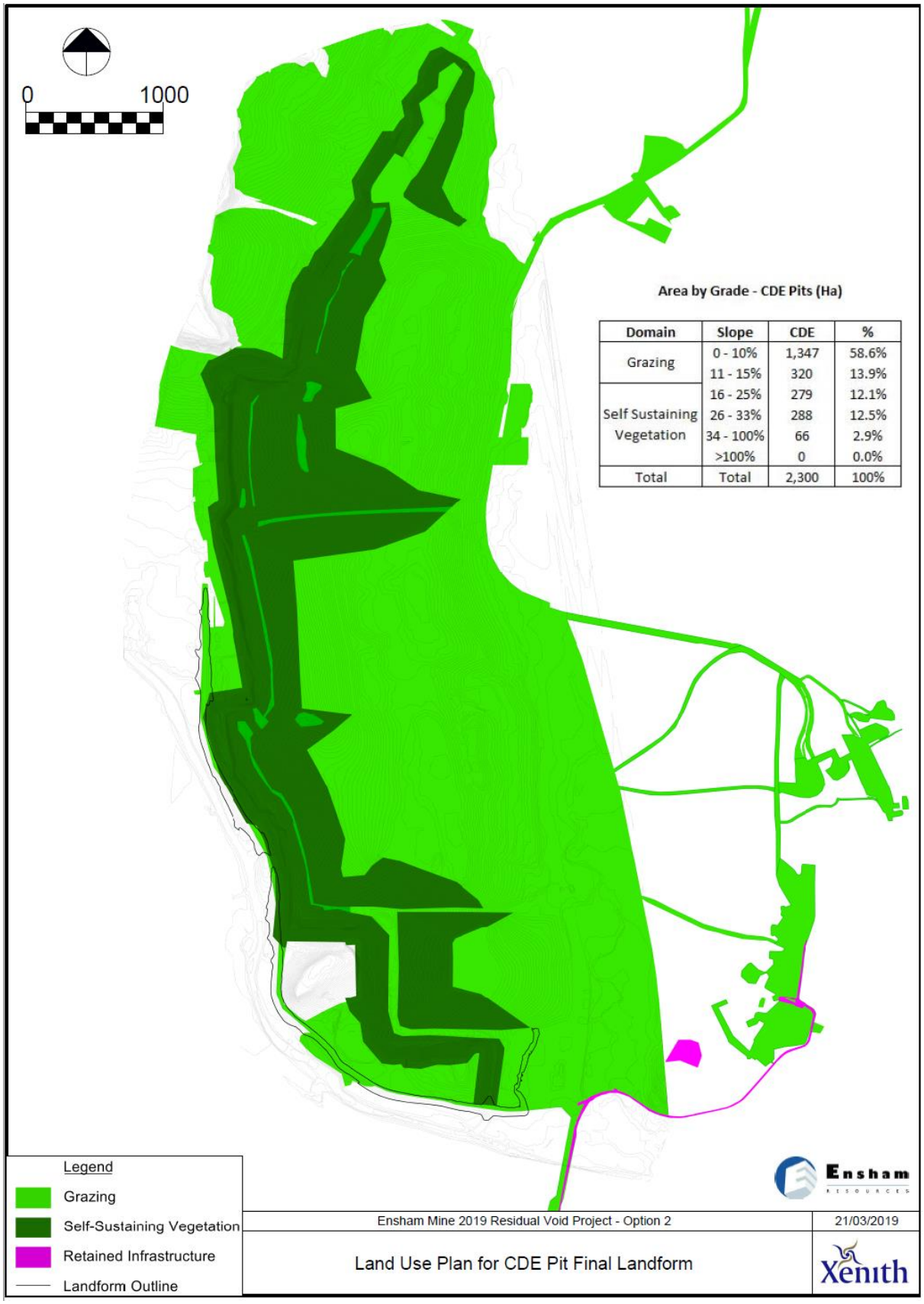


Figure 6.2.2.3.2 Landform C, D & E Land Use Mapping

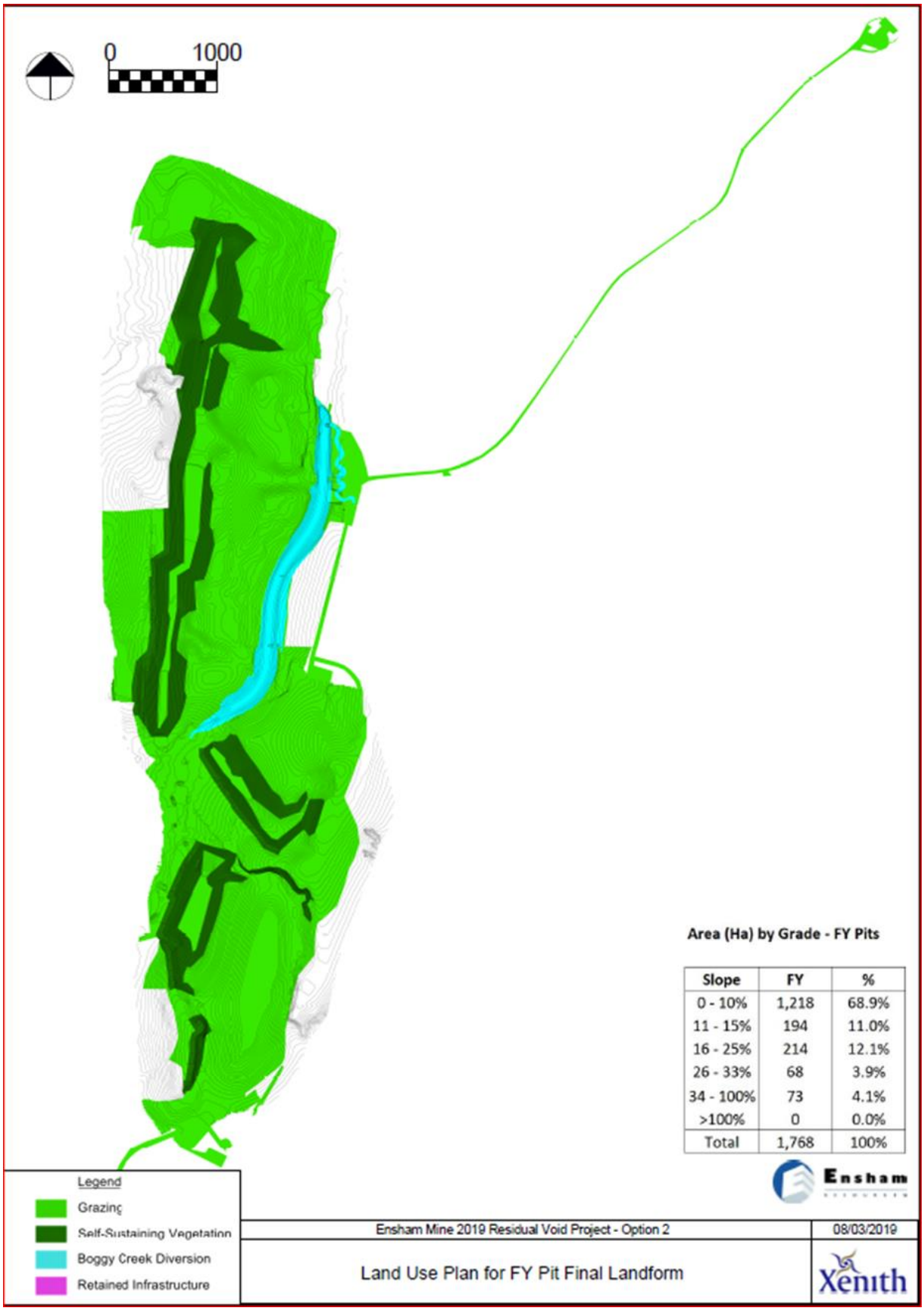
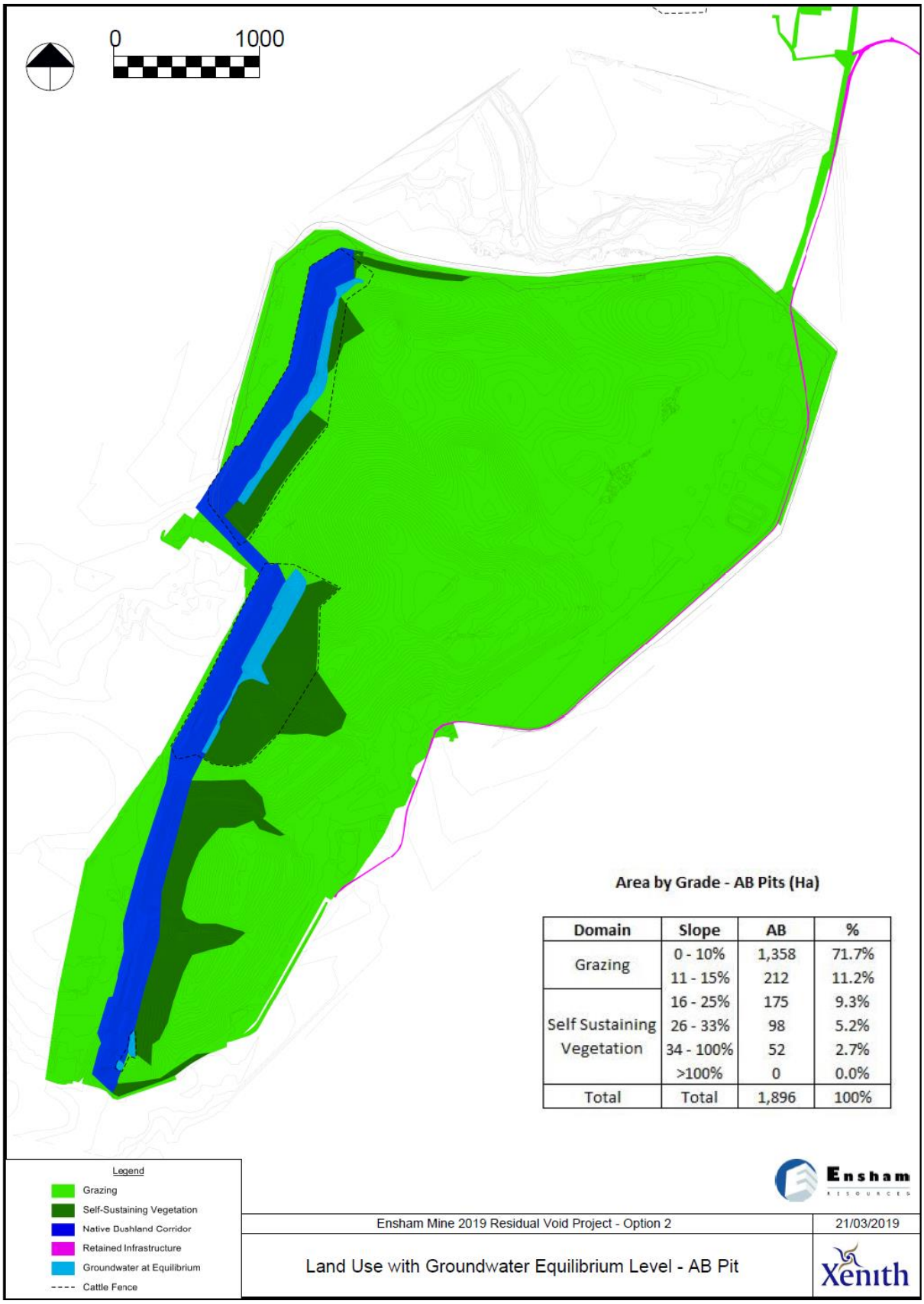


Figure 6.2.2.3.3 Landform F & Y Land Use Mapping



Domain	Slope	AB	%
Grazing	0 - 10%	1,358	71.7%
	11 - 15%	212	11.2%
Self Sustaining Vegetation	16 - 25%	175	9.3%
	26 - 33%	98	5.2%
	34 - 100%	52	2.7%
	>100%	0	0.0%
Total	Total	1,896	100%

Figure 6.2.2.3.4 AB Land Use Mapping with Water Area PMLU and Fencing

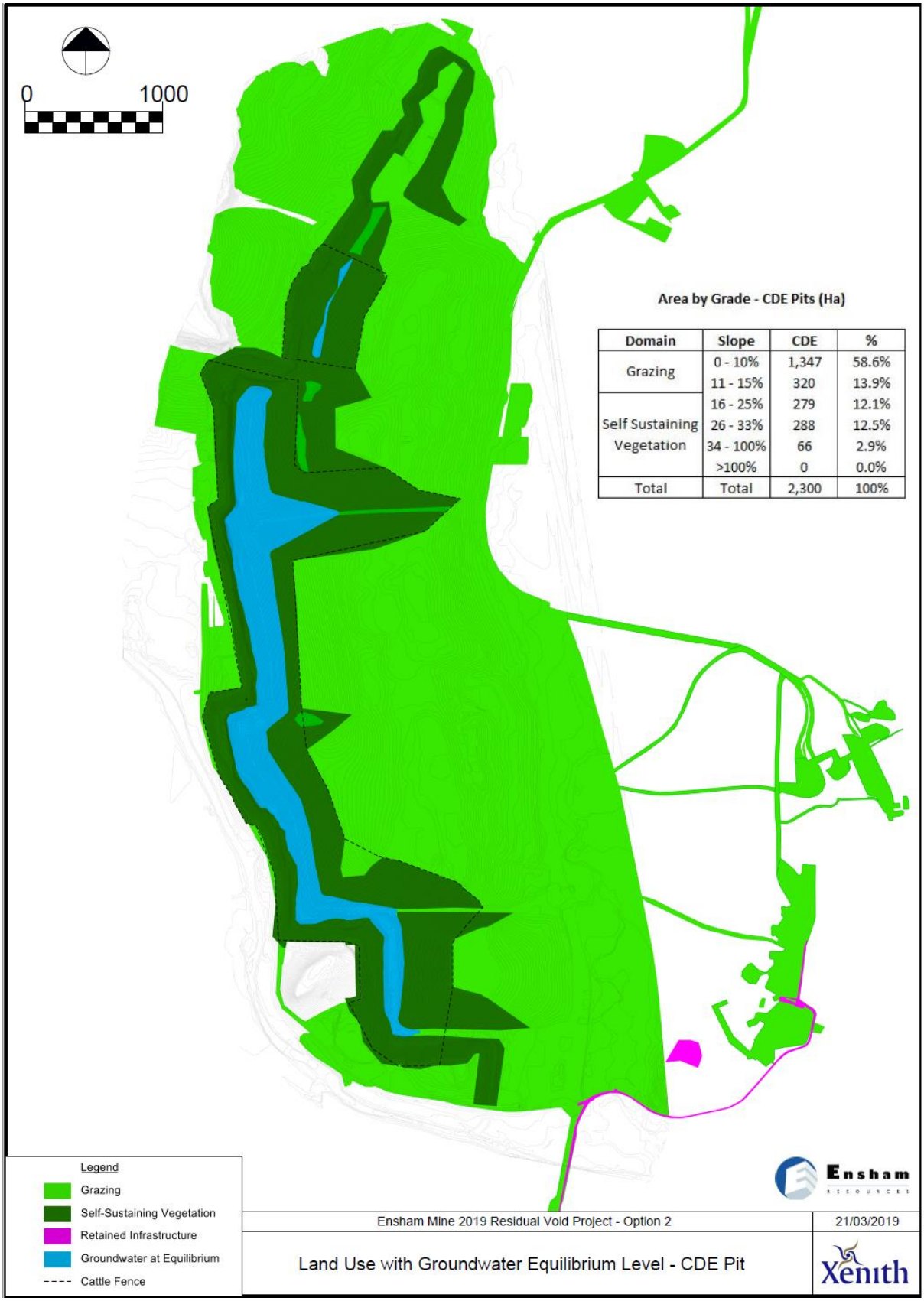


Figure 6.2.2.3.5 CDE Land Use Mapping with Water Area PMLU and Fencing

6.2.3 Mitigation and management

Successful delivery of *the Landform Design Criteria outlined in* ***Table 6.2.2.2*** *would mean that the rehabilitated landform would operate in a way that protects the environmental values of land including soils, subsoils, landforms and associated flora and fauna.*[23]

Activities that disturb land, soils, subsoils, landforms and associated flora and fauna are managed to prevent or minimise adverse effects on the environmental values of land. Areas disturbed will be rehabilitated or restored to achieve sites that are:

(i) safe to humans and wildlife;
(ii) non-polluting;
(iii) stable; and
(iv) able to sustain an appropriate land use after rehabilitation or restoration.

This option has been designed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants and so that the application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils.

To achieve the above, monitoring and maintenance would be required as part of normal land management until relinquishment. These requirements are contained in Table 11.1 and Section 11.2 of the Rehabilitation Management Plan[24]. Post relinquishment, recognised pastoral land management practices to maintain vegetation cover would be required by the land owner. These practices are not expected to be any more onerous than accepted grazing practices in the region.

Based upon the identified impacts and mitigation/management measures discussed above, the following impacts to land related environmental values have been summarised in Table 6.2.3.

Table 6.2.3 – Potential Impacts on Land Related Environmental Values

Aspect	Value	Consideration	Scoring Notes	Ranking	Evidence
Land	Visual amenity	Visual impact	Compared to the regional context	0	Landforms and slopes would be rehabilitated to be consistent with the surrounding environment. A native bushland corridor would be created adjacent to highwall between Corkscrew Creek, Nogoa River and the escarpment west of D Pit, which would reduce any visual impacts of the final landform

[23] Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Land
[24] Section provided in response to line 139 of the Stage 3 DES feedback sheet.

Aspect	Value	Consideration	Scoring Notes	Ranking	Evidence
	Landform stability	Slope failure	Risk of failure generated over the life of the option	3	All slopes have been regraded to achieve a FOS of 1.5. Spoil slopes are no greater than 25%.
		Erosion	Erosion of landform generated over the life of the option	3	All spoil slopes up to 15% would be topsoiled and/ or ameliorated to promote and sustain vegetation growth. Spoil slopes are no greater than 25%. Slope lengths are restricted with benches at intervals. Highwall and endwall batters flattened to retard erosion. Minimum 10m between HW/ Endwall batters and landform – acceptability confirmed by IPR[25]
	Incompatible land uses	Land suitability class	Compared to the regional context	-1	34%- 100% slopes (3.44% of the total rehabilitation area) would have a reduced carrying capacity for grazing relative to lower angled slopes.
	Agricultural potential	Long term available area	Compared to pre-mine available area	0	Slopes up to 15% would be suitable for agriculture (77.7% of the rehabilitated landform)
	Contaminated Land Potential	*NA*	*The scoring of this EV is addressed by the Waste Generation & Environmental Dispersal EV*		

6.2.4 Commitments

Section 5.1 of the Stage 3 Landform Report identifies the following actions required prior to construction commencing:[26]

1. An assessment should be made of rock mulch inventories, and identify potential sources for this material for Option 2 spoil slope stabilisation recommended for long-term stability reasons, or selected from overburden dumps on site. *Rock mulch separation is occurring at site now as part of spoil movement associated with the Boggy Creek rehabilitation.*
2. Trial sections should be undertaken on site to further improve erosion performance of 25% maximum regrade slopes with rock mulch and other suitable options. *Onsite trials using rock*

[25]Section provided in response to line 138 of the Stage 3 DES feedback sheet.
[26] Section provided in response to line 20 of the Stage 3 DES feedback sheet.

mulch or other suitable options will be undertaken to identify opportunities to improve the erosive performance of these slopes.

3. Further investigation will be required to confirm material characterisation of spoil dumps, to make more accurate assessments of relevant maximum slopes for rehabilitation efforts due to variability in this material on site. (i.e. confirmation of soil type as part of the final design of slopes for the bulk shaping) *This is currently being done in advance of bulk shaping and will continue to be conducted as part of normal pre-construction design.*
4. Refinement of landform modelling to smooth profiles, removing unnecessary gulleying or concentrated drainage paths, sharp ridge lines, optimise the landform (old levee) to minimise encroachment on the flood plain, and review benches on both highwall and lowwall regrades. *This is currently being done in advance of bulk shaping and will continue to be conducted as part of normal pre-construction design.*
5. Table 6.2.2.3 shows that 73ha of land will have a slope greater than 33% for F and Y pit final rehabilitated landforms. The 73ha is not from mine rehabilitation slopes. Rather this 73ha area is immediate to the rehabilitation area and has been included in the modelled area due to limitations in the modelling tool. There will be no slopes in the 34-100% gradient for F & Y pit rehabilitation areas.
6. The Water Area will be fenced either prior to relinquishment or once the groundwater daylights (whichever is the sooner).

6.3 Water Quality

6.3.1 Description of Environmental Values

The EVs that are relevant to Water Quality are listed in **Table 6.3.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.4 of the Stage 3 Environmental Assessment Report.

Table 6.3.1 Environmental Values – Water Quality

Environmental Aspect	Environmental Value	Assessment Considerations
Land	Agricultural potential	Downstream river quality
		Water availability
Water	Aquatic ecosystems (biodiversity & habitat)	Downstream river quality
		Impact on run off quality
	Irrigation use	Void water Quality
		Downstream river quality
		Water Availability
	Farm supply	Void water Quality
		Downstream river quality
	Stock use	Void water Quality
		Downstream river quality
	Aquaculture	Void water Quality
		Downstream river quality
	Human consumption	Downstream river quality
	Primary recreation	Void water Quality
	Secondary recreation	Void water Quality
	Visual recreation	Void water Quality
	Industrial use	Void water Quality
Waste	Evaporative concentration on salinity within the voids	Salinity issues in the void over the life of the option

6.3.1.1 Surface Water Quality setting

In response to ongoing refinement of the groundwater modelling and landform design, the floor levels of Pit F and Pit Y, have been raised to be approximately 5 metres above the modelled groundwater equilibrium level. Consequently, groundwater and seepage from in-pit spoil will be beneath the floor level of the rehabilitated landform and will not daylight[27]. Only surface water runoff will report to the lowest point in the landform and from there will drain through the backfill material to the

[27] Refer to page 113 of the Stage 3 Environmentall Assessment Report

groundwater table[28]. For this reason, these pits are not expected to hold water for extended periods and further modelling of the water quality and balance in these voids was not undertaken.

The Stage 3 Void Water Quantity and Quality Balance Modelling report (HEC, 2019a) involved modelling which included this Option 2 being used as a reservoir to store water for irrigation purposes. An additional model run, Model Run 8, has been prepared to simulate the water quantity and quality expected in Pits A, B, C, D and E for Option 2 with no Nogoa River interaction and no irrigation, assuming no reservoir. Model Run 8 has been Independently Peer Reviewed and is included in this report as Appendix 5b (HEC, 2019b).

Water quality modelling was undertaken to assess water volumes and concentrations over the 258-year simulation period for this option including the following water quality assessments:

- Solutes: calcium, chloride, magnesium, potassium, sodium and sulfate;
- Metals: arsenic, molybdenum, and selenium; and
- Salinity (derived from total dissolved solids).

6.3.2 Environmental Impacts to Environmental Values

The following information supports that *the activity will be operated in a way that protects environmental values of waters in that there is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from this option.*[29]

6.3.2.1 Water Quality from residual landform

There is no current proposal to utilise water from within the project area for irrigation, farm supply, stock use, aquaculture or industrial purposes, and therefore there would be no impacts on these EVs due to any adverse water quality condition.[30] In addition, there are no identified impacts in relation to void water being unacceptable for visual recreation purposes[31].

6.3.2.2 Downstream River Quality

Downstream river water quality would not be impacted by water in the rehabilitated areas[32]. This is due to the fact that any water in the rehabilitated areas will be at a lower height than river water and as such is unable to flow to the receiving environment. In addition, this water is isolated from the floodplain by the rehabilitation landforms[33]

For flood water to overtop the landforms there would need to be a flood event in the magnitude of 1.5 times greater than the 0.1% AEP, which is an extreme and very rare event (occurring around

[28] Refer to page 103 of the Stage 3 Environmental Assessment Report
[29] Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Water
[30] Section provided in response to line 38 and 89 of the Stage 3 DES feedback sheet.
[31] Refer to page 105 of the Stage 3 Environmental Assessment Report
[32] Refer to page 105 of the Stage 3 Environmental Assessment Report
[33] Refer to Figure 12 of the Stage 3 Catchment Hydrology and Flood Modelling Report

once every 5,000 years on average)[34]. Should such an event occur, the mixing of the relatively small volume of water in the rehabilitated areas, being a maximum of 20,860ML, with the vast volume of flood water would be inconsequential. Water remaining in the void once the flood had passed would be of the same quality as that in the flood[35] and would migrate down to groundwater over time.

There would be no requirement to pump out this water as there would be no negative impact on groundwater quality due to the better water quality remaining in the rehabilitated areas from flood flows relative to the groundwater quality. In this extreme flood event (1.5 times greater than the 0.1% AEP) scenario, the floodwater water retained in the rehabilitated areas would perform in a similar fashion to off stream storages[36]. The Stage 3 Ecology Assessment Report (p58) identifies that this water would be of lower salinity, and better quality than the current groundwater quality.

Therefore, the proposed rehabilitation is highly unlikely to impact water quality objectives for any downstream users for irrigation, farming, stock use, aquaculture or human consumption purposes[37].

6.3.2.3 Evaporative Concentration on Salinity within the residual landform

The water quality modelling predicts that the residual landforms where groundwater daylights have salinity concentrations that trended upwards over the simulation period due to water loss caused from evaporation. Groundwater data, reported by RGS (RGS, 2018 - Appendix 3c), shows that salinity levels experienced in regional bores have elevated levels of salinity, in some instance similar in concentration to that modelled for this option. (Refer to Tables 6.5.3 a and b)

It should be noted that use of this water under Option 2 is not proposed. In addition, there is no groundwater outflow to the receiving environment predicted from these pits. Hence, any increase in salinity or other contaminant concentrations will be confined to the rehabilitated landforms.

Analysis of the HEC (2019b) Void Water Quantity and Quality Balance Modelling Report Run 8 indicates that there is potential for metals/metalloids to bioaccumulate within the rehabilitated landform waters. Refer to Appendix 5b.

Salinity and trace elements (Arsenic (As), Molybdenum Mo and selenium (Se)) were modelled to determine water quality (excluding F and Y pits where groundwater will not daylight and runoff will infiltrate beneath the floor level).

The results for this modelling confirm that bioaccumulation will occur in the 153.9ha of the Water Area, however this represents a low risk to the receiving environment due to the design of the rehabilitated land which does not allow this water to report to the receiving environment, including groundwater. Specific results of the modelling can be found in the Void Water Quantity and Quality Balance Modelling Report Run 8 (Appendix 5b) which supports the Aquatic Habitat PMLU.

As groundwater daylights in this 153.9ha it is anticipated that aquatic bird life will reside in these areas[38], similar to current site dams and pits with water (from groundwater), that support large

[34] Page 12 of the Stage 3 Geomorphology Report
[35] Refer to Figures 105 and 108 of the Void Water Quantity and Quality Balance Modelling Report
[36] Refer to page 4 of the Stage 3 Geomorphology Report
[37] Refer to page 105 of the Stage 3 Environmental Assessment Report
[38] Refer to page 76 of the Environmental Assessment Report

numbers of aquatic bird life that would not exist on site otherwise. A survey of Ramp 4 Fill Point Dam identified 9 species of water birds. Photo's 6.1 and 6.2 show current bird life in Ramp 4 Fill Point and Ramp 3/4 Drain.

It is important to note that the modelled salinity (HEC, 2019) does not represent hypersaline water.

Photo 6.1 Bird life on Ramp 4 Fill Point Dam

Photo 6.2 Bird life at Ramp 3/4 Drain

6.3.1 Mitigation and Management

Based upon the information discussed above, the following impacts to the water quality related environmental values have been assessed in Table 6.3.1. Based upon these findings, no mitigation is proposed. Consistent with Condition G27 and G28 of the EA a Post Closure Management Plan (PCMP) will be prepared at least 18 months prior to final coal processing on site and will detail the monitoring requirements for surface water post relinquishment.

Table 6.3.1 Potential Impacts on Land Related Environmental Values

Aspect	Value	Considerations	Scoring Notes	Ranking	Evidence
Land	Agricultural potential	Downstream river quality	Impacts to agricultural water quality objectives for life of option	0	Pit voids are contained (no spill)
		Water availability	Quantity of water available to downstream users compared to current	0	Pit voids are contained (no spill)
	Aquatic ecosystems (biodiversity & habitat)	Downstream river quality	Impact on aquatic ecosystem water quality objectives for life of option	0	No impacts on downstream river quality are likely
		Impact on run off quality	Impact on aquatic ecosystem water quality objectives for life of option	0	No impacts on runoff quality are likely
	Irrigation use	Void water quality	Water quality modelling indicates suitability for irrigation within the region	0	Irrigation not proposed
		Downstream river quality	Impact on irrigation water quality objectives for life of option	0	Pit voids are contained (no spill)
		Water availability	Water supply infrastructure for increasing irrigation potential	0	Irrigation not proposed
	Farm supply	Void water quality	Water quality modelling indicates suitability for farm supply within the region	0	Farm supply not proposed

Aspect	Value	Considerations	Scoring Notes	Ranking	Evidence
		Downstream river quality	Impact on farm supply water quality objectives for life of option	0	Pit voids are contained (no spill)
	Stock use	Void water Quality	Water quality modelling indicates suitability for stock use within the region	0	Stock use not proposed
		Downstream river quality	Impact on stock use water quality objectives for life of option	0	Pit voids are contained (no spill to river)
	Aquaculture	Void water Quality	Impact on aquaculture water quality objectives prior to supply	0	Pit voids are contained (no spill to river)
		Downstream river quality	Water quality modelling indicates suitability for aquaculture within the region	0	Aquaculture not proposed
	Human consumption	Downstream river quality	Impact on human consumption water quality objectives (pre- treatment) for life of option	0	Pit voids are contained (very low risk of spill to river)
	Primary recreation	Void water Quality	Water quality suitability for primary recreation use within the voids	0	Primary recreation not proposed
	Secondary recreation	Void water Quality	Water quality suitability for secondary recreation use within the voids	0	Secondary recreation not proposed
	Visual recreation	Void water Quality	Water quality suitability for visual recreation use within the voids	0	There are no identified impacts in relation to void water being unacceptable for visual recreation purposes

Aspect	Value	Considerations	Scoring Notes	Ranking	Evidence
	Industrial use	Void water Quality	Water quality suitability for industrial uses within the region	0	Industrial use not proposed
Waste	Evaporative concentration on salinity within the voids	Salinity issues in the void over the life of the option	Salinity issues in the void over the life of the option	-1	Increase in concentration of salts and metals is expected in some voids however use of that water is not proposed and is contained. Modelled results are consistent with regional bore monitoring data.

6.3.2 Commitments

Consistent with Condition G27 and G28 of the EA a Post Closure Management Plan (PCMP) will be prepared at least 18 months prior to final coal processing on site and will detail the monitoring requirements for surface water post relinquishment.

6.4 Flooding

6.4.1 Description of Environmental Values

The EVs that are relevant to Flooding are listed in **Table 6.4.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.4.6 of the Stage 3 Environmental Assessment Report.

Table 6.4.1 Environmental Values - Flooding

Environmental Aspect	Environmental Value	Assessment Considerations
Flooding	Changes in flooding and runoff characteristics	Upstream flood levels
		Downstream flood levels
		Impact on local run-off volumes to river
		Velocity / erosion potential

6.4.2 Water Setting

The Nogoa River and its floodplain separate A and B pits to the south and C, D, E, F, and Y pits to the north of Ensham Mine. The Nogoa River is naturally ephemeral but generally has constant low flows due to controlled water supply releases from Fairbairn Dam, which is located approximately 60 km upstream of the Project Area. The main channel of the Nogoa River is relatively deep and well defined, however, overbank flooding can occur after heavy rains in the catchment. Within the Project Area, the river has a secondary anabranch channel that flows intermittently. Approximately 10 km downstream of the mine the Nogoa and Comet Rivers converge to form the Mackenzie River.

The Nogoa River floodplain in the vicinity of the mine has several overland flow channels, some of which are fed from breakout flows of the river further upstream during periods of high flow. Several ephemeral creeks are present in the area. Boggy Creek, a smaller ephemeral tributary of the Nogoa River flows from the north, parallel to the existing mine to join the Nogoa River close to the south-eastern extent of C Pit. Winton Creek flows from west to east, to the north of B Pit, before joining the Nogoa River. Old Winton Creek (now de-gazetted) was a large ephemeral tributary which formerly traversed the mine site through B pit. Corkscrew Creek is located to the south of A Pit and flows eastwards into Sandhurst Creek, which is a tributary of the Comet River (refer **Figure 6.4.2**). Downstream of the confluence of the Nogoa and Comet Rivers, the Fitzroy River flows out to the Coral Sea at Rockhampton.

Figure 6.4.2 Aerial View of Waterways Immediate to Ensham Mine

The Nogoa River catchment forms part of the headwaters of the Fitzroy River Basin, Queensland's largest eastward flowing catchment system with significant environmental and commercial value. The catchment area of the Nogoa River above the Project Area is 27,270 km^2 and includes Fairbairn Dam (KBR, 2006).

The land use on the floodplain immediately upstream and downstream of the mine is dominated by irrigated agriculture. Many of the irrigated areas are protected from minor to moderate flooding

events with raised earth embankments (either specially constructed levees or raised channel banks which form part of the irrigators' water distribution system).

Specific details relating to the flooding settings can be found in the Stage 3 Catchment Hydrology and Flood Modelling Report (HEC, 2018).

6.4.3 Impacts to Environmental Values

6.4.3.1 Flood Modelling

The adoption of Option 1 landform for this Option along an identical alignment, means that the flood impacts for Option 2 are the same as that for Option 1. The Option 1 flood modelling will be applied for this EV.

HEC (2018c) undertook flood modelling of peak flow depths for Option 1 at the 10%, 5%, 1% and 0.1%[39] AEP plus Probable Maximum Flood events. The modelling of Option 1 identifies that the landform is consistent with existing conditions up to 0.1% AEP events hence there is negligible forecast afflux compared to existing conditions. (HEC, 2018c).

The model results for peak flow depth are presented in **Figures 6.4.3.1 to 6.4.3.4.**

6.4.3.2 Local Run-off Volumes to the River

There is unlikely to be any material change to run-off volumes as a result of the landform design, therefore impacts to local run-off volumes to the river are not expected.

[39] Collectively these AEPs represent the 1 in 10, 1 in 20, 1 in 100 and 1 in 1,000 AEP flood events respectively

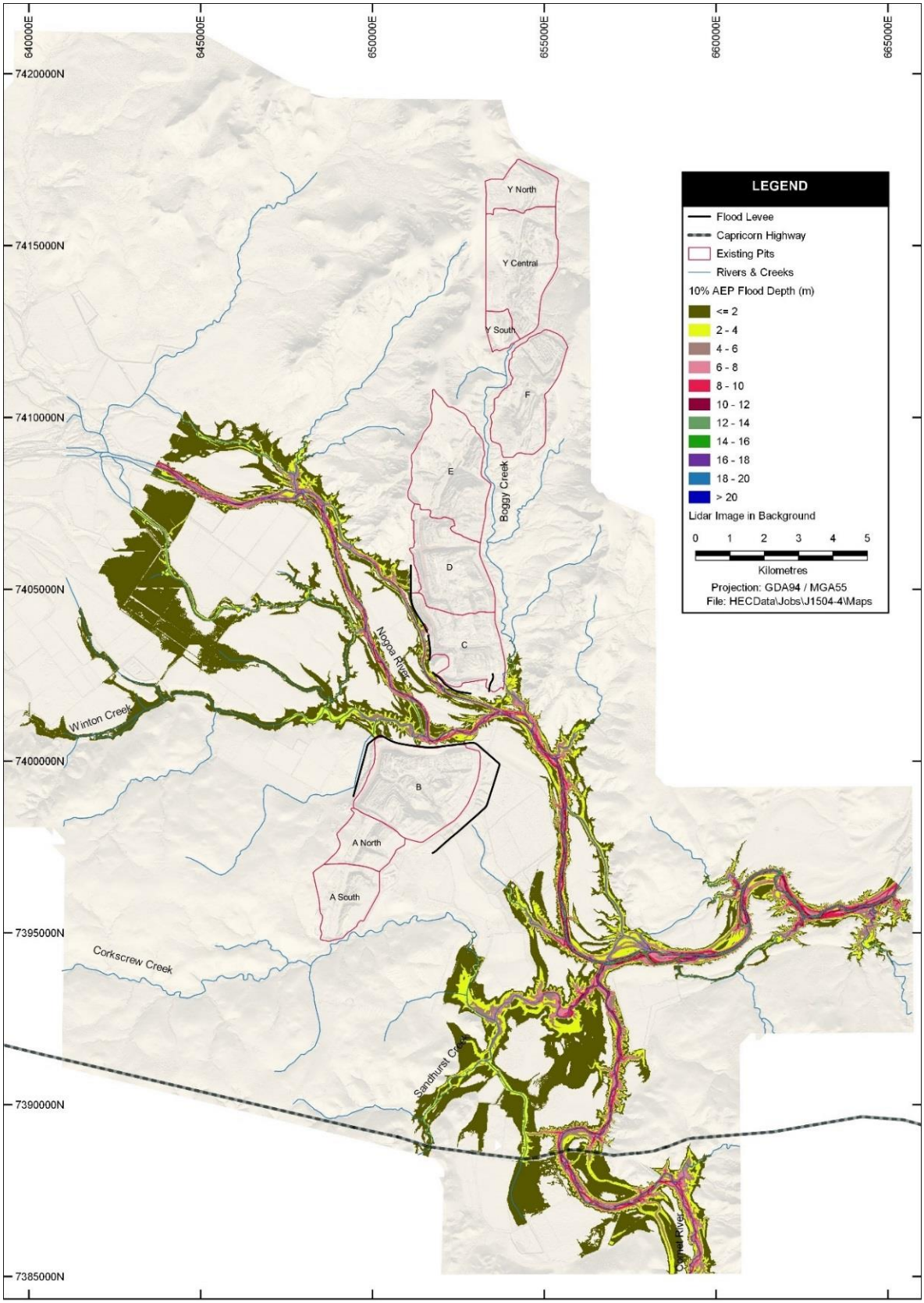


Figure 6.4.3.1 Peak Flow Depth 10% AEP

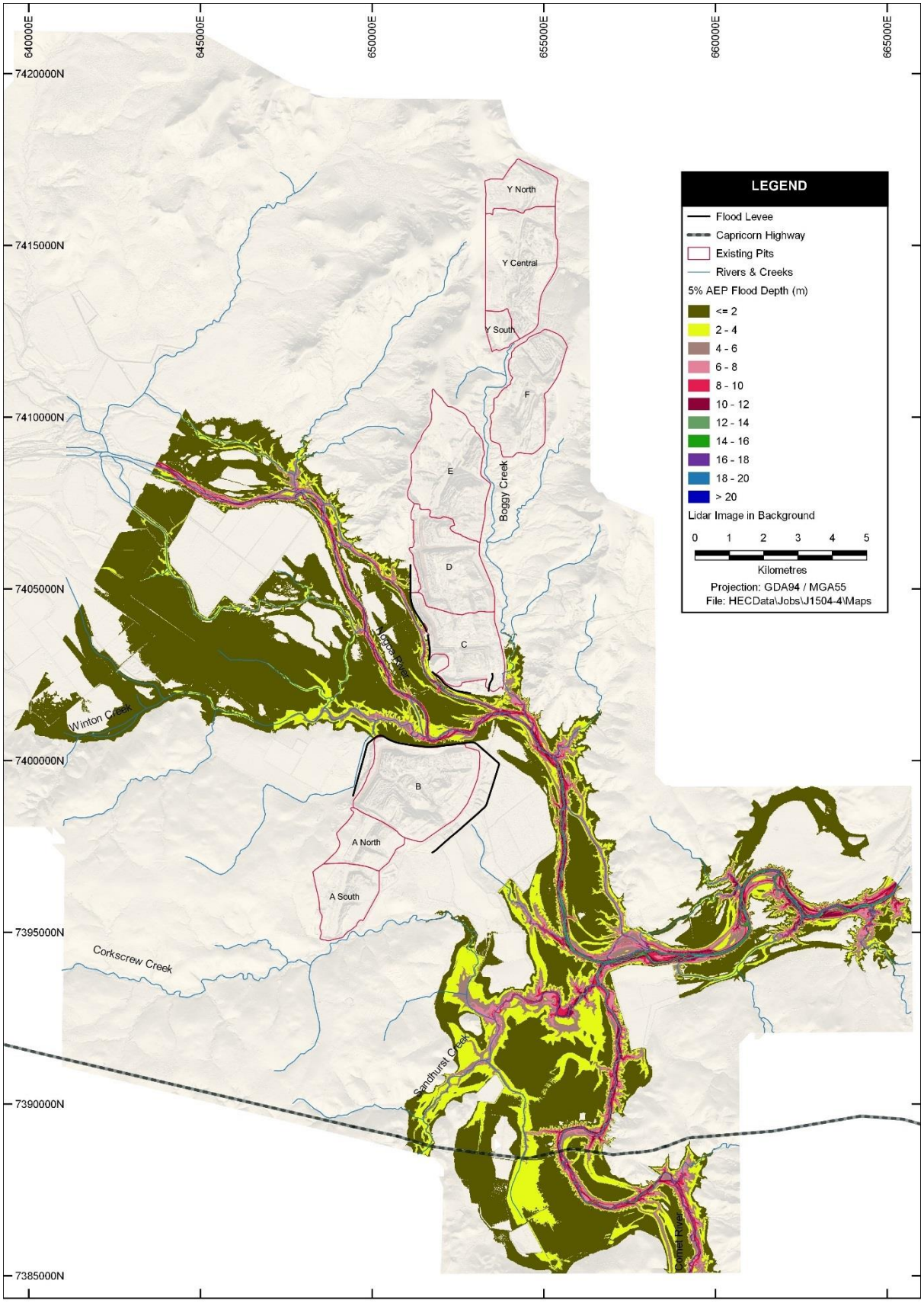


Figure 6.4.3.2 Peak Flow Depth 5% AEP

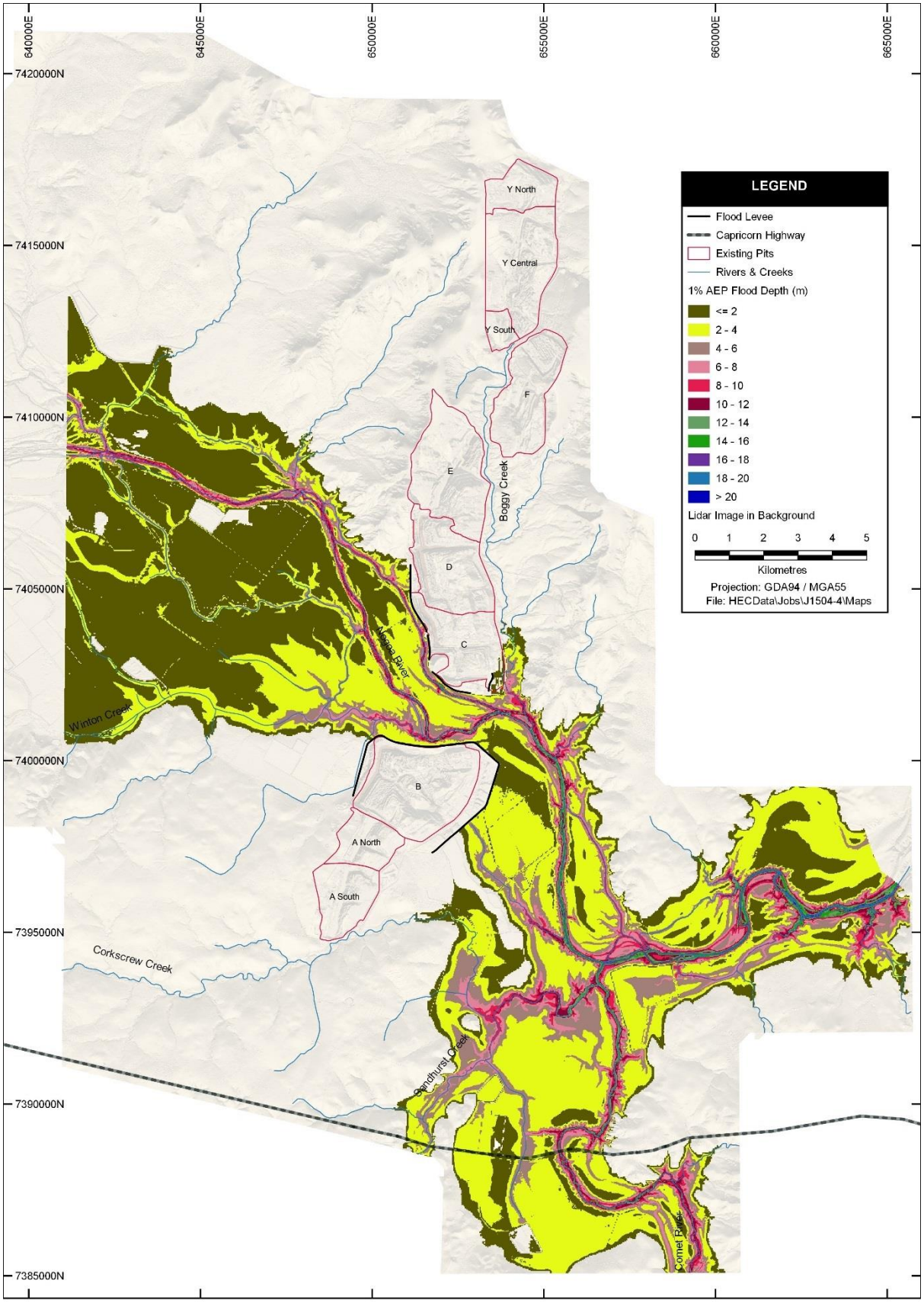


Figure 6.4.3.3 Peak Flow Depth 1% AEP

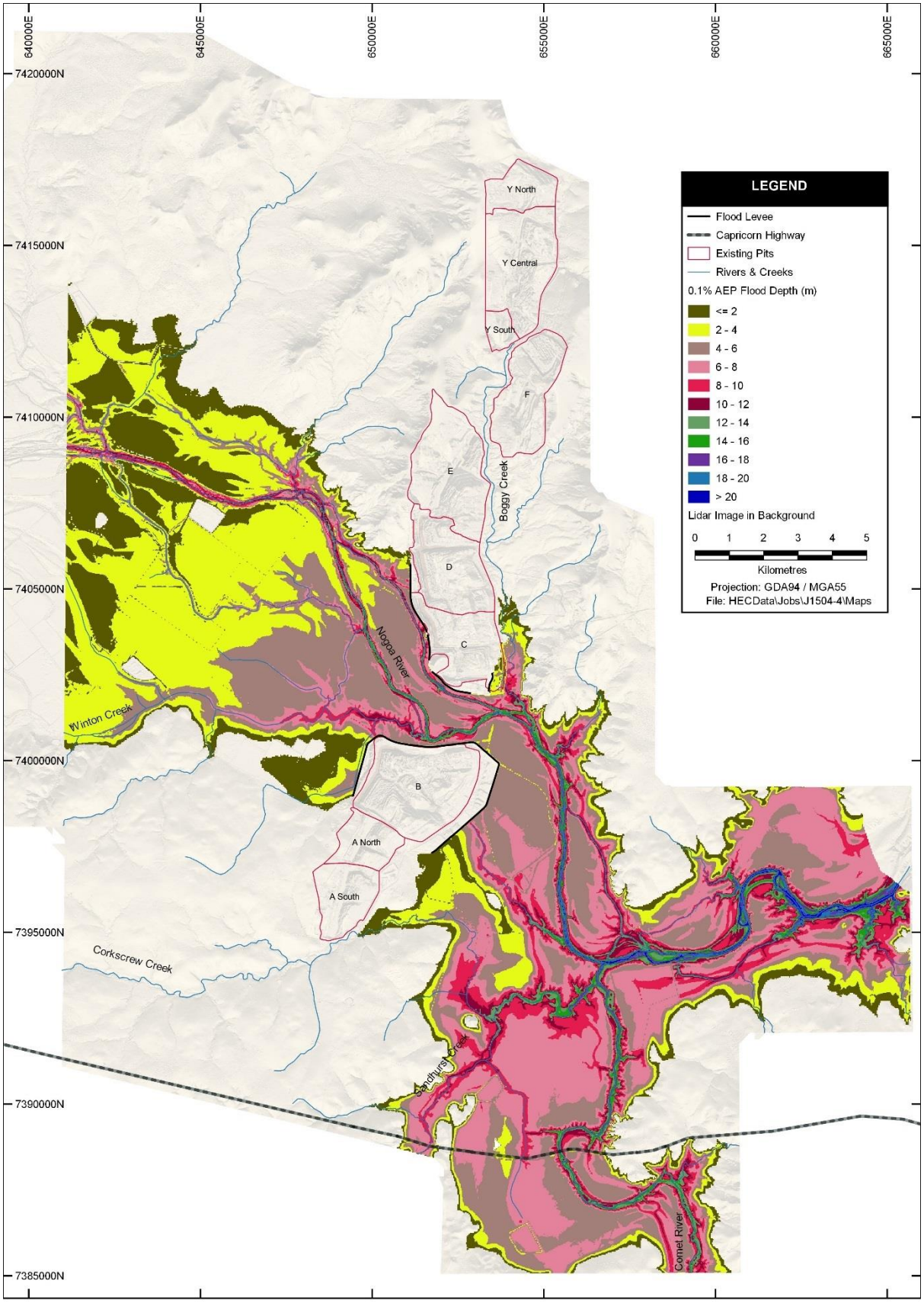


Figure 6.4.3.4 Peak Flow Depth 0.1% AEP

6.4.3.3 Geomorphology Assessment

Geomorphological modelling was undertaken by WRM Water & Environment (WRM, 2018) for Option 1. As the Option 1 landform has now been adopted for Option 2 the geomorphological assessment of Option 1 is applicable. This modelling incorporated flood model data (provided by HEC, 2018c) to assess the morphology of the Nogoa River floodplain. The modelling included an assessment of:

- The 10% AEP design flood event, to represent the behaviour of the river at the bank full flow conditions. The bank full flow is the maximum flow that the channel can carry before it overflows onto the adjacent floodplain. In geomorphologic studies, the bank full flow is often considered to be the stream forming flow, because it often exerts the greatest influence on channel geometry (WRM, 2018);

- The 1% AEP design flood event, to represent the behaviour of the river during a large and infrequent flood event; and

- A flood event 50% greater than the 0.1% AEP design flood event (i.e., an extreme event), to determine what would occur in the unlikely event that the levels of the landform are exceeded.

Compared to pre-mine conditions, the modelling shows that:

- there would be no change in peak velocities and shear stresses from pre-mine conditions for the 10% AEP flood;

- the differences between pre-mine and Option 1 flood velocities and shear stresses for the 1% AEP event are minor;

- where increases from pre-mine conditions occur for the 1% AEP event, the predicted velocities and shear stresses are no greater than pre-mine velocities and shear stress along the upstream reach of the river for the same event; and

- the extreme event (adopted as 50% greater than the 0.1% AEP event) would increase velocities and shear stresses along the Nogoa River channel and the adjacent floodplain for a distance of about 7 km, but these are no greater than pre-mine velocities and shear stress along the upstream reach of the river for the same event. The 50% greater than the 0.1% AEP is comparable to a PMF level event.

The assessment of pre-mine conditions found that the Nogoa River channel and floodplain would be stable in the short term and medium-term. Therefore, the short and medium-term risks to the Nogoa River for this landform are low.

The modelling identified a very low risk of morphological change to the Nogoa River for this Option for extreme and rare events that overtop the landform. This Option, however moderately reduces the risk of morphological change from existing conditions because the final landform levels are marginally higher and wider than the levees that are being replaced. If such an extreme event occurred, it would appear unlikely that the course of the Nogoa River or Anabranch would be altered.

These extreme or rare morphological risks could be reduced by the provision of designated overflow points on either side of the Nogoa River.

6.4.4 Mitigation and management

Successful delivery of the landform rehabilitation completion criteria would mean that there are no further management and mitigation measures required for this Option other than the designated overflow points on either side of the Nogoa River landforms

Based upon the above discussion, the following impacts to the flooding related environmental values have been assessed in **Table 6.4.4.**

Table 6.4.4 Potential Impacts on Land Related Environmental Values

Aspect	Environmental Value	Assessment Considerations	Scoring Notes	Ranking	Evidence
Flooding	Changes in flooding and runoff characteristics	Upstream flood levels	Compared with existing conditions	0	Changes to pre-mining afflux up to 1:100 are minor. For a 1.5 x the 0.1% AEP event there would be no greater velocities and shear stress along the upstream reach of the river compared to pre-mine. This event is identical to the pre-mining PMF event.
		Downstream flood levels	Compared with existing conditions	0	Preferred option 1 is consistent with existing conditions hence there is negligible forecast afflux (compared with existing conditions). Greater than 1:1000 events would be similar to pre-mine flooding.

Aspect	Environmental Value	Assessment Considerations	Scoring Notes	Ranking	Evidence
		Impact on local run-off volumes to river	Compared to current mine footprint	0	Very small changes to catchment area reporting to Nogoa River
		Velocity / erosion potential	Compared with existing conditions	1	There are no short or medium-term risks of accelerated morphological change. The risk of an overtopping event during a very rare and extreme event would be reduced with the introduction of designed designated overflow points on either side of the Nogoa River.

Overall there are no negative impacts to environmental values listed. A slight improvement in erosion potential would occur with the raising of the landform (levee).

6.4.5 Commitments

WRM Water and Environmental Pty Ltd (2018), Section 6, make recommendation that the already very low geomorphological risks could be reduced by providing a designated overflow point in the proposed landform along the C Pit highwall to allow an overtopping event to fill the C Pit void in a controlled manner. *Overtopping points will be incorporated into the final construction design for both B pit and C Pit landforms.*[40]

Both the Stage 3 hydrology and geomorphology reports, supported by the respective IPR's, recognise that the landform under this option represents a very low risk in terms of both flooding and geomorphological risk, as such no further actions are required to mitigate risk to these EV's.

This said there exists the potential to optimise the design further by widening the flood plain from 1.4 to 2km between the northern section of B pit and the southern section of C pit (refer Figure 6.4.5).

[40] Commitment provided in response to line 73 of the Stage 3 DES feedback sheet.

This would involve setting back the alignment of the landform of C pit, by approximately 600m to the north, as represented by the blue dotted line in Figure 6.4.5.

Figure 6.4.5 is a conceptual drawing and at this point in time there have been no studies undertaken of the impact of this opportunity. Further studies would be required to ascertain the feasibility of this landform alignment including: hydrology, geomorphology, landform, geotechnical and risk assessment

The studies to determine whether the conceptual realignment of the landform is feasible will be undertaken and submitted to the administering authority. These studies would be separate to the existing RVP and outside the scope of the TOR.

Figure 6.4.5 Future consideration of Landform realignment to open floodplain to 2km (conceptual drawing only)

6.5 Groundwater

6.5.1 Description of Environmental Values

The EVs that are relevant to Groundwater are shown in **Table 6.5.1**, with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.5 of the Stage 3 Environmental Assessment Report.

Table 6.5.1 Environmental Values – Groundwater

Environmental Aspect	Environmental Value	Assessment Considerations
Water	Aquatic Ecosystems	Groundwater drawdown
		Groundwater quality
	Irrigation Use	Groundwater drawdown
		Groundwater quality
	Farm Supply	Groundwater drawdown
		Groundwater quality
	Stock Use	Groundwater drawdown
		Groundwater quality

6.5.2 Groundwater Setting

The principal groundwater bearing strata within the Project Area is associated with the Permian coal seams (Rangal Coal Measures) and the Quaternary alluvium, with the siltstones and sandstones that make up the majority of the overburden largely found to have low permeability (HS, 2018). Details of these strata can be found in the groundwater report (HS, 2018).

Water level data of the Quaternary show the seasonal variability in groundwater to be limited and coincident with the heterogeneous distribution of these sediments. Shallow silts and clays are anticipated to be partially isolating the Nogoa River, limiting leakage from the river into the basal sands and gravels. It is possible that leakage may occur where these clays are absent or where the basal sands are exposed within the river. However, this is conceptually thought to occur only in localised areas. This hydraulic separation of the alluvium from the Nogoa River means that whilst the water in the river is fresh, the underlying alluvium can be naturally brackish to highly saline (HS, 2018)

The alluvium can, therefore, be considered as a largely unconfined system which is recharged by rainfall, irrigation campaigns and upward leakage from the underlying Rewan Group or Rangal Coal Measures. The alluvium may also receive localised baseflow recharge from the Nogoa River, where clay and silt layers are absent (HS, 2018).

Details of the Permian Rangal Coal Measures can be found in the Groundwater Technical Report (HS, 2018).

6.5.3 Regional Groundwater Quality

Groundwater samples from 58 bores within the project were collected between 2006 and 2017. RGS (2018) undertook a review of this data and provided the following information which is drawn from the Stage 3 Geochemical report:

- There is no evidence of acid and metalliferous drainage in groundwater;

- Groundwater pH results are circum-neutral, ranging from approximately 6 to 8 (refer **Figure 6.5.3.a**);

- EC results show a stark contrast between groundwater hosted in Quaternary and Permian aged rocks. Groundwater samples from Quaternary alluvium showed a much larger range of results compared to Permian aged samples (refer **Figure 6.5.3.b**). The higher range in results is due to the seasonal effects of dilution from rainfall and flow events in the river and evaporation and concentrative effects during the dry season. In most cases, median results are similar between the Quaternary and Permian samples. Groundwater electrical conductivity appears to have increased since 2011 with the difference in median values between stratigraphy ages becoming larger in 2016 and 2017.

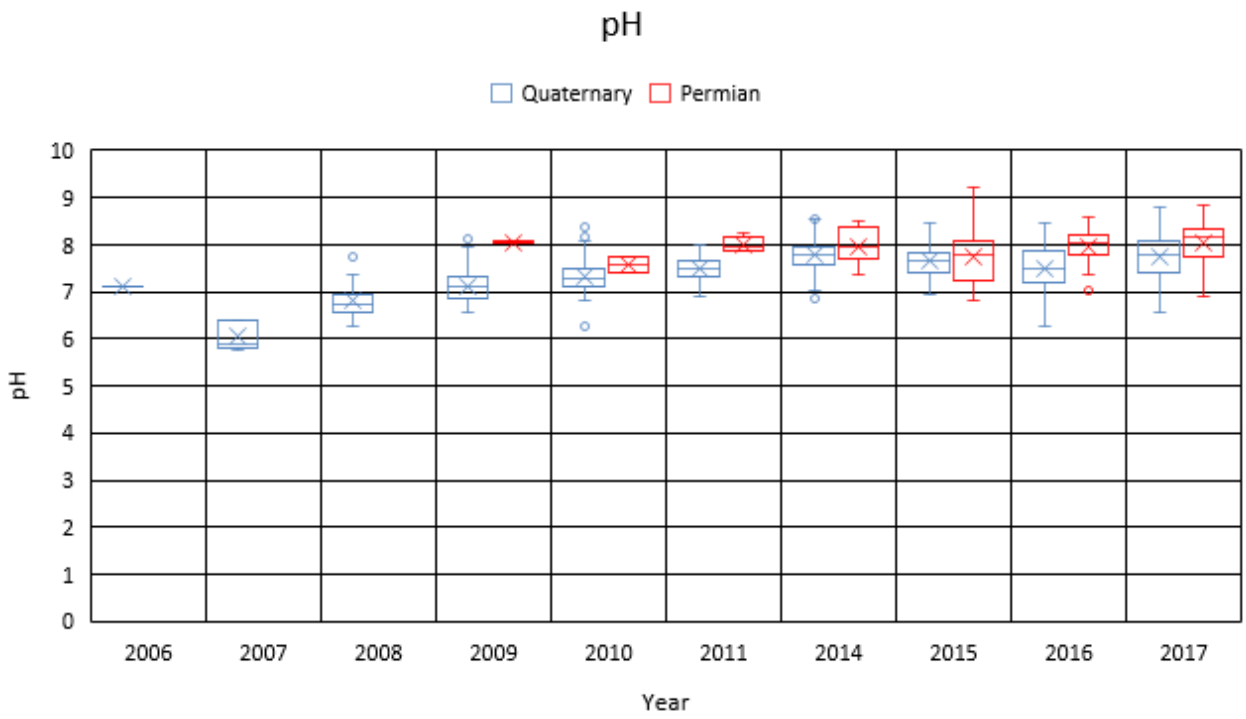


Figure 6.5.3.a Range, Median and Mean of Groundwater pH Results Over Time

(Source: RGS, 2018)

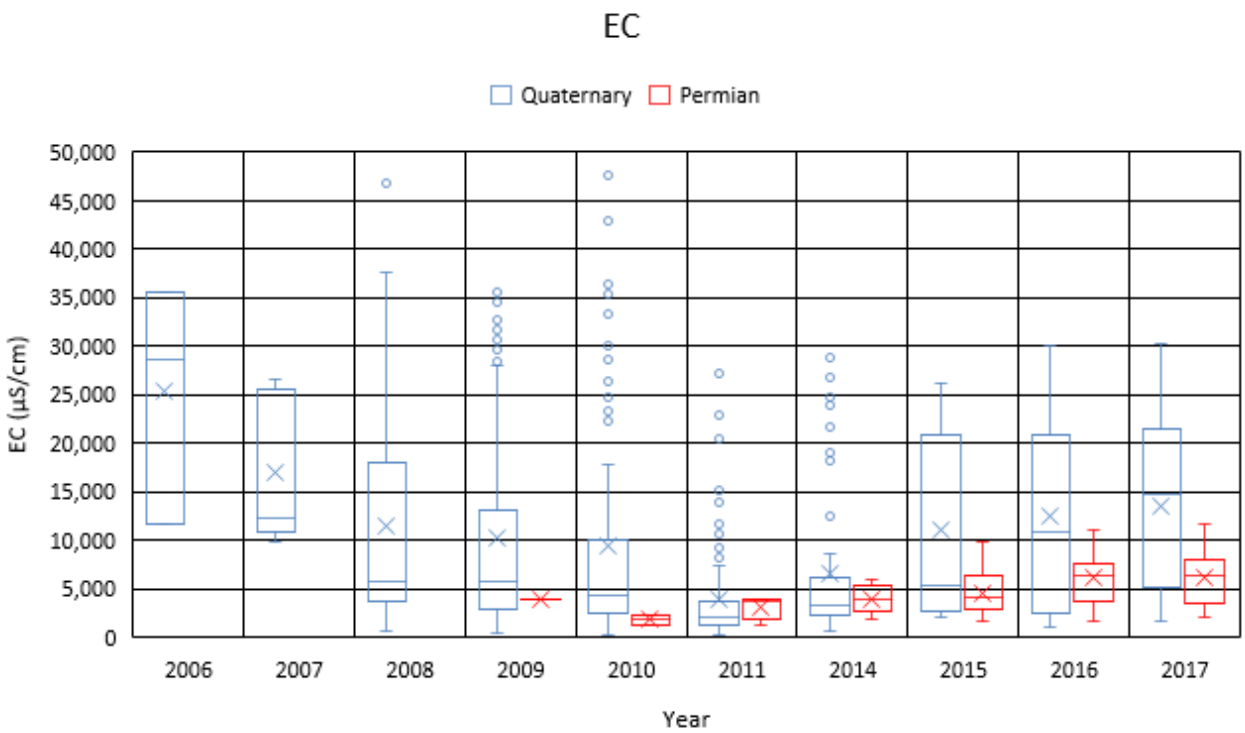


Figure 6.5.3.b Range, Median and Mean of Groundwater EC Results Over Time

(Source: RGS, 2018)

Other water quality data including sulphate, sodium and chloride concentrations are discussed in the Geochemical Report (RGS, 2018)

6.5.4 Impacts to Environmental Values

Based upon the above information, the following assessment of impacts to environmental objectives have been made. Of note, the groundwater modelling conducted as part of the RV Project and reported in Stage 3 remains valid for this option as it has been based on the same landform design criteria.

6.5.4.1 Aquatic Ecosystems

This aspect of the Stage 3 studies focussed on groundwater drawdown and groundwater quality. The findings of the ecology study, as recorded in the Stage 3 Ecology Report, supported that there would be negligible impact on either groundwater drawdown or groundwater quality, relative to the regional circumstances.

Specifically, the groundwater report identifies that there is predicted to be negligible drawdown in most riverine alluvium, and consequently negligible effect on river-aquifer interaction in general[41]and there is no expected effect on aquatic ecosystem groundwater water quality. This is supported by the Ecology Report which finds that the rehabilitated areas will predominantly act as groundwater sinks until groundwater equilibrium is achieved.

[41] Refer to page 8 and page 44 of the Stage 3 Groundwater Report.

Further supporting evidence can be found in Figures 1 to 4 of the Supplementary Model Run 8 Report (Appendix 5b). These figures evidence that there is no groundwater outflow to the receiving environment and that the rehabilitated areas are designed to act as a groundwater sink, not a groundwater source

As a consequence, there is not expected to be any adverse impacts on the deeper groundwater aquifers (and hence GDEs) present in and adjacent to the Project area[42].

6.5.4.2 Irrigation Use/Farm Use/Stock Use

Section 8.2 of the Stage 3 Groundwater Report HS (2018) examines potential impacts on groundwater bores using monitoring bore data. The following findings were made:

- the median maximum drawdown is 4.5 m and the median year of occurrence is about 2044 (25 years from now). None of the identified private bores lie within the 5m water table predicted drawdown envelope.
- minor groundwater drawdown impacts on private bores used for farm or stock water supply, with negligible impact on the one identified irrigation bore due to its distance from the mine.
- Negligible impact on groundwater quality at any private bores.
- Longer term marginal increase in the flow in the Nogoa River due to a reduction in the natural loss of water from the Nogoa River to its associated alluvium.

6.5.4.3 Groundwater levels in Final landforms

The results of the groundwater modelling show that the groundwater rest levels will stabilise at their long-term values after approximately 110 - 190 years post completion of mining. Predicted groundwater rest levels for the rehabilitated landform areas are shown in **Figures 6.2.2.3.4 and 6.2.2.3.5**. Table 6.5.4.3 identifies groundwater rest levels, affected area and time for groundwater to daylight and achieve equilibrium.

[42] P59 of the Stage 3 Ecological Assessment Report

Table 6.5.4.3: Predicted final equilibrium pit water levels

Area	GW Rest Level (mAHD)	Storage Volume (ML)	Area Affected (ha)	Total Rehabilitated Area (ha)	% of Rehabilitated Area	Time for Groundwater to Daylight (post mining)	Approximate year groundwater reaches equilibrium
A (Sth)	121	18	1	1895	1.3%	50yrs	2140
A (Nth)	129	889	12.5			50yrs	2140
B	109	476	11.8			50yrs	2200
CD	121	19,416	126.2	2,333	5.5%	55yrs	2220
E	134.1	61	2.4			55yrs	2185
F	Groundwater will not daylight in this area.			1,767	0%	N/A	N/A
Y	Groundwater will not daylight in this area.					N/A	N/A
Totals		20,860	153.9	5,995	2.57%		

F and Y pits have been designed such that the floor level is above the groundwater rest levels and accordingly, no groundwater will ever daylight in these areas.

In order to prevent the groundwater from daylighting in A to E pits, considerable fill would be required. The filling action in turn increases the groundwater level, hence requiring further fill. In light of this, and the very small areas where groundwater would daylight, significant period before any groundwater is predicted and very low risk of harm constituted by the existence of the groundwater in the landform, as currently designed in this option, it was decided to maintain the existing landform design.

Table 6.5.5. provides a summary of the impacts on Water and individual EV's drawn from the Table 15 of the Stage 3 Groundwater Report (the rankings) and the above information.

Table 6.5.5 Potential Impacts on Land Related Environmental Values

Aspect	Environmental Value	Assessment Considerations	Scoring notes	Ranking	Evidence
Water	Aquatic Ecosystems	Groundwater drawdown	Compared to regional groundwater level	-1	Negligible drawdown in most riverine alluvium, and consequently negligible effect on river-aquifer interaction in general
		Groundwater quality	Impact on aquatic ecosystem water quality objectives for life of option	0	There would be no effect on river water quality and a marginal beneficial effect on groundwater quality[43].

[43] P viii of the Stage 3 Groundwater Report

Aspect	Environmental Value	Assessment Considerations	Scoring notes	Ranking	Evidence
	Irrigation Use	Groundwater drawdown	Groundwater drawdown impact on users	0	No impact on boreholes immediate to the rehabilitated land
		Groundwater quality	Impact on groundwater quality objectives for life of option	0	No change in groundwater flow direction at 10km
	Farm Supply	Groundwater drawdown	Groundwater drawdown impact on users	-1	All identified bores will have less than 5m water table drawdown
		Groundwater quality	Impact on groundwater quality objectives for life of option	0	No feasible mechanism for change
	Stock Use	Groundwater drawdown	Groundwater drawdown impact on users	-1	All identified private bores to have less than 5m water table drawdown
		Groundwater quality	Impact on groundwater quality objectives for life of option	0	No feasible mechanism for change

6.5.5 Mitigation and Management

Given the negligible impact on groundwater drawdown and quality, as a result of rehabilitating the mine and the rehabilitated landforms remaining as groundwater sinks - not sources there are no further mitigation measures proposed. The existing monitoring conditions contained in the Ensham EA will be used to monitor the groundwater impacts (drawdown and quality) up to relinquishment. Consistent with Condition G27 and G28 of the EA a Post Closure Management Plan (PCMP) will be prepared at least 18 months prior to the final coal processing on site and will detail the monitoring requirements for groundwater post relinquishment.

Given *there will be no direct or indirect release of contaminants to groundwater from this option and there will be no actual or potential adverse effect on groundwater from the option*[44] it is reasonable to believe that this option will protect the environmental values of groundwater and any associated surface ecological systems.

6.5.6 Commitments

There are nil additional commitments for this EV.

[44] Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Groundwater

6.6 Ecology (Flora and Fauna)

6.6.1 Description of Environmental Values

The Environmental Values (EVs) that are relevant to Ecology for the RVP are shown in **Table 6.6.1.** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.6 of the Stage 3 Environmental Assessment Report.

Disturbance from this Option is retained within the existing Project area and will not impact any MNES or MSES[45].

Table 6.6.1 Environmental Values – Flora & Fauna

Aspect	Environmental Value	Assessment Considerations
Ecology	Terrestrial ecosystems	Habitats/Wetlands/Riparian Areas
		Terrestrial Subterranean Fauna Habitat
Water	Aquatic ecosystems (biodiversity and habitat)	Downstream River Quality
		Aquatic GDEs (stygofauna)
		Impact on run-off quality
Biosecurity	Bioaccumulation	Void Water Quality

6.6.2 Impacts to Environmental Values

6.6.2.1 Terrestrial Flora

Regrading of the outward facing levee batters on the B and C pit highwalls and similarly in limited sections will be required to minimise the erosion risk. Minimal clearing of regrowth in this area (previously disturbed for levee construction) would occur in an area already approved for disturbance. This would be minimised in the final design process, where possible. This clearing would result in an insignificant impact in the short-term upon non-regulated regrowth habitats immediate to the existing levees on the floodplain, there would be no long-term impacts[46].

The Stage 3 ecology report has identified potential areas of high conservation value and special significance based on a desktop assessment using government vegetation mapping over the project area[47]. An onsite field survey, conducted post Stage 3 and in response to feedback from the administering authority, has confirmed that there are no MNES impacted by this option, refer to Appendix 5e for the field survey report. [48] There is a potential for a minor impact of the C/D Pit landform overlaps the Category B area by about 1.4m (at worst) and is only 15m^2. This minor potential will be avoided by designing the landform to avoid this area. Given that there are no residual impacts

[45] Refer to page 114 of the Stage 3 Environmental Assessment Report and page 3 of the Threatened Species Survey Findings Report
[46] Refer to page 114 of the Stage 3 Environmental Assessment Report and
[47] Refer to page 40 of the Ecological Assessment Report
[48] Section provided in response to line10, 11, 60, 61, 62, 63, 64, 67, 70 and 74 of the Stage 3 DES feedback sheet.

on MNES or MSES then there will be no requirement for offsets.[49][50] Figure 6.6.2.1 identifies the location of the landform relative to mapped MNES and MSES.[51]

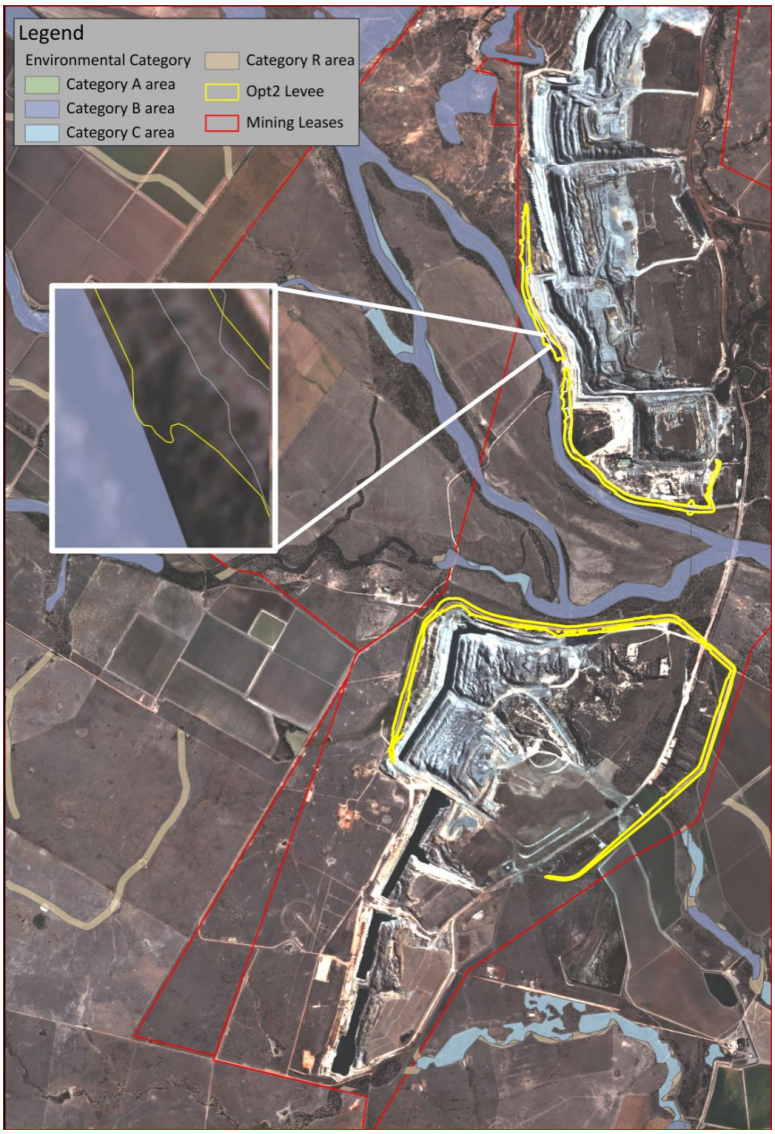


Figure 6.6.2.1 Location of the Landform Relative to Mapped MNES and MSES.

Following construction of the landforms, a native bushland corridor using native tree species (successfully applied under the current rehabilitation regime) would be established along the highwalls of A and B pits. This corridor would be approximately 100m in width and approximately 6.7km long, linking the vegetation associated with Corkscrew Creek with the Nogoa River. Following feedback from the administering authority an additional native bushland corridor will be provided adjacent to the CD highwall to provide improved connectivity between the Nogoa River and the escarpment area. The vegetation may extend partially along the rehabilitated highwall to further minimise erosion potential on the highwall

[49] Section provided in response to line 58 of the Stage 3 DES feedback sheet
[50] Refer to page 3 of the Threatened Species Survey Findings Report
[51] Section provided in response to line 54 of the Stage 3 DES feedback sheet.

domain and restrict vehicle access. This corridor would also augment the available habitats for flora and fauna species in addition to the rehabilitation aspect. This corridor is anticipated to be beneficial for a variety of native fauna species, through increasing the available vegetation groundcover and associated foraging opportunities in the locality over time as the corridor develops, as well as increasing fauna movement opportunities in this landscape. Figure 6.6.2.2 displays the existing vegetation corridors with the proposed Native Bushland Corridors.

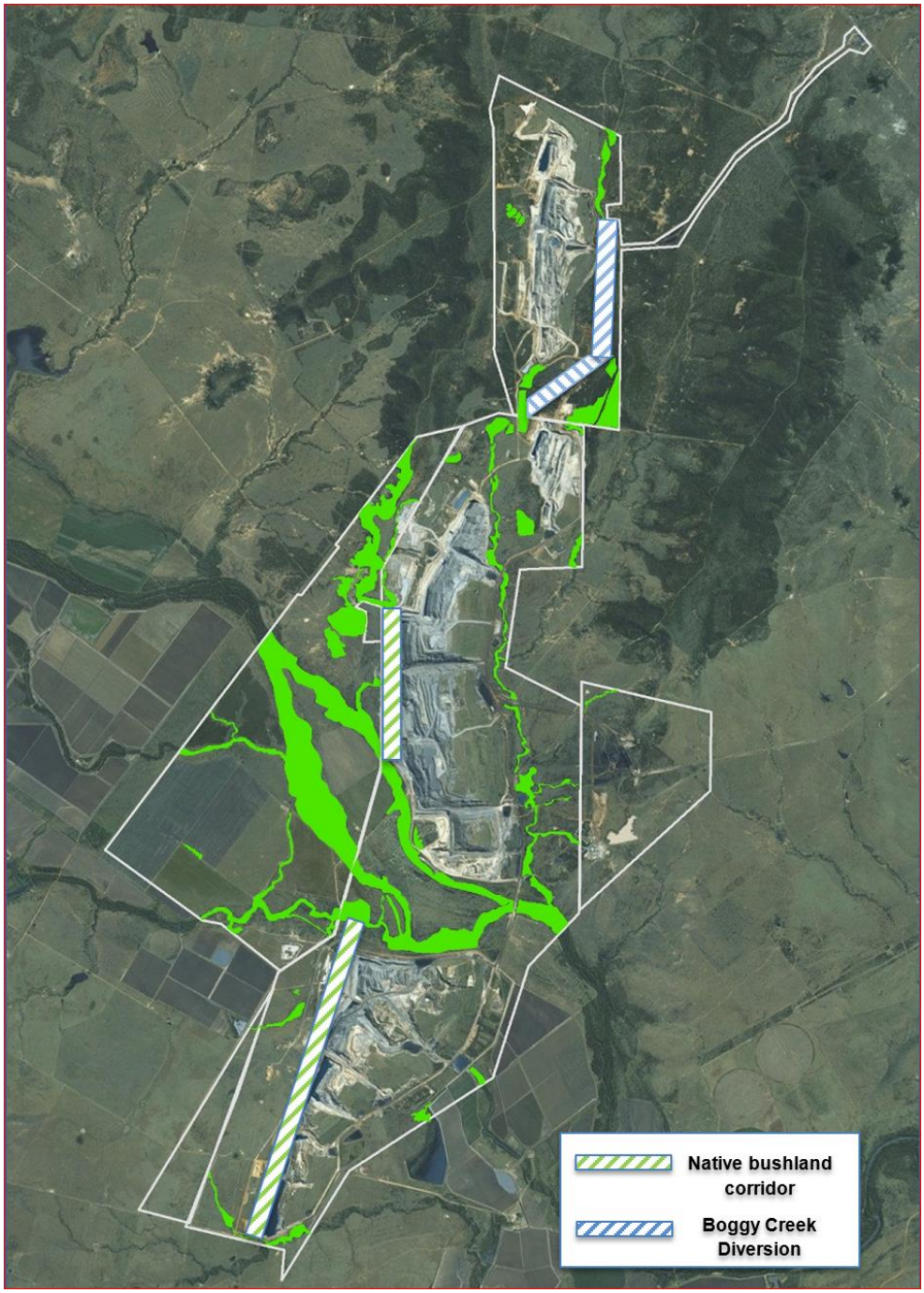


Figure 6.6.2.2 Displays the Existing Vegetation Corridors with Proposed Native Bushland Corridors

6.6.2.2 Terrestrial Fauna

Commonwealth and State listed Endangered species with potential to occur in the Project Area include Eastern Curlew (*Numenius madagascariensis*) and Australian Painted Snipe (*Rostratula australis*)[52]. The suitable habitat for these species within the Project Area is predominantly associated with the Nogoa River and its Anabranch. No clearing of riparian REs would occur as a result of this option. As a result, no significant impacts on species listed as Endangered are expected[53].

Several Commonwealth and State listed Vulnerable species are known to occur or have the potential to occur in the Project Area and are known to utilise RE 11.3.25e habitats. Based on available RE mapping, this option is not expected to result in the removal of any REs, as clearing would occur in already disturbed areas previously discussed.

No additional indirect impacts are expected to occur on any terrestrial fauna species known to utilise the Project Area as a result of this Option.

6.6.2.3 Aquatic Flora

Although no threatened aquatic flora species were identified as having potential to occur within 50 km of the Project Area, aquatic flora are known to occur within the Nogoa River. As this option does not interact with the Nogoa River or its Anabranch it is not expected to have any direct or indirect impact upon the Nogoa River or its Anabranch[54].

6.6.2.4 Aquatic Fauna

Two threatened turtle species were identified as having potential to occur within the Project Area. These species are known to occur within the Nogoa River. As this option has the same impact as Option 1 there will be no impact on REs or riparian vegetation would be cleared as a result of this Option, no direct or indirect impacts are expected on these species[55].

6.6.2.5 Terrestrial Groundwater Dependent Ecosystems

Mapping prepared by the Queensland Government (2018) indicates that the riparian corridor associated with the Nogoa River is considered a potential terrestrial GDE. This option does not propose to disturb the alluvium or the shallow Nogoa River aquifer and as such this option would not impact on terrestrial GDE's[56].

6.6.2.6 Stygofauna

The Project Area may support stygofauna in the two aquifer types present (alluvium and the deeper coal measures). This option is unlikely to significantly impact any potential stygofauna habitat (namely the alluvial aquifer that extends along the Nogoa River and the Anabranch). The basis for this is:

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[52] Refer to Table 7.4 of the Stage 3 Ecological Assessment Report
[53] Refer to page 114 of the Environmental Assessment Report
[54] Refer to page 114 of the Environmental Assessment Report
[55] Refer to page 49 of the Ecological Assessment Report
[56] Refer to page 115 of the Environmental Assessment Report and page 52 of the Stage 3 Ecological Assessment Report

- Groundwater quality in the Alluvial aquifer in the Project area, and surrounds, is typically within the ranges considered acceptable for stygofauna.

- Connectivity along the aquifer remains intact and no obstructions are planned which would cause the isolation of areas, thereby allowing taxa to disperse[57].

6.6.2.7 Wetlands

There are no wetlands in the project area and as such this option does not have any impact on the environmental values of a wetland[58].

6.6.2.8 Migratory Species

The project area occurs in a historically operated coal mine area (highly modified by past disturbance), and therefore likely to have an insignificant impact on any migratory species[59].

6.6.2.9 Bioaccumulation

Analysis of the HEC (2018c) Void Water Quantity and Quality Balance Modelling report indicates that there is potential for metals/metalloids to bioaccumulate within final landform waters.

All bioaccumulation will be contained within the final rehabilitated area as there is no connectivity to the receiving environment, including groundwater. This is supported by Figures 1 to 4 of the Supplementary Model Run 8 Report. These figures evidence that there is no groundwater outflow to the receiving environment and that the rehabilitated areas are designed to act as a groundwater sink, not a groundwater source.[60] Whilst the rehabilitation in the Aquatic Habitat PMLU area is not specifically designed to create a water habitat water quality will support the Aquatic Habitat PMLU[61]. Pits F and Y have been designed to prevent the daylighting of groundwater[62]. Accordingly, no bioaccumulation of salt or metals would occur in these landforms.

6.6.3 Mitigation and Management

Rehabilitation activities will be undertaken in compliance with the existing conditions in the Ensham EA. The following additional mitigation and management actions would be undertaken to address the above identified impacts:

1) Trees will be planted along the benches to further reduce water velocities and minimise erosion risk, in addition to the landform engineering design.

Based upon the identified impacts and mitigation/management discussions above, impacts to the ecological values have been assessed as shown in **Table 6.6.3** (the ranking). As can be seen, there is one insignificant negative impact and one insignificant positive impact.

[57] Refer to page 59 of the Ecological Assessment Report and page 115 of the Environmental Assessment Report
[58] Refer to page 52 of the Ecological Assessment Report
[59] Refer to page 3 of the Threatened Species Survey Findings Report and page 76 of the Ecological Assessment Report
[60] Section provided in response to line 59 of the Stage 3 DES feedback sheet.
[61] Refer to page 116 of the Environmental Assessment Report
[62] Refer to page 14 of the Stage 3 Landform Design Report

Table 6.6.3 Potential Impacts on Land Related Environmental Values

Environmental Aspect	Environmental Value	Assessment Considerations	Scoring Notes	Ranking	Evidence
Ecology	Terrestrial ecosystems	Habitats/Wetlands/Riparian Areas	Habitat/ Wetlands/ Riparian Areas	1	Compared to current extant vegetation (area)
		Terrestrial Subterranean Fauna Habitat	Terrestrial subterranean Fauna Habitat	0	Compared to current extant vegetation (area)
Water	Aquatic ecosystems (biodiversity and habitat)	Downstream River Quality	Impact on aquatic ecosystem water quality objectives for life of option	0	No impacts on downstream river quality are likely
		Aquatic GDEs (stygofauna)	Compared to current aquifer water quality and drawdown at impacted area	0	No impacts on aquatics GDEs are likely
		Impact on run-off quality	Impact on aquatic ecosystem water quality objectives for life of option	0	No impacts on runoff quality are likely
Biosecurity	Bioaccumulation	Void Water Quality	Potential for known contaminants to bioaccumulate	-1	There would be an insignificant concentration of both salts and metals increasing over time due to the effects of evaporation.

6.6.4 Commitments

The very minor overlap of the landform footprint for CD highwall area into Category B mapped area (15m^2) will be designed out prior to construction.

6.7 Biosecurity

6.7.1 Description of Environmental Values

The EVs that are relevant to this section are shown in **Table 6.7.1:** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.7 of the Stage 3 Environmental Assessment Report.

Table 6.7.1 Environmental Values - Biosecurity

Aspect	Environmental Value	Assessment Considerations
Biosecurity	Ecosystem vulnerability	Pests
		Weeds
		Overabundance of native species

The EVs selected were guided by relevant legislation, policies and best practice guidelines, including the *Central Highlands Regional Council Biosecurity Plan 2017-2022* (the Biosecurity Plan). The Biosecurity Plan identifies biosecurity matters (invasive pants and animals) listed under the *Biosecurity Act 2014*, as well as environmental weeds and declared pest species, and provides best practice strategies for the management of these matters.

The Project Area is dominated by cleared or disturbed lands associated with the current operation of the Ensham Mine, together with agricultural activities occurring in adjacent areas. Biosecurity at the Ensham Mine site is carried out in accordance with Ensham's Weed and Feral Animal Management Procedure, which is a part of the Ensham Mine Environmental Management System. This policy outlines the accepted measures to remove, control and limit the spread of pests, weeds, and disease pathogens on site.

6.7.1.1 Pathogens

A review of the Department of Agriculture and Fisheries plant pests and diseases web page[63] indicates there are no pathogens that are likely to affect the Ensham Mine Site.

6.7.1.2 Weeds

The Ecology Assessment Report (Umwelt, 2018) identifies the weed species or restricted matters that are known to occur within 10 km of the Project Area including species that are listed as Weeds of National Significance (WoNS) or listed under the *Biosecurity Act 2014* and identified under the *Central Highlands Regional Council Biosecurity Plan 2017-2022* (CHRC, 2017).

It is of note that Buffel Grass (*Cenchrus ciliaris*) is recognised as a weed of national significance due to its invasive nature into ecosystems. This species is also recognised as an important pasture species in Queensland however will not be used in rehabilitation at Ensham.

[63] https://www.daf.qld.gov.au/business-priorities/plants/health-pests-diseases/a-z-significant (accessed 20 August 2018)

6.7.1.3 Feral Species

The Ecology Assessment Report (Umwelt, 2018) identifies the feral animal species that may occur or are known to occur within 50 km of the Project Area that are listed as having National Significance or listed under the *Biosecurity Act 2014* and identified under the *Central Highlands Regional Council Biosecurity Plan 2017-2022* (CHRC, 2017).

6.7.2 Impacts to Environmental Values

There are no additional biosecurity risks associated with this Option that would not be managed effectively under the current land management practices for the Ensham Mine[64] during the rehabilitation stages and consistent with accepted land management practices regionally. Restricted matters, including weed and pest species, are currently controlled in accordance with this procedure.

6.7.3 Mitigation and management

Ensham Mine has an existing Weed and Feral Animal Management Procedure in place, which is a part of the site's Environmental Management System. The residual voids are likely to create waterbodies which may result in the proliferation of aquatic weeds. The Ensham Weed and Pest Animal Management Policy will need to be amended to incorporate monitoring and control procedures to manage potential occurrences of aquatic weed species for all residual voids.

Prior to surrender of the tenure, rehabilitation and land management will continue to be managed in accordance with this procedure. Post relinquishment weed and feral animal management will be the responsibility of the land owner consistent with other landowner obligations.
Table 6.7.3 identifies the assessed impacts on this aspect and EV. Mitigation/management measures discussed above for this option will not generate any impacts to biosecurity provided the nominated mitigation measures continue to be implemented.

Table 6.7.3 Potential Impacts on Land Related Environmental Values

Aspect	Environmental Value	Assessment Considerations	Ranking	Evidence
Biosecurity	Ecosystem vulnerability	Pests	0	Ongoing management practices would be implemented, which would include management of pest and feral species
		Weeds	0	Ongoing management practices would be implemented, which would include management of weeds
		Overabundance of native species	0	Ongoing management practices would be implemented, which would include management of any overabundant native species

[64] Refer to page 116 of the Stage 3 Environmental Assessment Report

6.7.4 Commitments

The Ensham Weed and Pest Animal Management Policy (Ensham EMS EP 8.1) will need to be amended to incorporate monitoring and control procedures to manage potential occurrences of aquatic weed species for all residual voids.

6.8 Air

6.8.1 Description of Environmental Values

The EVs that are relevant to this Option are shown in **Table 6.8.1:** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.8 of the Stage 3 Environmental Assessment Report.

Table 6.8.1 Environmental Values – Air and Emissions

Aspect	Environmental Value	Assessment Considerations
Climate	Air quality degradation – emissions	Dust
		Odour
		Fuel Usage
Air	Quality conducive to ecosystem health	Dust
		Odour
		Other air contaminants
	Quality conducive to aesthetics	Dust
		Odour
		Other air contaminants
	Quality conducive to human health	Dust
		Odour
		Other air contaminants
	Quality conducive to agricultural usage	Dust
		Other air contaminants

The only sensitive receptors are a number of isolated rural residences, the closest of which is located approximately 3 km from the closest open pit (refer **Figure 2.2).**

The 2006 EIS (Hansen Consulting) characterised the background air environment (relevant at that time) based on results of monitoring from 1998 to 2003. This report indicated that concentrations of PM_{10} and dust deposition rates were low and below air quality thresholds, despite the mine being in operation at the time of monitoring.

6.8.2 Impacts to Environmental Values

During construction, dust emissions would be generated due to the earth moving associated with the land rehabilitation activities. These impacts will be managed in compliance with the existing EA conditions.

Greenhouse gas total emissions associated with the construction of this Option are estimated at 142,612 equivalent tonnes CO2 (Deloitte, 2018) which is the lowest of the 3 options studied in the RV

Project[65]. The Ensham site National Greenhouse and Energy Reporting baseline emissions level would not be exceeded for Option 2. Given the lack of emission sources associated with this Option post construction, there is not expected to be any short / long term impacts on air quality within the Project Area, as such the activity will be operated in a way that protects the environmental values of air.[66]

6.8.3 Mitigation and management

The current dust management plan will be maintained for the rehabilitation works.

Air emissions pre-relinquishment would be managed under the current EA and the site Dust Management Procedure.

The vegetation will be maintained before relinquishment to achieve self-sustaining status in accordance with the success criteria so that post relinquishment, there would be negligible dust emissions

Based upon the above, the impacts to the environmental values are shown in **Table 6.8.3**. As can be seen, there are no impacts to EVs.

Table 6.8.3 – Potential Impacts on Land Related Environmental Values

Aspect	Environmental Value	Assessment Considerations	Ranking	Evidence
Climate	Air quality degradation – emissions	Dust	0	No dust generating sources to remain
		Odour	0	No odour generating sources to remain
		Fuel Usage	0	No other sources of air contaminants to remain
Air	Quality conducive to ecosystem health	Dust	0	No dust generating sources to remain
		Odour	0	No odour generating sources to remain
		Other air contaminants	0	No other sources of air contaminants to remain
	Quality conducive to aesthetics	Dust	0	No dust generating sources to remain
		Odour	0	No odour generating sources to remain
		Other air contaminants	0	No other sources of air contaminants to remain
	Quality conducive to human health	Dust	0	No dust generating sources to remain
		Odour	0	No odour generating sources to remain

[65] Refer to page 117 of the Stage 3 Environmental Assessment Report and page 41 of the Stage 4 Economic Assessment Report
[66] Schedule 5, Table 1 Air of the Environmental Protection Regulation 2008

Aspect	Environmental Value	Assessment Considerations	Ranking	Evidence
		Other air contaminants	0	No other sources of air contaminants to remain
	Quality conducive to agricultural usage	Dust	0	No dust generating sources to remain
		Other air contaminants	0	No other sources of air contaminants to remain

6.8.4 Commitments

There are no additional commitments required.

6.9 Noise and Vibration

6.9.1 Description of Environmental Values

The EVs that are relevant to Noise and vibration are shown in **Table 6.9.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.9 of the Stage 3 Environmental Assessment Report.

Table 6.9.1 Environmental Values – Noise & Vibration

Aspect	Environmental Value	Assessment Considerations
Acoustics	Quality conducive to ecosystem health	Noise
		Vibration
	Quality conducive to human health	Noise
		Vibration
	Quality conducive to community amenity	Noise
		Vibration

6.9.2 Acoustic Setting

As discussed for the Air section, the closest sensitive receptor is located approximately 3 km from the closest open pit (refer **Figure 2.2)**.

6.9.3 Impacts to Environmental Values

Noise and vibration will be generated during the rehabilitation works due to equipment operating. Minor blasting of the highwall to layback the highwall to minimise erosion risk could be undertaken during this stage. All of these activities are permitted and would be undertaken in compliance with the existing EA.

Post rehabilitation *sound from the activity will not be audible at any sensitive receptor. The release of sound to the environment under this option will be managed so that adverse effects on*

environmental values including health and wellbeing and sensitive ecosystems are prevented or minimised.[67][68]

As such, this option protects the environmental values of the acoustic environment.

6.9.4 Mitigation and management

The current Noise Management plan will be utilised during the rehabilitation works. During this time, noise and vibration impacts would be managed in accordance with the EA as occurs for current mining operations.

No additional management and mitigation measures would be required in respect of noise or vibration post construction for this Option[69].

The impacts to the noise and vibration values have been assessed and shown in Table 6.9.4. As can be seen, there are no impacts to EVs.

Table 6.9.4 Potential Impacts on Noise and Vibration Environmental Values

Aspect	Environmental Value	Assessment Considerations	Ranking	Evidence
Acoustics	Quality conducive to ecosystem health	Noise	0	No noise sources to remain
		Vibration	0	No vibration sources to remain
	Quality conducive to human health	Noise	0	No noise sources to remain
		Vibration	0	No vibration sources to remain
	Quality conducive to community amenity	Noise	0	No noise sources to remain
		Vibration	0	No vibration sources to remain

6.9.5 Commitments

There are no additional commitments required.

[67] Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Noise
[68] Refer to page 118 of the Stage 3 Environmental Assessment Report
[69] Refer to page 118 of the Stage 3 Environmental Assessment Report

6.10 Waste Management

6.10.1 Description of Environmental Values

The EVs that are relevant to Waste Management are shown in **Table 6.10.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.10 of the Stage 3 Environmental Assessment Report.

Table 6.10.1 Environmental Values – Waste

Aspect	Environmental Value	Assessment Considerations
Waste	Waste generation and environmental dispersal	Quantity of waste
Land	Contaminated land potential	N/A -Covered in other sections

6.10.2 Impacts to Environmental Values

The management of waste is regulated by the EA and the *Waste Reduction and Recycling Act 2011, Environmental Protection (Waste Management) Policy 2000*, and the *Environmental Protection (Waste Management) Regulation 2000*, as well as the EP Act and the EP Regulations. Post relinquishment, this Option would not generate any waste that would be considered regulated[70]. As such *the design of this option protects all environmental values.*[71]

Geochemical analysis, water quality modelling and flood modelling indicate that any seepage from the spoil material would not be released to surface waters.

6.10.3 Mitigation and Management

Waste Management during the construction phase (eg infrastructure removal) would be undertaken in accordance with the existing Ensham Mine Waste Management and Minimisation Plan. Disposal of any regulated waste would be done using Ensham's licenced waste disposal contractor.

No additional mitigation or management measures would be required in respect of waste management.

Based upon the identified impacts and mitigation/management measures discussed above, the impacts to the waste EVs have been assessed in Table 6.10.3. As can be seen, there are no impacts to Waste EVs.

Table 6.10.3 Potential Impacts on Land Related Environmental Values

Aspect	Value	Assessment Considerations	Ranking	Evidence
Waste management	Waste generation and environmental dispersal	Quantity of waste	0	Landform remains in perpetuity with no infrastructure designated for disposal

[70] Refer to page 118 of the Stage 3 Environmental Assessment Report
[71] Schedule 5, Part 3, Environmental objectives and performance outcomes, Table 1: Waste

Aspect	Value	Assessment Considerations	Ranking	Evidence
Land	Contaminated land potential	NA -Covered in other sections	NA	NA

6.10.4 Commitments

There are no additional commitments required.

6.11 Hazards and Safety

6.11.1 Description of Environmental Values

The EV that is relevant to Hazard and Safety is shown in **Table 6.11.1,** with a summary assessment following. The detailed impact assessment on this aspect is contained in Section 6.11 of the Stage 3 Environmental Assessment Report.

Table 6.11.1 Environmental Value – Hazards and Safety

Environmental Aspect	Environmental Value	Assessment Considerations
Hazards and safety	Vulnerability to natural hazards	Covered in individual EV assessments

6.11.2 Natural and Induced Hazards

6.11.2.1 Impacts to Environmental Values

The Queensland Government's bushfire hazard area layer provides an assessment of potential bushfire intensity within the state. **Figure 5.25** of the Environmental Assessment Report shows the potential bushfire intensity within the Project Area and the surrounding region which illustrates limited high or very high potential bushfire intensity areas within the Project Area and surrounding region. Parts of the Project Area has a designated bushfire intensity of medium potential, or is a potential impact buffer area. This medium potential bushfire intensity designation is generally associated with the woody vegetation within the Project Area.

Other natural hazards for consideration would include cyclones induced rain events and associated flooding. The issue of flooding is discussed in detail in Section 6.4

6.11.2.2 Mitigation and management

Grazing is expected to minimize fire fuel loads reducing the severity of any bushfire.

6.11.2.3 Commitments

There are no additional commitments required.

6.12 Economic

An Economic Impact Assessment (EIA) was undertaken by Deloitte Access Economics (Deloitte) and independently peer reviewed by the Centre for International Economics. The EIA was completed consistent with the requirements of the Economic Impact Assessment Guideline (2017) published by the Queensland Department of State Development, Manufacturing, Infrastructure and Planning. The monetised benefits and employment generated for each of the three Preferred Options is detailed in the following report: Economic Assessment of the Ensham Residual Void Project, Deloitte Access Economics.

The TBLA is detailed in Section 4 and the description of the selected Final Option is provided in Section 5. As previously discussed, the design of Option 2 has evolved from consultation with the administering authority. While Option 2 has been designed to accommodate a potential future use as a reservoir, that future use does not form part of this application and would be subject to a future application. The economic benefits of Option 2 with a post mining land use of grazing is compared in the following table with the opportunity benefits of a potential future reservoir, which was the original PMLU for Option 2. Changes to the EIA for Option 2 PMLU Grazing have been confirmed by Deloitte and the Independent Peer Reviewer.

RVP Project Summary (Queensland)	Option 2 PMLU (Grazing)	Option 2 Potential (Reservoir)
Monetised Benefits ($m, NPV)		
Direct		
RVP	12.30	128.27
Mining Operation	285.22	285.22
Total Direct Benefits	**297.52**	**413.49**
Economy Wide Benefits of RVP		
GRP - Central Highlands	9.0	137.6
GRP - Rest of Queensland	-1.1	19.2
Total Economy Wide Benefits of RVP	**7.9**	**156.8**
Employment (Annual Average FTE)		
Direct		
RVP	40.00	40.00
Mining Operation	475.00	475.00
Total Direct Employment	**515.00**	**515.00**
Economy Wide Benefits of RVP		
Employment - Central Highlands	7.3	247.4
Employment - Rest of Queensland	1.4	23.2
Total Economy Wide Employment of RVP	**9**	**271**

For the grazing option, there are clear monetised economic benefits ($12.30M NPV) and employment opportunities to the local (40 FTE's) Central Highlands region.

6.13 Social

6.13.1 Current social landscape

A Social Impact Assessment was undertaken by Umwelt in accordance with the key social terms of reference, as issued by the DES in July 2017 and the Coordinator-General's Social Impact Assessment Guideline, July 2013 as stipulated in the ToR.

The ToR for the Ensham RVP was prepared in July 2017, at which time the current SIA Guideline (March 2018) had not been released. However, the SIA has been guided by the requirements of the SIA Guideline (March 2018) in addressing the core social matters relevant to the Project.

The SIA has been Independently Peer Reviewed by Dr Ana Maria Esteves of Community Insights Group.

The social impacts that were assessed for this Option are presented in Table 6.13.1 and a broad summary of the key potential impacts relevant to this Option are also provided.

Table 6.13.1 Social Impacts Summary

SIA Matter	Social Impacts	Key Potential Impacts
Health & Community Wellbeing	Flood related impacts	Option 1 and 2 are unlikely to have any significant impacts on livelihood or health and wellbeing in a 1:100 flood event for either upstream or downstream landholders.
Health & Community Wellbeing	Water Quality related impacts	Option 1, and by default this option, is unlikely to have any significant impacts on livelihood or public safety and security of upstream and downstream landholders, or residents of Comet, Emerald or Central Highlands due to water quality.
Health & Community Wellbeing Workforce Management	Management related impacts	This Option is unlikely to have any significant impact on the public safety and security or livelihood / way of life of the Comet, Emerald or Central Highlands community as a result of the ongoing management of the options post relinquishment.
Health & Community Wellbeing	Community related impacts	Options 1, and by default this option, is unlikely to have significant impacts on the livelihood or way of life of landholders and the broader community through the increase of available land for grazing.
Health & Community Wellbeing	Landform design related impacts	This option is unlikely to have any significant impact on visual amenity due to landform design - the location of the rehabilitated landform is not easily visible.

In terms of understanding the social impacts it needs to be recognised that each option studied under the RVP has a specific combination of design criteria that enables the PMLU (or PMLU's).

Despite the change to the Option 2 PMLU (reservoir to grazing) the social benefits identified for reservoir option in Table 6.13.2 remain relevant for this option as:

- the land design remains largely unchanged except that the levee is proposed to be augmented to a landform to avoid ongoing management of a regulated structure and to protect the residual areas to flooding engross to 1:1000.

- the design criteria delivers sufficient storage volume for a reservoir allowing for the future potential benefit of a reservoir. Whilst not the proposed PMLU for this option, a reservoir remains a viable potential future post mining land use based on the RV Project studies and subject to future approvals.

Table 6.13.2 Social Values Assessment

Primary Aspect	Secondary Aspect	Assessed Impacts
Social Values	Supports future recreational uses	+2
Aesthetic	Sympathetic with the surrounding landscape	+2
Human Capital	Community health risk from water quality impacts	-1
	Risk to people's health and emotional wellbeing	-1
Economic Capital	Risk to people's livelihoods and income	-1
	Water security	+3
	Supports local business vitality	+3
Social Capital	Enhanced sense of community	+2
	Security from flood impacts	-1
Resilience	Supports economic/industrial diversity	+3
Community Acceptance	Supported by neighbouring landholders	+2
	Supported by the Central Highlands Regional Council Strategies and Plans	+2
	Supported by broader local and regional community	+3
Regulator Acceptance	Supported by the State Government (DNRME, DES, OCG) Strategy and Policy	0
	Supported by the federal DoEE	0

This community sentiment was evidenced through:

- 48 stakeholders participated across two rounds of SIA engagement, Round 1 in April 2018 and Round 2 in July 2018;

- Engagement through the Community Reference Group;

- Engagement with the Central Highlands Regional Council;

- 3 days of community engagement at AgGrow. More than 300 community members were engaged in face to face discussions on the 3 Options under study, with 62 community members expressing their wishes through the online survey; and

- An online survey of the Ensham workforce.

6.13.2 Mitigation and Management

As identified in the SIA this option has minimal impacts of a social nature that require mitigation or management.

6.13.3 Commitments

There are no additional commitments required.

7 Consultation Process

7.1 Overview

Ensham has conducted a comprehensive community consultation program to raise awareness and ensure an open and transparent interactive communication process with the community.

A broad range of stakeholders were identified for engagement, as shown in **Figure 7.1.**

Figure 7.1 Project Stakeholders Consulted

7.2 Stakeholders

7.2.1 Community Reference Group

A Community Reference Group (CRG) was established in October 2017 to work with Ensham in relation to the Project. The CRG consists of 11 members, including:

- The Independent Chair,
- Nearby neighbours (3),
- The mining area landholder (1),
- Central Highlands Council (2),
- Central Highlands Regional Resources Use Planning Cooperative (1),
- Fitzroy Partnership for River Health (1),
- Sunwater (1),
- Cotton Growers and Irrigators Association (1) and
- Community (1).

Since inception there have been 7 CRG meetings held. The minutes for each meeting are located at:

https://www.idemitsu.com.au/mining/projects/ensham-rv-community-reference-group/ensham-rv-scommunity-reference-group-meeting-minutes/

CRG members have been provided with all Stage 1, 2, 3 and 4 reports for review and comment. In addition to the CRG membership the Rockhampton Regional Council was invited to attend the CRG meetings by the Independent Chair.

A copy of the CRG Charter is provided in Appendix 5a. In addition, the SIA engagement was undertaken with State and Local Government agencies, Traditional Owners and Affected Property Owners.

Changes to this option (discussed in the report above) have been discussed with the CRG and Central Highlands Regional Council.

7.2.2 State and Local Government

Ensham consults with the State Government in Brisbane and Emerald on a regular basis. During the preparation of the RV studies, meetings were held with State Government to discuss issues of potential relevance to the project. Additional engagement includes but was not limited to:

- Scheduled 6 monthly briefings with DES/ DNRME as per the ToR requirements.
- Meetings with the CHRC Mayor and Councilors to brief the council on the project's progress.
- Responses to State Government feedback on the Stage 2 and 3 Reports.

All feedback gathered during engagement activities has been used to inform the RV Project.

7.2.3 Traditional Owners

There were two Traditional Owner Groups consulted in relation to the RV Project, being the Western Kangoulu and the Garingbal and Kara people. Workshops were arranged in Rockhampton with the Garingbal and Kara people, and Brisbane with the Western Kangoulu people.

7.2.4 Affected Property Owners

Engagement with the owners of the Yongala property (the Shaws) has been undertaken on a regular basis. Three of the family members also participate in the CRG and have regularly attended these meetings.

Ensham appreciate the time given by the Shaws in the RV Project which has resulted in a better landform design for F & Y Pits. Improvements include:

- Gentler slope angles that will accommodate 100% grazing;
- Lifting the floor of the rehabilitated landform above groundwater rest such that groundwater can never daylight; and
- Improved land carrying capacity relative to mapped land capability in the EMOS of 1993 prior to mining commencement.

8 Risk Assessment

A Residual Void Options Analysis Risk Assessment (Rowan & Associates 2018) was undertaken to review the outcomes of the technical investigations of the three preferred options identified in Stage 1 of the RVP, using a recognised Hazard and Operability Studies (HAZOPs) methodology. Refer to Appendix 3i.

The risk assessment conducted considered all EV impacts from the technical studies and this is provided in Table 3 of the Ensham Residual Void Options Analysis Risk Assessment (Rowan & Associates Pty Ltd). The HAZOP study in Table 2 considered all matters from Table 3 and the views of the expert group undertaking the risk assessment. Specific consideration to EVs for each option are in pages 9-19.[72]

The Studies conducted and independently peer reviewed, confirms that there is no serious impact to any EV under all three options.

This study was used to identify potential hazards and operational problems that could result from the proposed project design. The study was used to identify potential deviations from the expected normal operating conditions inherent in the design that could lead to hazardous situations or future operational difficulties.

[72] Section provided in response to line 124 and 125 of the Stage 3 DES feedback sheet.

This risk assessment process involved the systematic scrutiny of the three design options against the three key performance criteria, being consistent with the Rehabilitation Objectives:

- Safety
- Stability; and
- Non-polluting

The risk assessment identified possible deviations from the planned "normal operating conditions" and reviewed proposed Preventative Control strategies designed to prevent these deviations, together with any recovery or contingency strategies planned to mitigate the consequences of any deviations should they occur. The quality and effectiveness of these strategies was then qualitatively assessed to assign the "level of confidence" in the effectiveness of the proposed control strategies.

The resultant "Risk Rating" was then used to provide the opportunity to make a considered determination of the acceptability, or otherwise, of each identified risk.

The risk assessment has shown that the level of confidence for this option is predominantly greater than 90% which is the highest level of confidence.

9 References

Bureau of Meteorology (BoM), 2018a, accessed on 31 July 2018 via <http://www.bom.gov.au/climate/averages/tables/cw_035264_All.shtml>

Central Highlands Regional Council Biosecurity Plan 2017-2022

Ensham Resources, July 2017, Residual Void Project Terms of Reference

Ensham Resources, 2019, Triple Bottom Line Assessment Report

Ensham Resources, 2017a, *Residual Void Project, Stage 2 – Environmental Values Workshop Report*

Ensham Resources, 2017b, *Residual Void Project Terms of Reference*, July 2017

Hansen Consulting, 2006, *Ensham Central Project Environmental Impact Statement*

HEC, 2019a, Void Water Quantity and Quality Balance Modelling

HEC, 2019b, Ensham Residual Voids Project: Stage 3 Void Water Balance Supplementary Report for Additional Model Run

HEC, 2018c, Ensham Coal Mine Residual Void Project: Stage 2 and 3 Catchment Hydrology and Flood Modelling

Hollingsworth, Dames and Moore, 1990, *Ensham Coal Project Impact Assessment Study*

HydroSimulations (HS), 2018, *Ensham Resources Residual Void Project – Groundwater Assessment Stage 3*, Prepared for Ensham Resources Pty Ltd, September 2018

Kellogg Brown and Root (KBR), 2006, *Ensham Central Project Surface Water Report*

Major and Minor Amendments - Guideline ESR/2015/1684 version 7.02

RGS, 2018, Material characterisation and source term development for the Ensham Coal Mine Final Void Plan

Rowan & Associates Pty Ltd, 2018, Ensham Residual Void Options Analysis Risk Assessment, 25 October 2018.

WRM Water and Environmental Pty Ltd (WRM), 2018, Ensham Mine Residual Void Study – Geomorphic Impact Assessment of Options Stage *3*, Prepared for Ensham Resources Pty Ltd, September 2018

WSP, 2018, Stage 3 Geotechnical Assessment

WSP, 2019, Stage 3 Technical Report - Landform Design

Umwelt Australia, 2018, Ecological Assessment Report

10 Glossary and Abbreviations

Acronym/Term	Abbreviation/Meaning
AEP	Annual Exceedance Probability
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHD	Australian Height Datum
AMD	Acid and Metalliferous Drainage
ANC	Acid Neutralising Capacity
ARI	Average Recurrence Interval
Biosecurity Plan	*Central Highlands Regional Council Biosecurity Plan 2017-2022*
BoM	Bureau of Meteorology
CEC	Cation Exchange Capacity
CFD	Computational Fluid Dynamics
CHDC	Central Highlands Development Corporation
CHRC	Central Highlands Regional Council
CPT	Cone Penetration Testing
CRG	Community Reference Group
DES	Queensland Department of Environment and Science
DNRME	Queensland Department of Natural Resources, Mines and Energy
EA	Environmental Authority
EFO	Environmental Flow Objectives
EHP	Queensland Department of Environment and Heritage Protection (former)
EIS	Environmental Impact Statement
Ensham	Ensham Resources Pty Ltd (Ensham), operates Ensham Mine on behalf of the Ensham Joint Venture participants (Bligh Coal Limited, Idemitsu Australia Resources Pty Ltd and Natural Resources Investment (Australia) Pty Ltd
Ensham Mine	Comprises the following tenements: ML7459, ML7460, ML70049, ML70326, ML70365, ML70366 and ML70367
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPP Air	*Environmental Protection (Air) Policy 2008*
EPP Noise	*Environmental Protection (Noise) Policy 2008*
EPP Water	*Environmental Protection (Water) Policy 2009*
EV	Environmental Value
FOS	Factor of Safety
GDE	Groundwater Dependent Ecosystem
HEC	Hydro Engineering and Consulting Pty Ltd
HS	HydroSimulations

Acronym/Term	Abbreviation/Meaning
IQQM	Integrated Quantity-Quality Model
MNES	Matters of National Environmental Significance
ML	Mining Lease
MSES	Matter of State Environmental Significance
Mtpa	Million tonnes per annum
NAF	Non-acid Forming
NC Act	*Nature Conservation Act 1992* (Qld)
PMF	Probable Maximum Flood, referred to as the lateral extent of the predicted probable maximum flood inundation, effectively delineating the maximum extent of the floodplain.
PMST	Protected Matters Search Tool
Project Area	For the purposes of this report, the Project Area consists of the Ensham Mine MLs, i.e.: ML7459, ML7460, ML70049, ML70326, ML70365, ML70366 and ML70367
PSD	Particle Size Distribution
RE	Regional Ecosystem
RGS	RGS Environmental Pty Ltd
RVP	Residual Void Project, a component of work required under the terms of EA Condition G16
TEC	Threatened Ecological Communities
ToR	Terms of Reference for the Residual Void Project
Umwelt	Umwelt (Australia) Pty Ltd
VM Act	*Vegetation Management Act 1999* (QLD)
VMP	Vegetation Management Plan
Water Plan	*Water Plan (Fitzroy Basin) 2011*
WoNS	Weeds of National Significance
WRM	WRM Water & Environment Pty Ltd
WMP	Water Management Plan
WQO	Water Quality Objective

11 Accompanying Documents

A list of documents accompanying this report are detailed below:

Appendix 1	Stage 1 Options Appraisal Reports
Appendix 2a	Stage 2 Environmental values Workshop Report
Appendix 2b	Stage 2 Hydrology Report
Appendix 2c	Stage 2 Groundwater Report
Appendix 2d	Stage 2 Water Solute and Balance Report
Appendix 2e	Stage 2 Geotechnical Report
Appendix 2f	Stage 2 Landform Design Report
Appendix 2g	Stage 2 Civil Design Report
Appendix 2h	Stage 2 Ecological Assessment Report
Appendix 2i	Stage 2 Environmental Assessment Reports
Appendix 3a	Stage 3 Hydrology Report
Appendix 3b	Stage 3 Groundwater Report
Appendix 3c	Stage 3 Geochemistry Report
Appendix 3d	Stage 3 Water Solute and Balance Report
Appendix 3e	Stage 3 Geotechnical Report
Appendix 3f	Stage 3 Landform Design Report
Appendix 3g	Stage 3 Civil Design Report
Appendix 3h	Stage 3 Geomorphology Report
Appendix 3i	Stage 3 Risk Assessment Report
Appendix 3j	Stage 3 Regulatory Approvals Flow Chart
Appendix 3k	Stage 3 Ecological Assessment Report
Appendix 3l	Stage 3 Environmental Assessment Report
Appendix 4a	Stage 4 Social Impact Assessment Report
Appendix 4b	Stage 4 Economic Impact Assessment Report
Appendix 4c	Stage 4 Triple Bottom Line Report
Appendix 5a	CRG Charter
Appendix 5b	Model Run 8
Appendix 5c	Draft EA G Conditions plus Appendix 4
Appendix 5d	Landform Letters Option 1 landforms on Option 2
Appendix 5e	Onsite Ecology Field Survey Results Report
Appendix 5f	Integrated Quality and Quantity Modelling Report
Appendix 5g	DES Progress Reports