MACHEnergy
Mount Pleasant Operation

A JOINT VENTURE WITH JCDA Japan Coal Development Australia

Attachment 8

Rehabilitation and Mine Closure Addendum

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1 INTRODUCTION

The Mount Pleasant Operation Development Consent DA 92/97 was granted under the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 22 December 1999. The Mount Pleasant Operation was also approved under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) in 2012 (EPBC 2011/5795).

MACH Energy Australia Pty Ltd (MACH Energy) acquired the Mount Pleasant Operation from Coal & Allied Operations Pty Ltd on 4 August 2016. MACH Energy commenced construction activities at the Mount Pleasant Operation in November 2016 and commenced mining operations in October 2017, in accordance with Development Consent DA 92/97 and EPBC 2011/5795.

MACH Mount Pleasant Operations Pty Ltd manages the Mount Pleasant Operation as agent for and on behalf of the unincorporated Mount Pleasant Joint Venture between MACH Energy (95 per cent [%] owner) and J.C.D. Australia Pty Ltd (5% owner)[1].

The approved Mount Pleasant Operation includes the construction and operation of an open cut coal mine and associated rail spur and product coal loading infrastructure located approximately three kilometres (km) north-west of Muswellbrook in the Upper Hunter Valley of NSW (Figures 1 and 2).

The mine is approved to produce up to 10.5 million tonnes per annum of run-of-mine (ROM) coal. Up to approximately 9 trains per day of thermal coal products from the Mount Pleasant Operation are transported by rail to the Port of Newcastle for export, or to domestic customers for use in electricity generation.

1.1 PURPOSE

This Rehabilitation and Mine Closure Addendum (this Addendum) forms part of an Environmental Impact Statement (EIS) which has been prepared to accompany a Development Application for the Mount Pleasant Optimisation Project (the Project) in accordance with Part 4 of the EP&A Act.

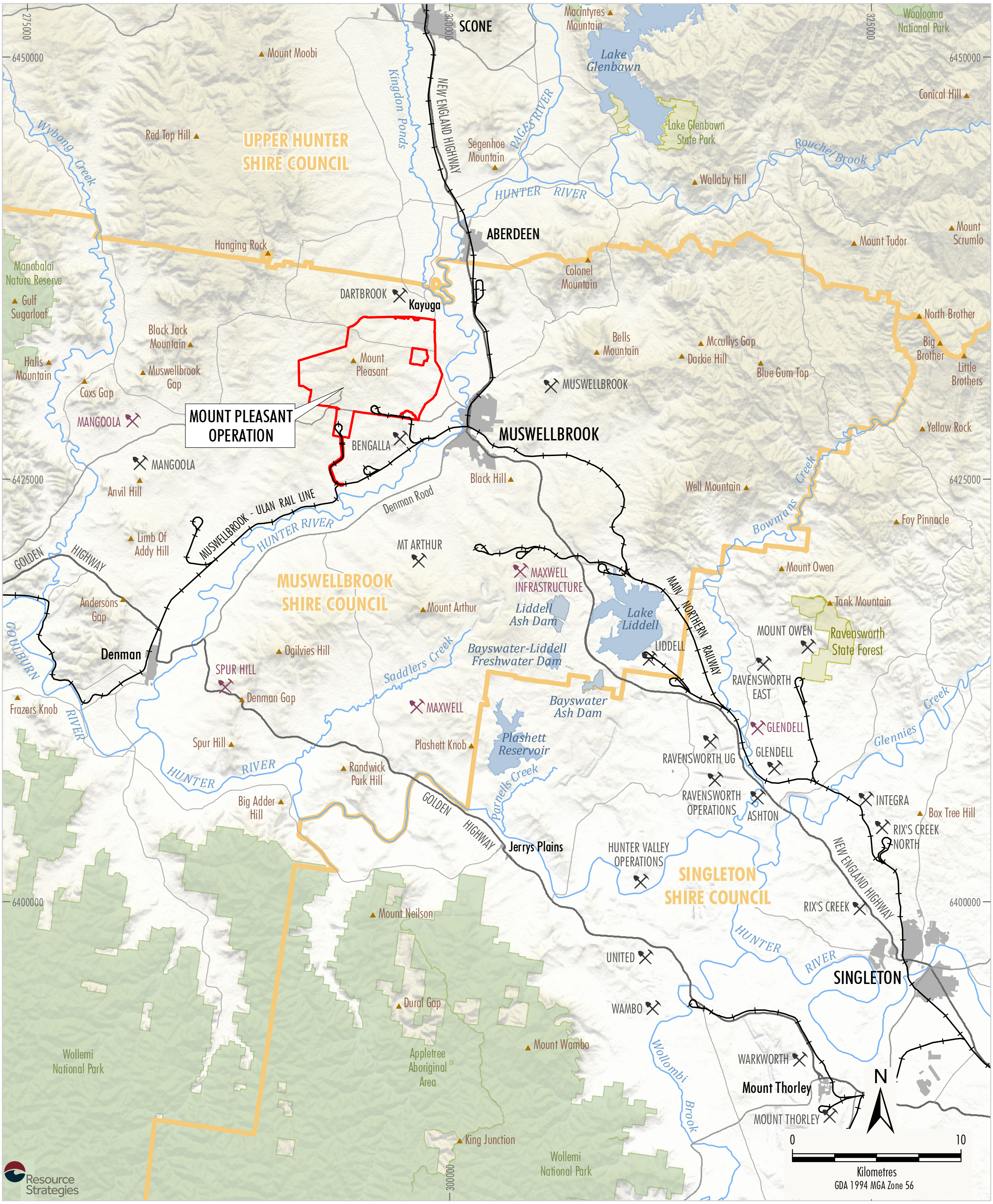
This Addendum has been prepared to satisfy the rehabilitation requirements of the Secretary's Environmental Assessment Requirements (SEARs), regulatory input to the SEARs and relevant rehabilitation guidelines (Section 2). Specific reference has also been made to the requirements of the *ESG3: Mining Operations Plan (MOP) Guidelines* (the MOP Guidelines) published by the Department of Trade and Investment, Regional Infrastructure and Services - Division of Resources and Energy (DRE, now NSW Resources Regulator) in 2013 the draft Form and Way guidelines released for public consultation by the NSW Resources Regulator in 2020.

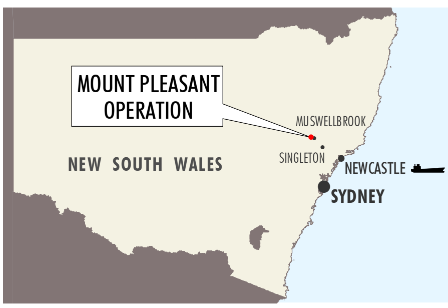
Mine closure planning is integral to life of mine planning and requires progressive review over the life of a mine. The content of this Addendum will be reviewed and updated to form the basis for the content that is required to be presented in the subsequent Mining Operations Plan and Rehabilitation Management Plan (MOP), should the Project be approved. The key components of the planned rehabilitation implementation and improvement methodology at the Mount Pleasant Operation and the role of this document are shown on Figure 3.

The proposed landform design and post-mining land use have been informed by extensive consultation with Project stakeholders (Section 3). The tables and figures shown in this Addendum are conceptual in nature and subject to review and revision as a result of subsequent detailed design and ongoing refinement of the Mount Pleasant Operation's landforms and rehabilitation techniques over the life of the Project. Any future updates would be undertaken in consultation with key regulatory agencies and other Project stakeholders.

This Addendum has been prepared on the basis that mining ceases at the completion of the Project. However, it is noted that there is the potential to recover additional coal beyond the life of the Project. An updated Rehabilitation and Mine Closure Addendum would be prepared as part of any future assessment to recover additional coal, should MACH pursue such a proposal in future.

[1] Throughout this Addendum, MACH Mount Pleasant Operations Pty Ltd and the unincorporated Mount Pleasant Joint Venture will be referred to as MACH.





LEGEND
- Mining Operation
- Proposed Mining Operation (Application Lodged)
- Railway
- Local Government Boundary
- State Forest/Reserve
- National Parks and Wildlife Estate
- Mining Lease Boundary (Mount Pleasant Operation)

Source: NSW Spatial Services (2020)

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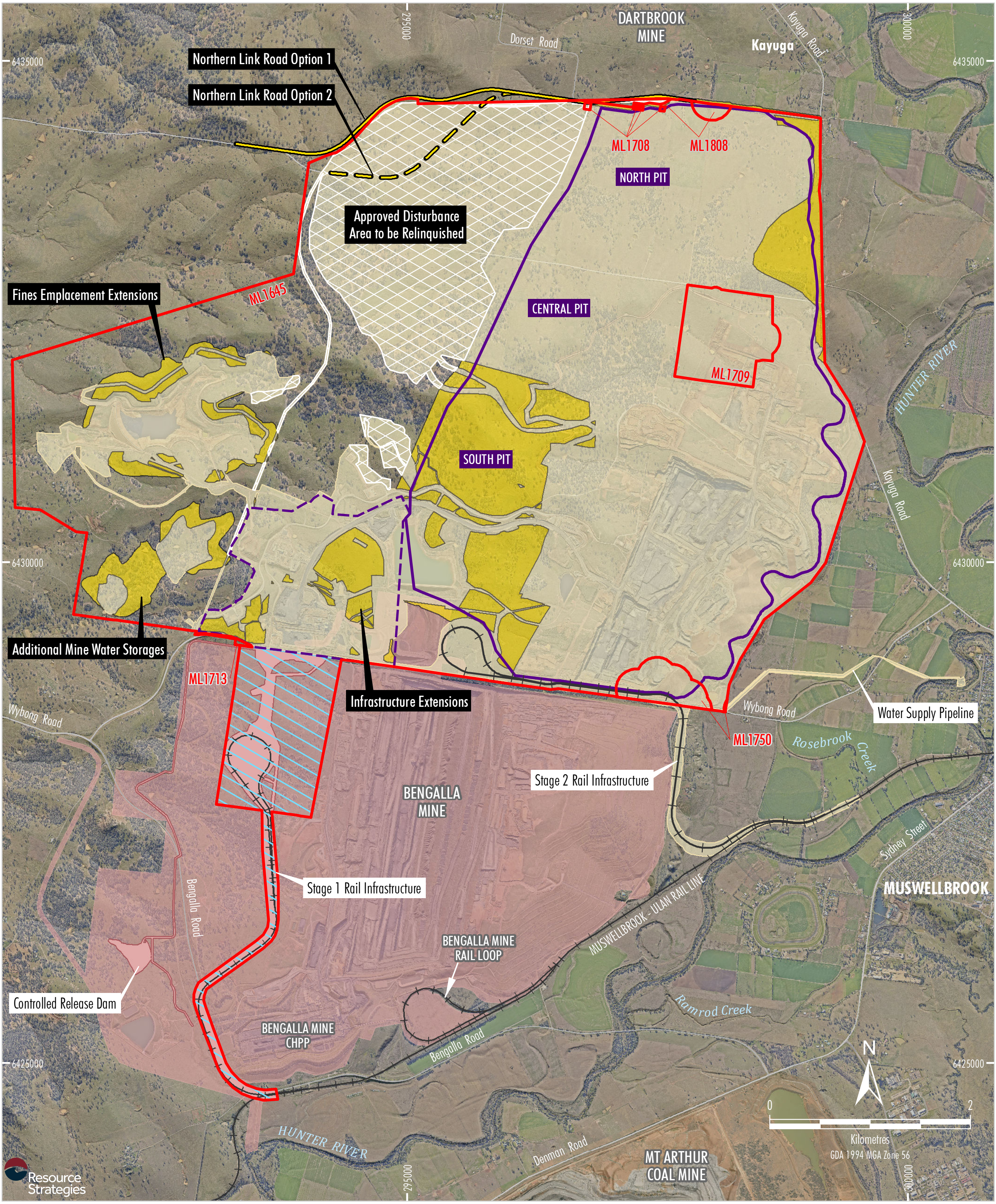
MOUNT PLEASANT OPTIMISATION PROJECT

Project Location

Figure 1



MAC-18-02 SSD_EIS_App Rehab_204A

LEGEND

Existing Mine Elements

- Mining Lease Boundary (Mount Pleasant Operation)
- Approximate Extent of Existing/Approved Surface Development (DA92/97) [1]
- Infrastructure to be removed under the Terms of Condition 37, Schedule 3 (DA92/97)
- Bengalla Mine Approved Disturbance Boundary (SSD-5170)
- Existing/Approved Mount Pleasant Operation Infrastructure within Bengalla Mine Approved Disturbance Boundary (SSD-5170) [1]

Additional/Revised Project Elements

- Approved Disturbance Area to be Relinquished [2]
- Approximate Additional Disturbance of Project Extensions [1]
- Northern Link Road Option 1 Centreline [3]
- Northern Link Road Option 2 Centreline
- Approximate Extent of Project Open Cut and Waste Rock Emplacement Landforms
- Revised Infrastructure Area Envelope

NOTES

1. Excludes some incidental Project components such as water management infrastructure, access tracks, topsoil stockpiles, power supply, temporary offices, other ancillary works and construction disturbance.
2. Subject to detailed design of Northern Link Road alignment.
3. Preferred alignment subject to landholder access.

Source: MACH (2020); NSW Spatial Services (2020); Department of Planning and Environment (2016) Orthophoto: MACH (2020)

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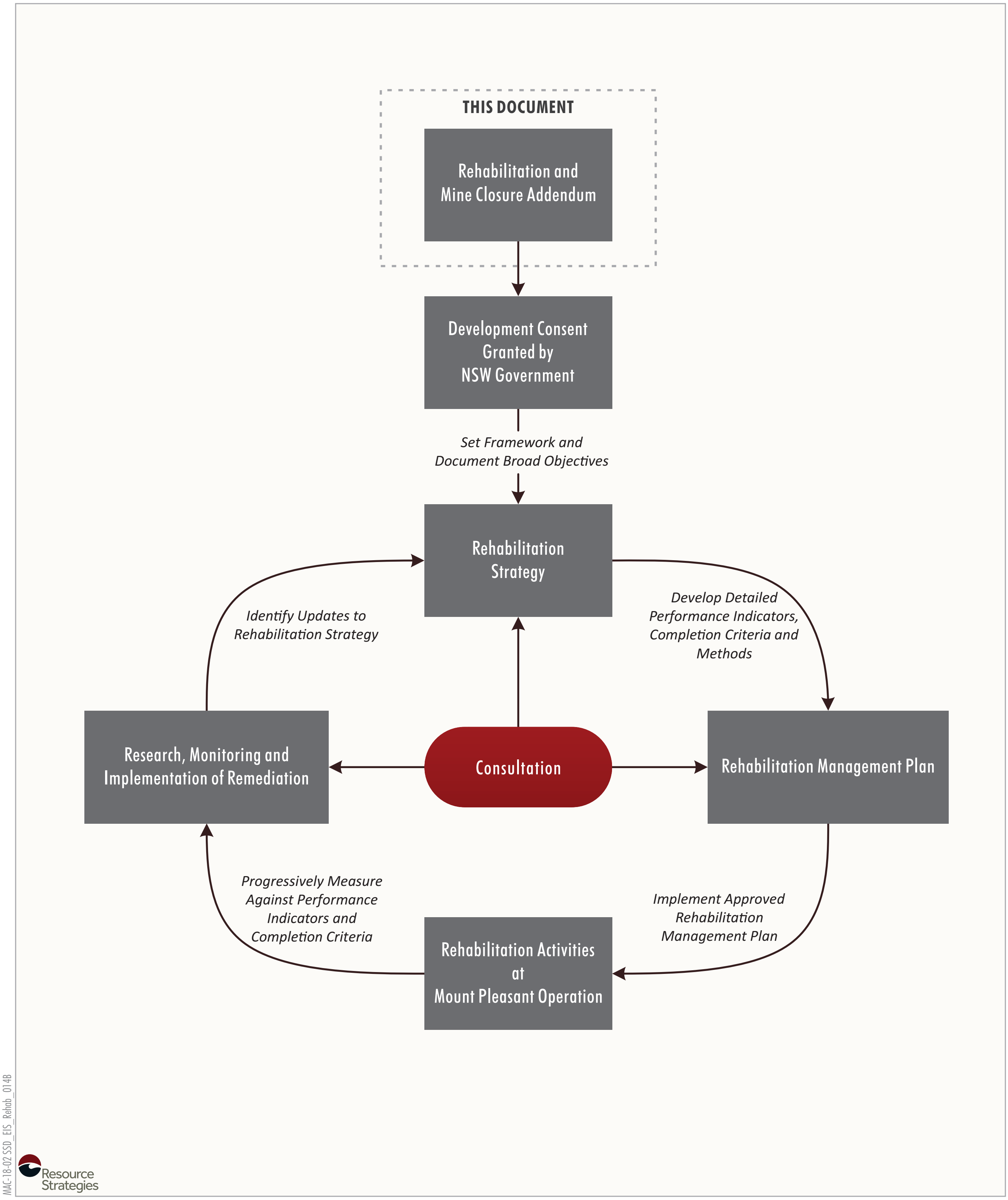
MOUNT PLEASANT OPTIMISATION PROJECT

Project General Arrangement

Figure 2



Source: MACH (2020)

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MOUNT PLEASANT OPTIMISATION PROJECT

Key Components of Rehabilitation Implementation and Improvement Methodology

Figure 3

1.2 REHABILITATION AT THE APPROVED MINE

Rehabilitation at the Mount Pleasant Operation is managed in accordance with the *Mining Operations Plan and Rehabilitation Management Plan (1 July 2020 – 30 June 2021)* (the Approved MOP). The Approved MOP describes the process to monitor the progress of rehabilitation activities under Mining Lease (ML) 1645, ML 1713, ML 1708, ML 1709, ML 1750 and Development Consent DA 92/97.

Mining operations at the Mount Pleasant Operation commenced in October 2017 and rehabilitation activities to date have focussed on construction of the lower batters of the Eastern Out-of-Pit Emplacement to the final landform profile and the rapid spreading of topsoil to target early revegetation of these batters, to progressively minimise visual impacts in Muswellbrook and other locations to the east.

The total rehabilitation area at the commencement of the Approved MOP (i.e. 1 July 2020) was approximately 54 hectares (ha). This is expected to increase to approximately 85 ha at the end of the current MOP term (i.e. 30 June 2021).

Photographs of some of the rehabilitation completed at the Mount Pleasant Operation on the Eastern Out-of-Pit Emplacement are provided on Plates 1 and 2.

1.3 SUPPORTING INFORMATION

This Addendum for the Project draws on information assessments in the following technical reports:

- *Mount Pleasant Optimisation Project – Geomorphic Landform Design Notes* prepared by Golder Associates Pty Ltd (Golder) (Attachment 1).
- *Mount Pleasant Optimisation Project – SIBERIA Parameterisation and Modelling* prepared by Associate Professor Gregory Hancock, University of Newcastle (Attachment 2).
- *Mount Pleasant Operation – No Final Void Groundwater Review* (Australasian Groundwater and Environment Consultants, 2020a) (Attachment 3).
- Relevant data from the *Mount Pleasant Optimisation Project – Soil Resource Assessment* (GT Environmental, 2020), which is appended to the Agricultural and Land Resources Assessment (Appendix I of the EIS).
- *Mount Pleasant Optimisation Project – Geochemistry Assessment* (RGS Environmental, 2020) (Appendix K of the EIS).

This Addendum has also been informed by extensive consultation with NSW State regulators, Muswellbrook Shire Council and the local community (Section 3).

PLATE 1
Progressive Rehabilitation of the Eastern Out-of-Pit Emplacement (Oblique View Facing North-West)

PLATE 2
Initial Rehabilitation of the Eastern Out-of-Pit Emplacement (View From Ground Level)

Resource Strategies

MAC-18-02 SSD_EIS_Rehab_009B

Source: MACH (2020)

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MOUNT PLEASANT OPTIMISATION PROJECT

Existing Rehabilitation Areas on Eastern Out-of-Pit Emplacement

Plates 1 and 2

2 REGULATORY REQUIREMENTS

2.1 REGULATORY FRAMEWORK

The EP&A Act and *Environmental Planning and Assessment Regulation, 2000* set the framework for planning and environmental assessment in NSW. Approval for the Project will be sought under the State Significant Development provisions of Part 4 of the EP&A Act. This Addendum forms part of an EIS which has been prepared to accompany a Development Application for the Project.

Subject to approval of the Project under the EP&A Act, a Development Consent would be issued that would prescribe the rehabilitation conditions relevant to the Project (including a conceptual final landform). The Development Consent would also require the preparation of management plans that describe how activities would be undertaken at the site to manage potential environmental impacts (including rehabilitation activities).

The objects of the *Mining Act, 1992* are to encourage and facilitate the discovery and development of mineral resources in NSW, having regard to the need to encourage ecologically sustainable development. Under the *Mining Act, 1992*, environmental protection and rehabilitation are regulated by conditions included in all MLs, including requirements for the submission of a MOP prior to the commencement of operations, and for subsequent Annual Environmental Management Reports (submitted with Annual Reviews).

All mining operations must be carried out in accordance with the MOP which has been prepared to the satisfaction of the NSW Resources Regulator. The MOP describes site activities and the progress toward environmental and rehabilitation outcomes required under ML conditions, Development Consent conditions and other approvals. A MOP may be approved for a period of up to seven years, after which a new MOP is required. Titleholders can submit a MOP amendment if an activity is proposed that is not in accordance with an approved MOP.

MACH operates the Mount Pleasant Operation in accordance with the Approved MOP. Where relevant, this Addendum draws on information from the Approved MOP.

All titleholders engaged in mining activities are required to lodge a security deposit (Section 8). The security deposit covers the NSW Government's full estimated costs in undertaking rehabilitation in the event of default by the titleholder. The security deposit is reviewed and progressively increased or decreased, based on the extent of disturbed land and rehabilitation activities described in each new or amended MOP.

2.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs for the Project were issued by the NSW Department of Planning, Industry and Environment (DPIE) on 17 February 2020. Relevant government agencies provided input into the SEARs, including the NSW Resources Regulator and Muswellbrook Shire Council.

The SEARs relevant to this Addendum are summarised in Table 1.

2.3 AGENCY INPUT TO SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The NSW Resources Regulator recommended that the standard mining development rehabilitation SEARs be applied to the Project. A summary of the standard mining development rehabilitation SEARs, and where they are addressed in this Addendum, is provided in Table 2.

Muswellbrook Shire Council also provided input to the SEARs regarding rehabilitation and the final landform. Muswellbrook Shire Council's input, and where it has been considered in this Addendum, is provided in Table 3.

Table 1
Secretary's Environmental Assessment Requirements

Requirement	Report Section
General Requirements *In particular, the EIS must include:* *…* – *a rehabilitation strategy;*	This Document
***Rehabilitation and Final Landform** – including*	
– *a description of final landform design objectives, having regard to achieving a natural landform that is safe, stable, non-polluting, fit for the nominated post-mining land use and sympathetic with surrounding landforms;*	Section 5.1
– *an analysis of final landform options, including the short and long-term cost and benefits, constraints and opportunities of each, and detailed justification for the preferred option;*	Sections 5.3 and 5.4
– *identification and assessment of post-mining land use options, having regard to any relevant strategic land use planning or resource management plans/policies;*	Sections 5.3 and 6.1
– *rehabilitation objectives and completion criteria to achieve the nominated post-mining land use;*	Sections 6.2 and 6.3
– *a detailed description of the progressive rehabilitation measures that would be implemented over the life of the development and how this rehabilitation would be integrated with surrounding mines and land uses;*	Section 7
– *a detailed description of the proposed rehabilitation and mine closure strategies for the development, having regard to the key principles in Strategic Framework for Mine Closure; and*	Section 8
– *the measures which would be put in place for the long-term protection and/or management of the site and any biodiversity offset areas post-mining;*	Section 9

Table 2
Standard Mining Development Rehabilitation SEARs

Requirement	Report Section
Post-mining Land Use	
a) *Identification and assessment of post-mining land use options;*	Section 5.3
b) *Identification and justification of the preferred post-mining land use outcome(s), including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives;*	Sections 5.3 and 5.4
c) *Identification of how the rehabilitation of the project will relate to the rehabilitation strategies of neighbouring mines within the region, with a particular emphasis on the coordination of rehabilitation activities along common boundary areas;*	Section 5.1
Rehabilitation Objectives and Domains	
d) *Inclusion of a set of project rehabilitation objectives and preliminary completion criteria that clearly define the outcomes required to achieve the post-mining land use for each domain. Completion criteria should be specific, measurable, achievable, realistic and time-bound. If necessary, objective criteria may be presented as ranges;*	Section 6
Rehabilitation Methodology	
e) *Details regarding the rehabilitation methods for disturbed areas and expected time frames for each stage of the rehabilitation process;*	Section 7
f) *Mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key assumptions (e.g. production milestones) of the mine layout sequence, before being translated to indicative timeframes throughout the mine life. The mine plan should maximise opportunities for progressive rehabilitation;*	Section 5
Conceptual Final Landform Design	
g) *Inclusion of a drawing at an appropriate scale identifying key attributes of the final landform, including final landform contours and the location of the proposed final land use(s);*	Section 5.1

Table 2 (continued)
Standard Mining Development Rehabilitation SEARs

Requirement	Report Section
Monitoring and Research	
h) *Outlining the monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria;*	Section 7.9
i) *Details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices;*	Section 7.9
j) *Outlining any proposed rehabilitation research programs and trials, including their objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices;*	Section 7.10
Post-closure Maintenance	
k) *Description of how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land use(s) in order to demonstrate progress towards meeting the rehabilitation objectives and completion criteria in a timely manner;*	Sections 8 and 9
Barriers or Limitations to Effective Rehabilitation	
l) *Identification and description of those aspects of the site or operations that may present barriers or limitations to effective rehabilitation, including:*	Section 4
(i) *evaluation of the likely effectiveness of the proposed rehabilitation techniques against the rehabilitation objectives and completion criteria;*	Section 6.3
(ii) *an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (e.g. acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden/interburden and reject material;*	Sections 7.3
(iii) *the processes that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes;*	Sections 4.2 and 7.3
(iv) *a life of mine tailings management strategy, which details measures to be implemented to avoid the exposure of tailings material that may cause environmental risk, as well as promote geotechnical stability of the rehabilitated landform; and*	Sections 7.3 and 5.2
(v) *existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how key geomorphological characteristics evident in stable landforms within the natural landscape can be adapted to the materials and other constraints associated with the site.*	Section 5.1
m) *Where a void is proposed to remain as part of the final landform, include:*	
(i) *a constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;*	Sections 5.2 and 5.4
(ii) *a preliminary geotechnical assessment to identify the likely long term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and*	Section 5.2.2
(iii) *outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required be implemented to minimise associated impacts to the environment and downstream water users.*	Section 5.2.3
n) *Consideration of the controls likely to be required to either prevent or mitigate against rehabilitation risks as part of the closure plan for the site;*	Sections 4 and 8
o) *Where an ecological land use is proposed, demonstrate how the revegetation strategy (e.g. seed mix, habitat features, corridor width etc.) has been developed in consideration of the target vegetation community(s);*	Section 7.5
p) *Where the intended land use is agriculture, demonstrate that the landscape, vegetation and soil will be returned to a condition capable of supporting this; and*	Section 7.6
q) *Consider any relevant government policies.*	This section

Table 3
Relevant Muswellbrook Shire Council Input to SEARs

Requirement	Report Section
• *Give consideration to the employment of micro-relief to the rehabilitation of the site, in line with the principles of Geofluv design, to ensure long-term site stability and erosion control, and to create a more natural looking landscape post development;*	Section 5.1
• *Consider a design/mining sequence that will result in no final voids; and*	Section 5.4
• *Provide a detailed description of the progressive rehabilitation measures that would be implemented over the life of the development and how this rehabilitation would be integrated with surrounding mines and land uses.*	Sections 5.1, 5.2 and 7

2.4 KEY GUIDELINES

The following guidelines have been considered in the preparation of this Addendum:

- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government, 2016a);
- *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government, 2016b); and
- *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia [ANZMEC-MCA], 2000).
- Draft Form and Way guidelines released by the Resources Regulator for public consultation in 2020.

The above guidelines have been applied as they relate to this initial stage of rehabilitation planning. The guidelines and applicable future guidance materials would continue to be considered further in the subsequent MOP over the life of the Project, should the Project be approved.

3 STAKEHOLDER CONSULTATION

3.1 CONSULTATION TO DATE

Stakeholder identification and consultation are integral in mine closure planning. This Addendum is informed by (Figure 4):

- consultation undertaken by Coal & Allied Operations Pty Ltd since 1997, prior to MACH's acquisition of the Mount Pleasant Operation;
- consultation undertaken during Modification 3 to Development Consent DA 92/97, which sought approval for a new interim final landform;
- consultation undertaken as part of developing the Approved MOP;
- ongoing consultation associated with day-to-day activities of the Mount Pleasant Operation; and
- Project-specific consultation undertaken for the EIS.

3.1.1 Community Consultative Committee

The Community Consultative Committee (CCC) was formed in 2004. The CCC is an important communication and engagement tool, as the Committee acts as the point of contact to provide feedback between MACH and the community. The CCC is made up of community members and one Muswellbrook Shire Council representative.

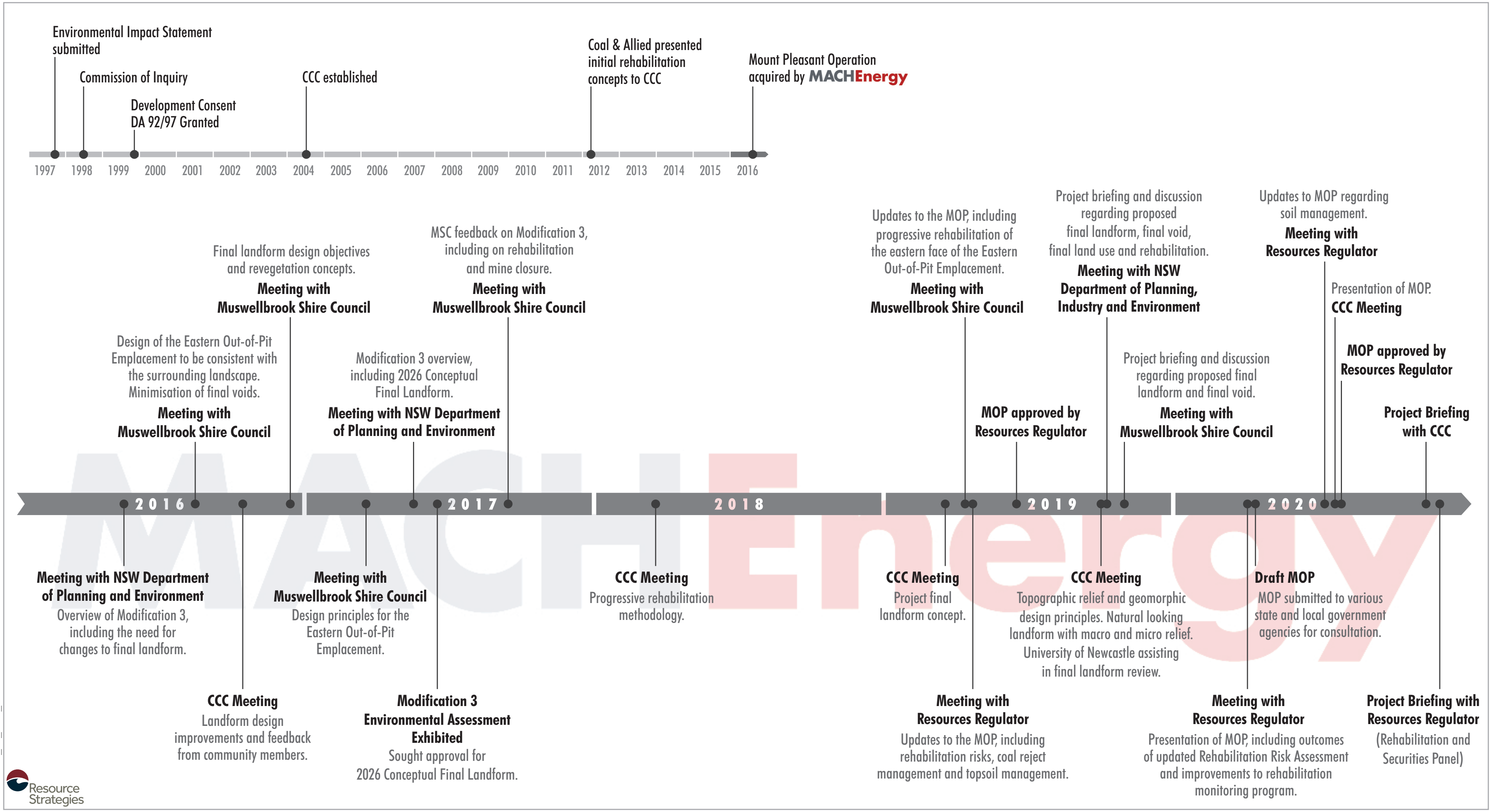
The CCC has been provided with an opportunity to comment on the various Modifications submitted for the Mount Pleasant Operation as part of the public exhibition process. Feedback on rehabilitation concepts provided by the CCC to date has included:

- Support for the use of analogue (reference/control) sites to assess rehabilitation success.
- Concerns regarding interactions between the Mount Pleasant Operation and the Bengalla Mine.
- A preference by members of the community for a final landform that integrates with the surrounding landscape (i.e. does not form the shape of a 'bread loaf').

The MOP was presented to the CCC on 23 July 2020 and MACH coordinated a site visit to existing rehabilitation areas. Members of the CCC provided positive feedback regarding the progressive rehabilitation completed to-date, including the following statements from members of the community (*Record of Meeting – Community Consultative Committee*, 23 July 2020[2]):

> *There has been strong interest from local residents about the rehabilitated areas you can see when driving down Wybong Road. The site tour today was very informative, and I am personally really impressed with the efforts on the rehabilitation. The main comments from town are that they are interested in Mount Pleasant and what they can see, it is good to be able to provide an update.*
>
> *…*
>
> *It is excellent to be able to see the rehabilitation up close. It is really a great job by all those involved.*
>
> *…*
>
> *The rehabilitation has really taken off over the past six months, from town it looks good and can only improve.*
>
> *…*
>
> *Really good job on the rehabilitation work, I appreciate it. Top job.*

[2] https://machenergyaustralia.com.au/wp-content/uploads/CCC-Minutes-July-2020-.pdf



Source: MACH (2020)

Figure 4

3.1.2 Muswellbrook Shire Council

Throughout consultation to date, Muswellbrook Shire Council has expressed significant interest in the design of the Eastern Out-of-Pit Emplacement, its consistency with the surrounding landscape and its long-term stability. Muswellbrook Shire Council has also provided comments regarding tree plantings for visual screens, final void minimisation, dust management and the potential for high-intensity post-mining land uses.

MACH also developed the approved Rehabilitation Strategy and MOP in consultation with Muswellbrook Shire Council in accordance with the relevant provisions of Development Consent DA 92/97. MACH has addressed feedback from Muswellbrook Shire Council in the approved Rehabilitation Strategy and MOP.

Muswellbrook Shire Council also provided input to the SEARs (Table 3).

3.1.3 Resources Regulator

MACH has met with the NSW Resources Regulator at various times throughout the development of the approved Rehabilitation Strategy and MOP and through the course of day-to-day activities of the Mount Pleasant Operation.

MACH met with the NSW Resources Regulator on 31 March 2020 and on 8 July 2020 to discuss the scope of mining and rehabilitation activities described within the Approved MOP and on-site soil management practices. MACH incorporated feedback from the NSW Resources Regulator in the Approved MOP.

The NSW Resources Regulator recommended that the standard mining development rehabilitation SEARs be applied to the Project. A summary of the standard mining development rehabilitation SEARs, and where they are addressed in this Addendum, is provided in Table 2.

MACH held a videoconference with representatives of the NSW Resources Regulator (Rehabilitation and Securities Panel) on 2 December 2020. MACH provided a briefing on rehabilitation methods at the Mount Pleasant Operation and the proposed Project final landform. During the videoconference, representatives of the Rehabilitation and Securities Panel raised queries regarding:

- vegetation establishment and use of seeding and/or tubestock (Section 7.4);
- long-term water quality of the final void (refer Surface Water Assessment in Appendix C of the EIS);
- the 'Tailings to Topsoil' research project (Section 7.10.1);
- landscape evolution modelling and associated erosion monitoring, including the use of erosion monitoring to inform future completion criteria (Sections 5.2.1 and 7.10.2);
- whether MACH had considered partial backfilling of the final void (Section 5.4); and
- progressive rehabilitation, including commitments regarding timing of rehabilitation establishment (Sections 7 and 7.4).

The Resources Regulator also noted the rehabilitation reporting and compliance reforms. The reforms include the development of a new regulation under the *Mining Act, 1992* and a series of Form and Way guidelines. Drafts of the Form and Way guidelines were released by the Resources Regulator for public consultation in 2020 and have been considered in this document where relevant.

3.2 STAKEHOLDER ENGAGEMENT PLAN

Stakeholder consultation has been undertaken to date to inform potential post-mining land uses, mine landform design and rehabilitation objectives. These would periodically be reviewed in consultation with relevant stakeholders throughout the life of the Project.

A high-level stakeholder engagement plan for the remainder of the Project life is provided in Table 4. Consultation would be undertaken commensurate with the stage of the Project. In addition to the specific engagement activities outlined in Table 4, MACH maintains a number of available points of contact for the community to ask specific questions or provide feedback, including:

- 24/7 Community Hotline (1800 886 889);
- community Blasting Hotline (1800 931 872);
- a dedicated community call line for general enquiries (18 931 873);
- an email address (info@machenergyaustralia.com.au); and
- media contact point.

Table 4
Initial Stakeholder Engagement Plan – Rehabilitation and Mine Closure

Development Phase	Consultation Mechanism	Description
Project Assessment	Public Exhibition	• EIS will be placed on public exhibition to provide all Project stakeholders an opportunity to comment. • MACH will prepare a detailed response to submissions addressing the issues raised in stakeholder comments.
	Assessment Phase	• MACH will liaise with the DPIE and other regulators as necessary to address issues or concerns raised by stakeholders.
	CCC Meetings	• MACH will discuss key issues raised in the stakeholder submissions and receive feedback through CCC meetings.
Project Determination	Public Hearings	• The Independent Planning Commission will hold a public hearing to provide stakeholders with a further opportunity to comment, including to provide feedback on MACH's response to submissions.
	Determination Phase	• MACH will liaise with the approval authority and other regulators as necessary to address issues or concerns raised by stakeholders.
	CCC Meetings	• MACH will continue to provide updates to the community and receive feedback through CCC meetings.
Pre-mining	MOP	• MACH would prepare a detailed MOP for the Project in consultation with the relevant regulators and to the satisfaction of the NSW Resources Regulator.
	CCC Meetings	• MACH would present the key components of the MOP to the CCC and incorporate feedback to the satisfaction of the NSW Resources Regulator.
During-mining	MOP	• MACH would prepare updated MOPs as mining progresses, in consultation with the relevant regulators and to the satisfaction of the NSW Resources Regulator.
	CCC Meetings	• MACH would continue to hold CCC meetings, including updates on rehabilitation progress, outcomes of any rehabilitation trials and any proposed changes to the MOP.
Pre-closure	Mine Closure Plan	• Towards the end of the mine life, MACH would prepare a detailed Mine Closure Plan (expanding on the plan in the MOP) in consultation with relevant stakeholders and to the satisfaction of the DPIE and/or NSW Resources Regulator.
	CCC Meetings	• MACH would present detailed mine closure strategies and provide updates on the performance of rehabilitation with respect to the approved rehabilitation completion criteria.
Post-closure	Closure Committee Meetings	• Regular CCC meetings would continue during the post-closure phase for a period of at least five years, with the CCC acting as a Closure Committee. • Relevant regulators would also be invited to attend Closure Committee meetings as required. • Closure Committee meetings would include updates on the progress of rehabilitation in achieving rehabilitation completion criteria and any relinquishment activities.

4 REHABILITATION RISK ASSESSMENT

4.1 ENVIRONMENTAL RISK ASSESSMENT UNDERTAKEN FOR THE PROJECT

An Environmental Risk Assessment workshop was undertaken for the Project on 27 November 2019.

The risk assessment process was based on the framework provided in *Australian and New Zealand Standard International Organisation for Standardisation* (*AS/NZS/ ISO*) 31000:2018, *MDG1010 Minerals Industry Safety and Health Risk Management Guideline* (NSW Department of Trade and Investment, 2011) and HB 2003:2012 *Managing environment related risk* (HB 2003:2012).

The Environmental Risk Assessment is included as Appendix P to the EIS.

4.2 REHABILITATION RISK ASSESSMENT

On 29 January 2020 MACH undertook a risk assessment workshop to evaluate the risks associated with successful rehabilitation of the Mount Pleasant Operation.

The risk assessment was facilitated by Operational Risk Mentoring Pty Ltd (ORM) and undertaken in accordance with the *AS/NZS ISO 13000:2018 Risk Management Guidelines*.

The *Final Mount Pleasant Operation Rehabilitation Risk Assessment Report April 2020* documents the results of the risk assessment. The key risks to successful rehabilitation, and to biodiversity and land management of the Mount Pleasant Operation are also relevant to the rehabilitation of the Project.

The rehabilitation risk assessment would be periodically updated as part of the development of MOPs for the Project.

5 FINAL LANDFORM DESIGN AND POST-MINING LAND USE

5.1 FINAL LANDFORM DESIGN PRINCIPLES

MACH is aware of the level of local interest with respect to the shape and form of Mount Pleasant Operation final mine landforms. Accordingly, MACH has undertaken a comprehensive approach to landform design based on the following key design principles:

- The emplacement landform has been designed to look less “engineered” when viewed from Muswellbrook (i.e. incorporation of macro-relief to avoid simple blocky forms).
- Surface water drainage from the waste emplacement landform would incorporate micro-relief to increase drainage stability, avoid major engineered drop structures and limit erosion.
- The final void (and associated drainage network) would be shaped to reflect a less engineered profile that is more consistent with the surrounding natural environment.
- The final void has been designed as a long-term groundwater sink to maximise groundwater flows from the Eastern Out-of-Pit Emplacement to the final void.
- MACH would continue to progressively develop and revegetate the final landform to reduce visual impacts in Muswellbrook and continue to monitor the performance of rehabilitation and implement remediation as required.

5.2 PROPOSED FINAL LANDFORM

The proposed final landform for the Project is shown on Figure 5a. Cross-sections through the final landform are shown on Figures 5b and 5c.

The proposed final landform has been developed using geomorphic design principles to address these key design principles. The landform been designed using the GeoFluv™ methodology, which uses characteristics of relevant stable natural landforms in the local environment (referred to as analogues) and applies these characteristics to the design of new landforms of similar materials. More detailed erosional based assessment and design methods are then used to refine parts of the landform that are steeper than alluvial analogues (Attachment 1).

The geomorphic design approach reduces the reliance on contour banks and linear engineered drop structures.

5.2.1 Landform and Erosional Stability

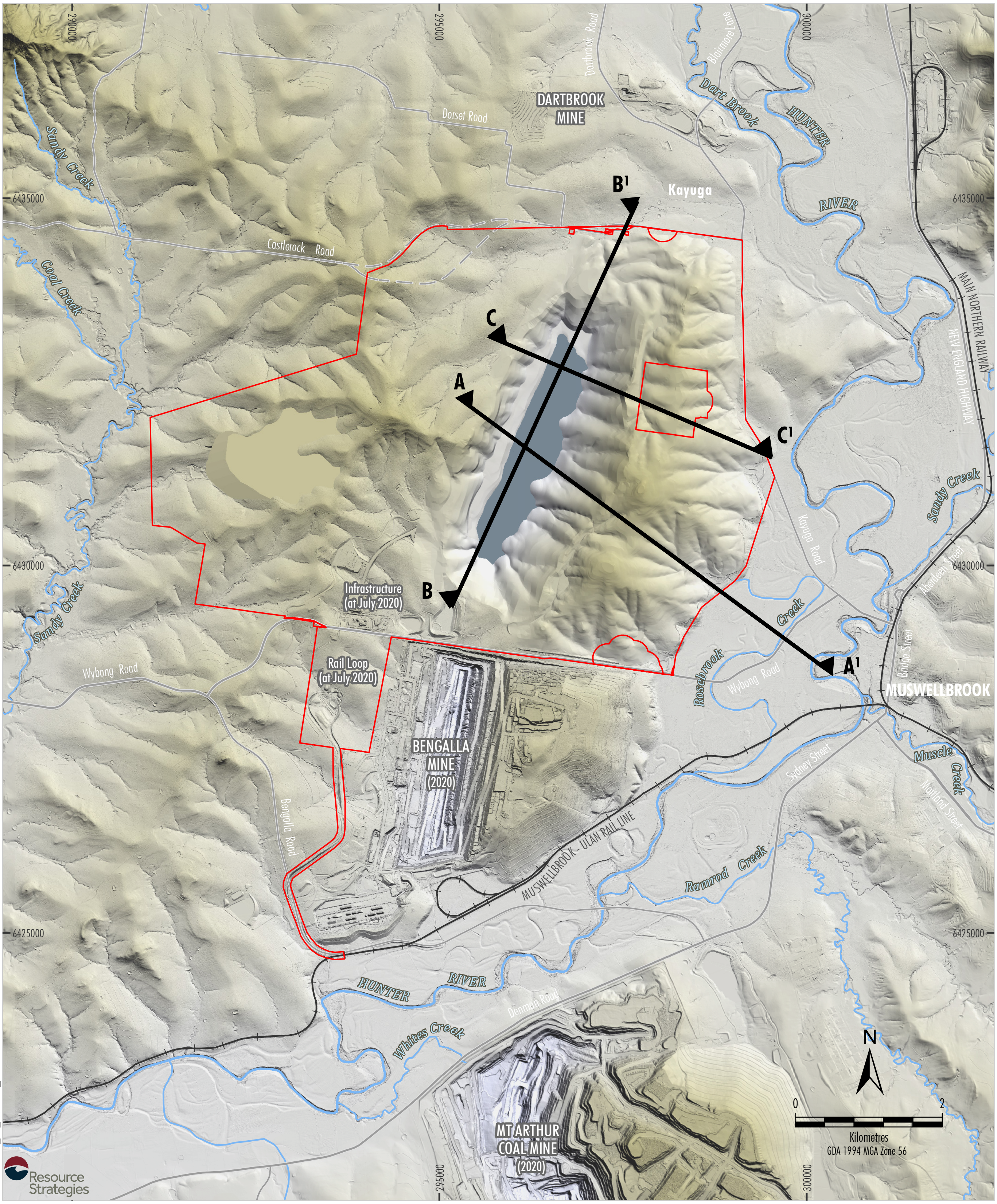
The conceptual final landform has been developed using geomorphic design to address the key design principles summarised in Section 5.1. The resulting final landform largely limits slopes to less than 33% (18 degrees [°]). There are some areas where the slopes are up to 33%, but this only represents a small proportion of the total surface area of the final landform (Figure 6).

The erosional stability of the final landform has been iteratively tested in two ways (Attachment 1):

- A static erosion risk assessment was undertaken as part of the design process.
- Representative portions of the conceptual final landform have been modelled in the Landscape Evolution Model (LEM) SIBERIA to determine the likely long-term erosion rates.

Where the above process identified areas where erosion risk was unacceptable, the final landform was iteratively re-designed and re-tested. This process was repeated until erosion risk was considered acceptable. The final landform design would continue to be tested and updated as additional data is collected as part of ongoing rehabilitation and landform erosion monitoring (Section 7.9).

The outcomes of the static erosion risk assessment are presented on Figure 7. The Topography Factor (TF) relates erosion risk to catchment area and slope. Areas with a TF of greater than 50 (shown in red) would require rock armouring where there is flow concentration. Gravel mulch (or similar) may also be required in some diffuse areas with a TF of greater than 50 to limit the risk of rilling (Attachment 1).



LEGEND

Mining Lease Boundary (Mount Pleasant Operation)

Cross-section Location

Source: MACH (2020); NSW Spatial Services (2020)

Refer Figures 5b and 5c for Cross-sections.

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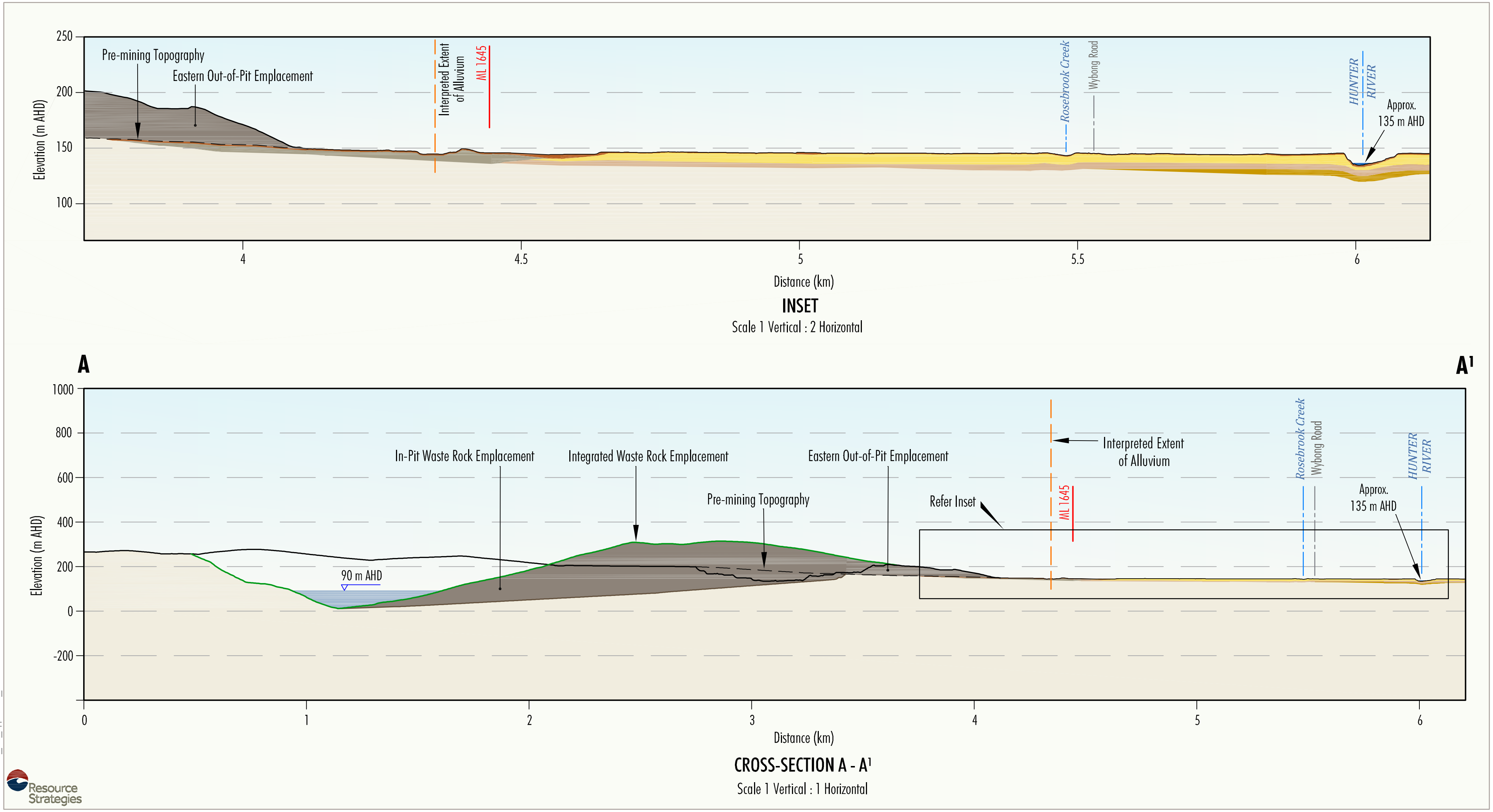
MOUNT PLEASANT OPTIMISATION PROJECT

Conceptual Final Landform

Figure 5a



LEGEND

— — —	Pre-mining Topography		Silt
——	Existing Surface (July 2020)		Clay
——	Conceptual Project Final Landform Surface		Sand/Loam
	Waste Rock Emplacement		Gravel
	Final Void Waterbody		Clayey Gravel

Refer Figure 5a for cross-section location.

Source: MACH (2020); AGE (2020); ENRS (2019)

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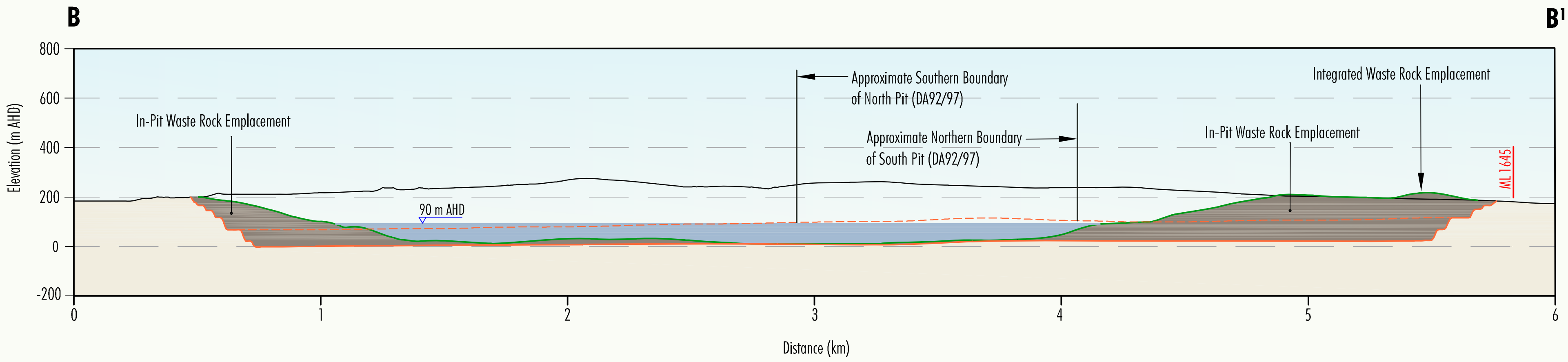
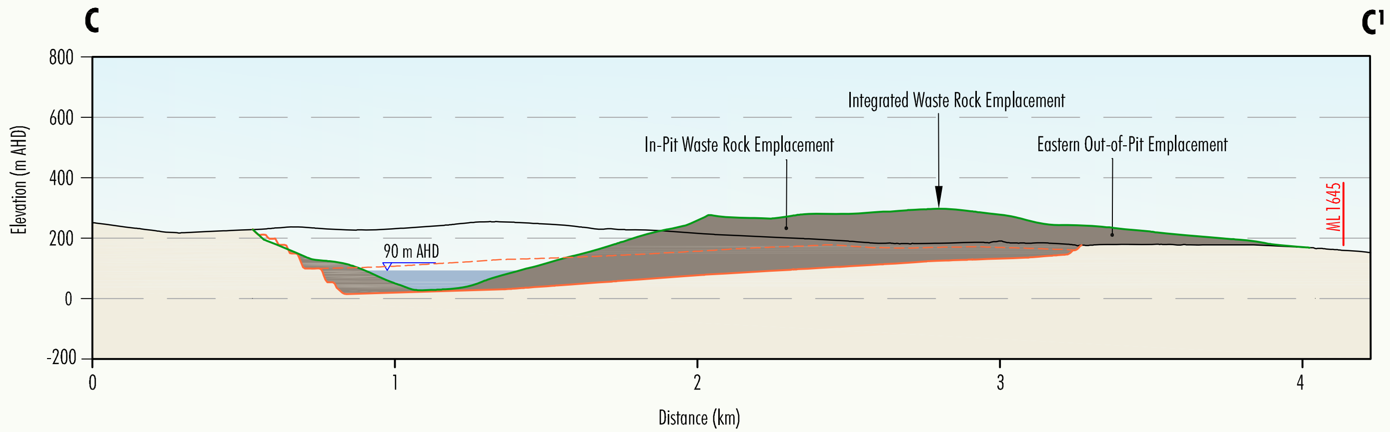
MOUNT PLEASANT OPTIMISATION PROJECT

Conceptual Final Landform
Cross-section A - A1

Figure 5b



CROSS-SECTION B - B1
Scale 1 Vertical : 1 Horizontal



CROSS-SECTION C - C1
Scale 1 Vertical : 1 Horizontal

MAC-18-02 SSD_EIS_App Rehab_102B

Resource Strategies

LEGEND
- Existing Natural Surface (July 2020)
- Base of Vaux Seam
- Project Open Cut
- Conceptual Project Final Landform Surface
- Waste Rock Emplacement
- Final Void Waterbody

Refer Figure 5a for cross-section locations.

Source: MACH (2020); AGE (2020); ENRS (2019)

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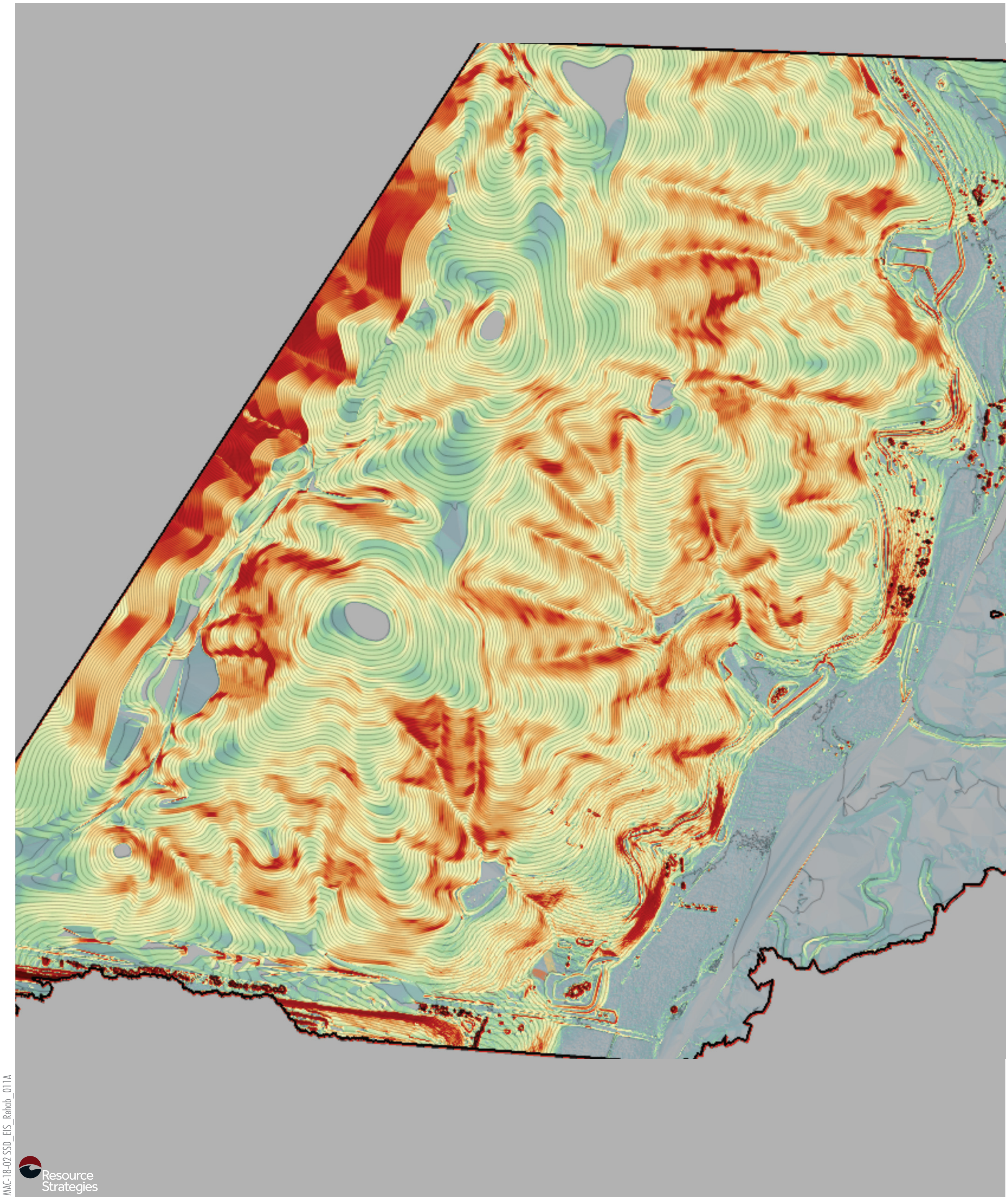
MOUNT PLEASANT OPTIMISATION PROJECT

Conceptual Final Landform
Cross-sections B - B1 and C - C1

Figure 5c



LEGEND
Slope (%)
0.0
8.25
16.5
24.75
>33.0

Source: Golder (2020)

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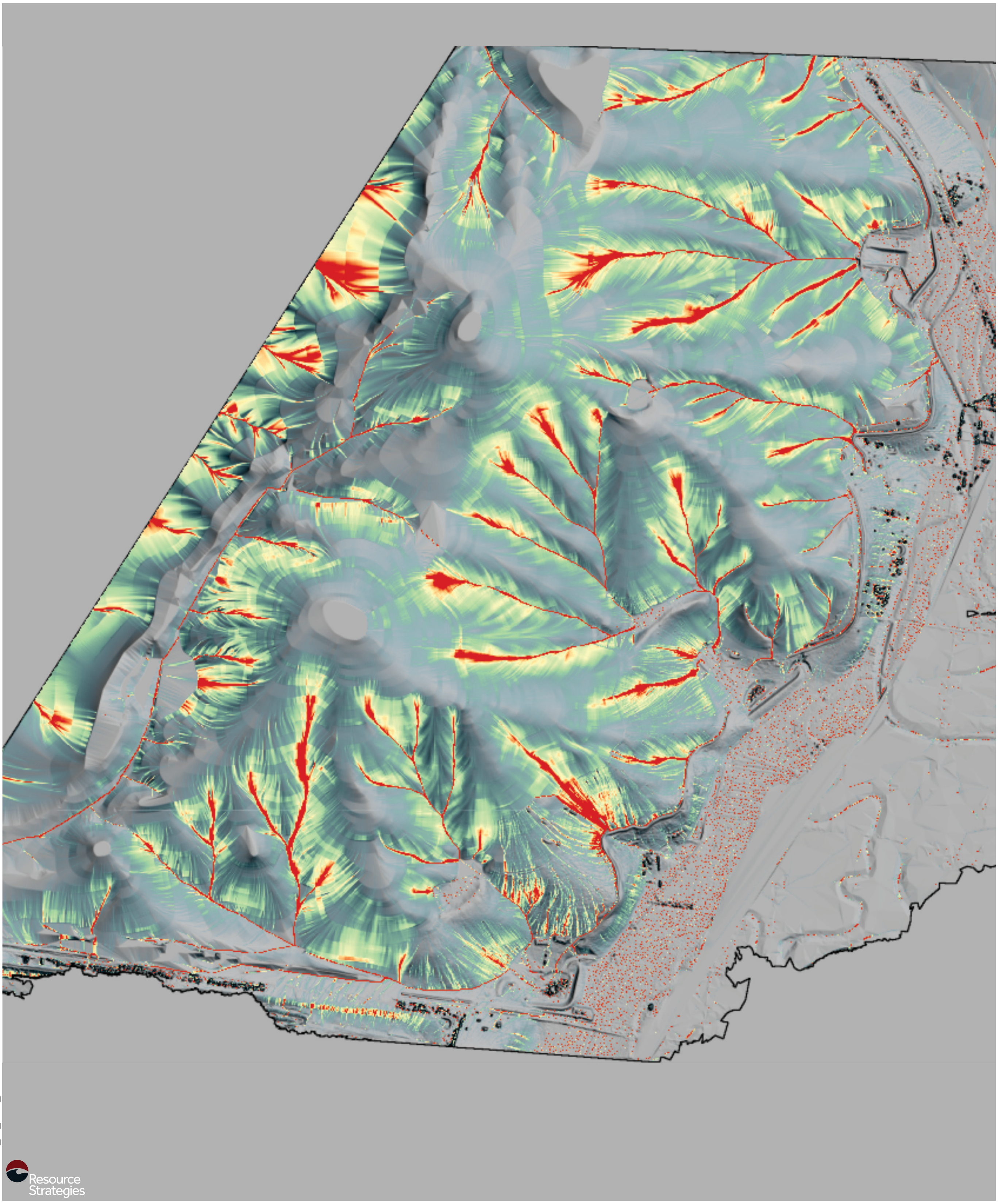
MOUNT PLEASANT OPTIMISATION PROJECT
Example Conceptual Final Landform
Slope Analysis

Figure 6



LEGEND

Erosion Risk as Topography Factor

- 0.0
- 12.5
- 25.0
- 37.5
- >50.0

Source: Golder (2020)

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MOUNT PLEASANT OPTIMISATION PROJECT

Example Conceptual Final Landform
Static Erosion Risk Assessment
– Topography Factor

Figure 7

Three parts of the proposed final landform were selected for detailed SIBERIA modelling to determine the likely long-term erosion rates. The following representative areas were selected (Attachment 1):

- South East Corner Rehabilitation Area: Representative of the steeper slopes and drainages on the eastern face of the out-of-pit emplacement. Contains areas identified in the static erosion risk assessment with a TF of greater than 50.
- Northern Side Slopes Rehabilitation Area: similar to the South East Corner, but slightly flatter and more typical of the other side slope areas (e.g. those areas on the northern face of the out-of-pit emplacement and the final void lowwall).
- Upper Surface Rehabilitation Area: Representative of the flatter top of the waste emplacement. Largely contains areas identified in the static erosion risk assessment with a low TF.

SIBERIA modelling was completed by Associate Professor Gregory Hancock (University of Newcastle). This process involved (Attachment 2):

- Collection of representative waste rock and topsoil samples directly from the Mount Pleasant Operation Eastern Out-of-Pit Emplacement being rehabilitated in the South East Corner Rehabilitation Area (Plate 3).
- Analysis of representative waste rock and topsoil samples, including:
  - Basic material analysis: Electrical Conductivity, pH, percentage sand, silt and clay by hydrometer, sieve analysis (<2 millimetres [mm] and >2 mm size fraction) and bulk density.
  - Infiltration rate: Determined using a flume (Plate 4) designed to simulate runoff from a 1:2 year storm IFD (Intensity Frequency Duration) based on data obtained from the Bureau of Meteorology (BoM) for the Mount Pleasant Operation area.
- Modelling of the representative areas of the proposed final landform in the SIBERIA model using parameters derived from:
  - Testing of site-specific material properties using the process described above.
  - Reference data from a natural hillslope located in the area (Hancock and Wells, 2020).

Testing of representative waste rock and topsoil samples from the Mount Pleasant Operation indicated these had lower erodibility than data collected from the reference site in the area (Attachment 2). Accordingly, SIBERIA modelling was completed using both sets of parameters (i.e. to test a scenario where the Mount Pleasant Operation measured site-specific parameters were unable to be achieved across the entire final landform).

SIBERIA modelling completed with the reference site data indicates the erosion rates can be expected to be elevated in the first few years, before stabilising at a long-term erosion rate of approximately 3 to 4 tonnes per hectare per year (t/ha/year). The predicted landform for the South East Corner at 100 years and 500 years post-mining is shown on Figure 8.

Application of the Mount Pleasant Operation site-specific parameters determined by University of Newcastle results in long-term erosion rates of the following (Attachments 1 and 2):

- South East Corner: 2.7 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr by 500 years post-mining.
- Northern Side Slopes: 2.8 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr by 500 years post-mining.
- Upper Surface: 2.2 t/ha/yr at 100 years post-mining, reducing to 1.3 t/ha/yr by 500 years post-mining.

The predicted long-term erosion rates for the conceptual final landform are similar to erosion rates predicted for the natural hillslope in the area (2.1 t/ha/year) (Attachment 2).

5.2.2 Geotechnical Stability

A geotechnical review of the Project mine plan and proposed final landform was undertaken by GeoTek Solutions (2020) (Attachment 13 of the EIS). The geotechnical review has considered the geotechnical stability of the operational open cut walls as well as the stability of the final landform slopes.

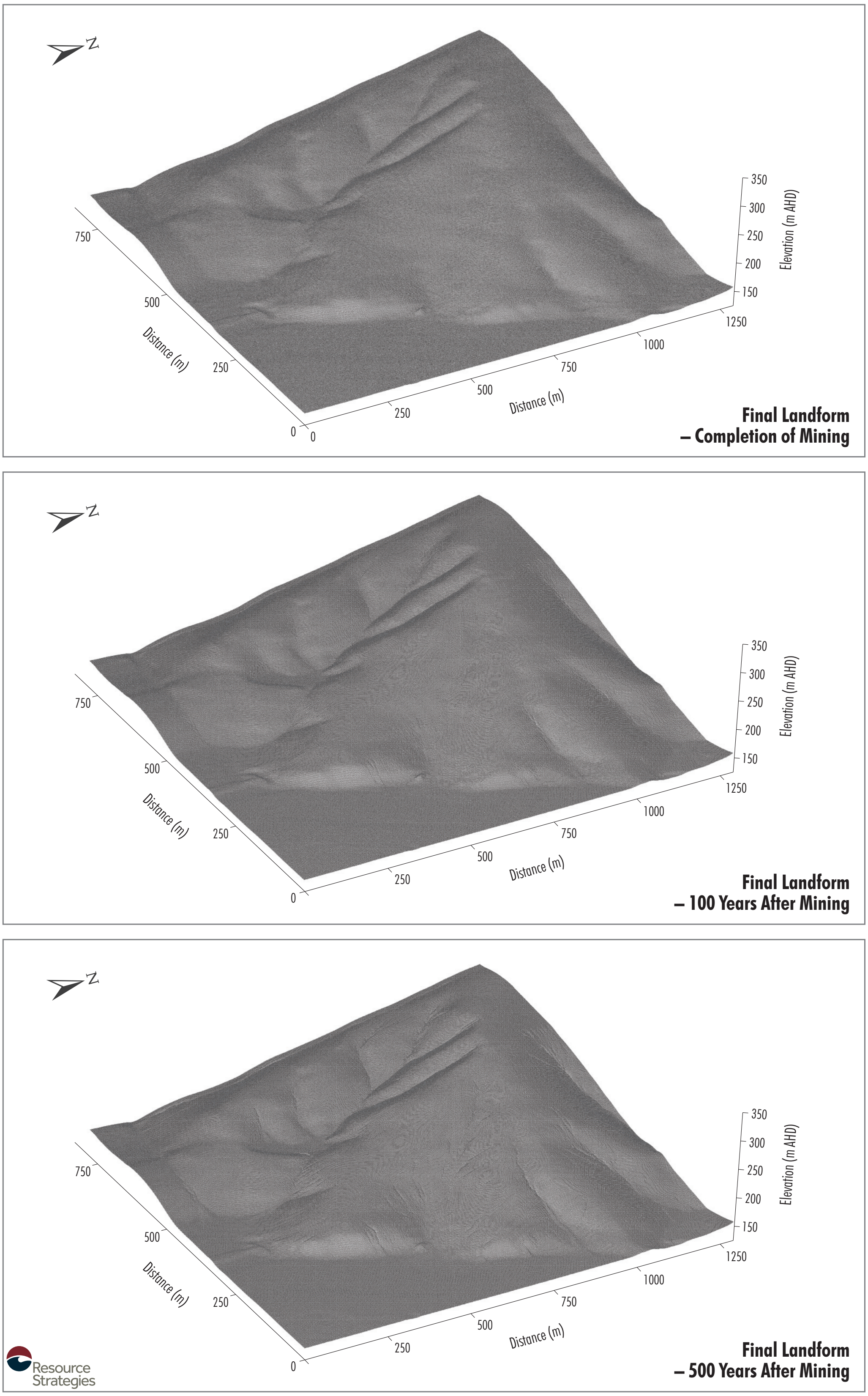
A summary of the findings of the geotechnical review is provided below.

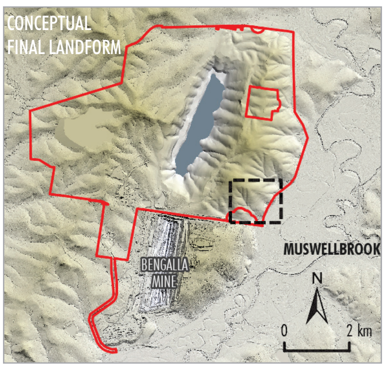
PLATE 3
Collection of Representative Samples from South East Corner

PLATE 4
Representative Sample Being Tested in Flume

MAC-18-02 SSD_EIS_Rehab_010A

Source: UoN (2020)





LEGEND
Mining Lease Boundary (Mount Pleasant Operation)
SIBERIA Modelling Extent

Source: University of Newcastle (2020)

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MOUNT PLEASANT OPTIMISATION PROJECT

SIBERIA Modelling Results - South East Corner

Figure 8

Geotechnical Conditions

The Mount Pleasant Operation coal resource is located in the Permian Wittingham Coal Measures within the Denman Formation and Jerrys Plains Subgroup and the Archerfield Sandstone and Vane Subgroup. The overburden and interburden strata consist mainly of sandstone with lesser proportions of siltstone and claystone.

The strata dip gently towards the west-northwest at approximately 6° to 8° in the east (closest to the anticline axis) easing to 2° to 4° in the west. The weathering depth ranges from 10 to 35 metres (m) and is usually about 20 m (GeoTek Solutions, 2020).

The fresh intact sandstone which predominates the interburden strata has an average uniaxial compressive strength of 30 megapascals (GeoTek Solutions, 2020).

The gentle strata dip, shallow overburden depth, strength of the fresh overburden, the moderately strong Edderton Seam floor and the absence of severe faulting effects combine to form a geotechnically benign mining environment (GeoTek Solutions, 2020).

Geotechnical Stability of Operational Open Cut Walls

Various geotechnical assessments have been carried out for the existing Mount Pleasant Operation. These assessments have determined that adequate factors of safety (FoS) would be achieved in weathered strata excavated at 45° and in fresh strata with pre-split batters excavated at 75° (GeoTek Solutions, 2020).

These slope angles have been successfully applied to the existing Mount Pleasant Operation and have been applied to the design of the Project open cut.

GeoTek Solutions (2020) has also undertaken a geotechnical review of the Wybong Road corridor, which is located between the Mount Pleasant Operation and Bengalla Mine. A three-dimensional numerical model was prepared to analyse the southern endwall of the Project open cut. The Mount Pleasant Operation endwall is sufficiently far away from Wybong Road as to not interact with it. However, the model predicted movement in the order of 30 to 40 centimetres (cm) at the base of the walls in tuff partings within the Edderton Seam (GeoTek Solutions, 2020).

Final Landforms

To achieve long term landform stability the excavated walls and in-pit overburden in the final landform will be substantially re-shaped from their operational profiles to flatter, and more natural profiles.

When considering appropriate FoS a typical minimum value for a geotechnical slope where the public is exposed is 1.5 (GeoTek Solutions, 2020).

The stable mining slopes associated with the final void highwalls would be flattened to a slope with an overall angle of about 18°. The FoS for the rock buttress is approximately 1.5 and therefore the slopes that it supports are conserved to be in a geotechnically acceptable configuration (GeoTek Solutions, 2020).

The Eastern Out-of-Pit Emplacement will consist mostly of fresh medium strong sandstone. The minimum FoS for the western face of the emplacement (i.e. facing the final void) is approximately 2.0 and for the eastern face (i.e. facing Muswellbrook) is 5.2.

Geotechnical Monitoring

MACH would implement the following geotechnical monitoring and management measures during the life of the Project:

- Ground water pressure in the Wybong Road corridor would be monitored using vibrating wire piezometers. The results would be used to verify the geotechnical modelling.
- Deflection data would be collected using time domain reflectometry cables installed in the piezometers.
- Survey data would be collected using both prisms and laser scanners. This data would indicate whether subsurface movement is occurring.
- Structural geological information would be obtained by routine mapping undertaken as part of exploration activities. These data would be used to carry out kinematic stability analyses and predict where structural features are headed.
- Visual inspections would be undertaken as part of a geotechnical principal hazards management plan.

5.2.3 Final Void

Once mining operations cease, water in the final void would no longer be collected and pumped out, and as a result, the void would gradually begin to fill with water. Water in other on-site operational storages may also be transferred to the final void to facilitate decommissioning and rehabilitation.

Inflows into the final void would comprise incident rainfall, runoff within the final void catchment area and groundwater. The catchment area of the final void would be defined by permanent perimeter bunds, diversion channels and/or embankment walls.

Final void water recovery analyses have been conducted as part of the Surface Water Assessment (Appendix D of the EIS). The assessment is based on predicted groundwater inflows developed as part of the Groundwater Assessment (Appendix C of the EIS).

The simulated water level in the final void reaches a maximum of approximately 90 metres above Australian Height Datum (m AHD), which is more than 110 m below the spill level (i.e. the final void waterbody would be contained under all climate scenarios) (Appendix D of the EIS). The large surface area of the void provides a suitable evaporative surface to offset inflows to the void and, therefore, maintain a final void equilibrium level that is well below the pre-mining groundwater table.

At the equilibrium water level (90 mAHD), the void would act as a groundwater sink, drawing groundwater from the *in-situ* strata, Eastern Out-of-Pit Emplacement and Fines Emplacement Area towards the final void (Appendix C of the EIS). As evident in Figure 5b, the predicted final void equilibrium level is well below the elevation of the Hunter River.

The potential for seepage from the proposed final landform has been assessed using groundwater model outputs and the semi-analytical particle tracking software MODPATH (Pollock, 2016). The MODPATH analysis demonstrates that seepage from the Fines Emplacement Area and Eastern Out-of-Pit Emplacement is predicted to primarily report to the Project and Bengalla Mine final voids (Appendix C of the EIS and Attachment 3).

5.3 POST-MINING LAND USE

The final land use goals for the Project are based on the following:

- successful design and rehabilitation of landforms to ensure structural stability, revegetation success and containment of wastes; and
- post-mining land use compatible with surrounding land uses.

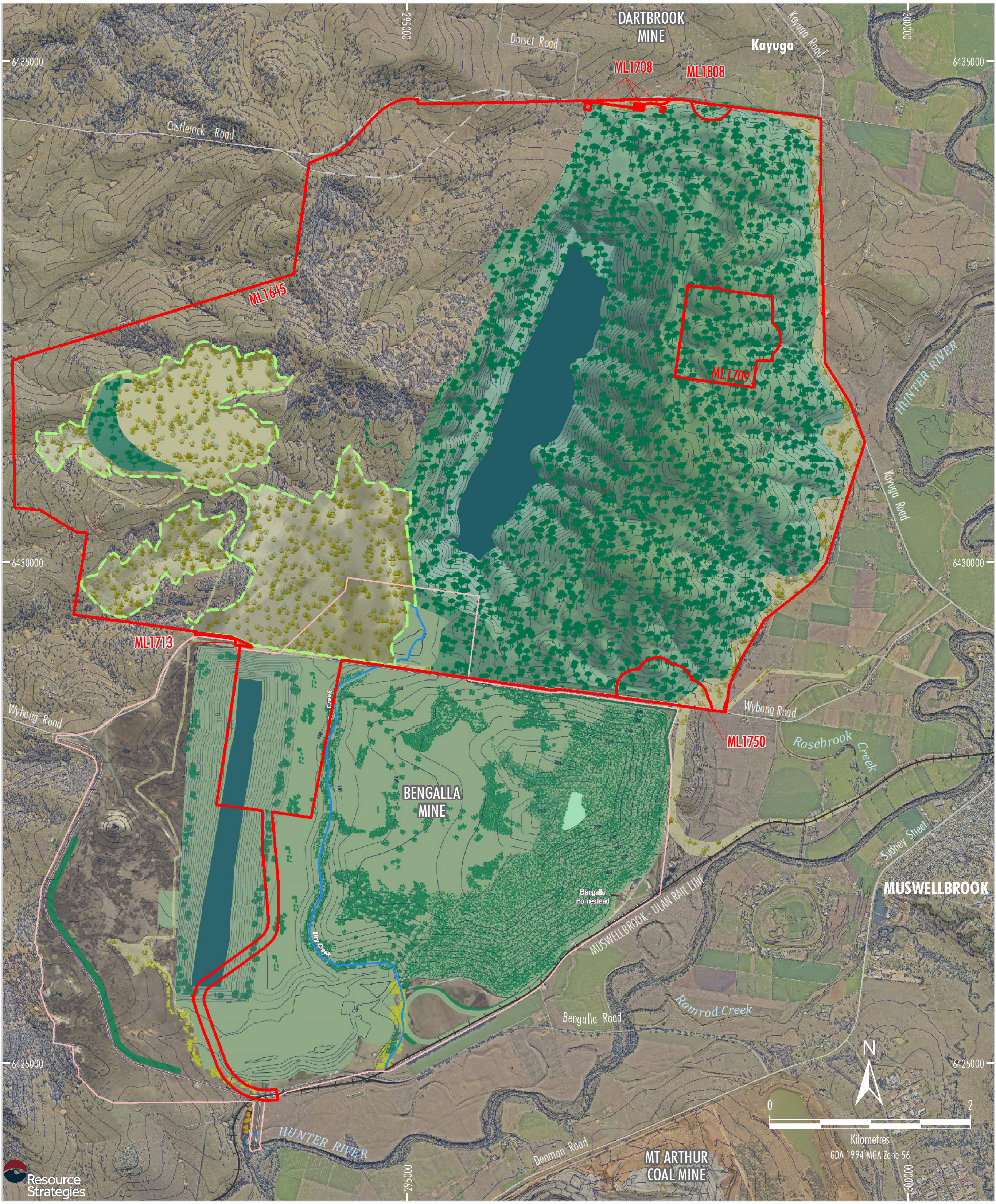
MACH has undertaken a preliminary assessment of potential post-mining land uses (e.g. nature conservation, agriculture) taking into account relevant strategic land use objectives of the area in the vicinity of the Project and the potential benefits of the post-mining land use to the environment, future landholders and the community. This has included consultation with Muswellbrook Shire Council which indicated a preference for the inclusion of some intensive agricultural/industrial post-mining land uses that provide employment for the local community (Section 3.1.2).

The proposed final land uses for the Project have also been designed to satisfy the requirements of EPBC 2011/5795 relevant to post-mining land use and on-site rehabilitation.

Accordingly, proposed final land uses for the Mount Pleasant Operation area include permanent water infrastructure and storage areas, agricultural land, native woodland and grassland areas and the final void (Figure 9).

MACH has identified parts of the Project final landform that would potentially be conducive to high-intensity agricultural use (e.g. existing mine infrastructure areas) (Figure 9). These areas would be rehabilitated to pasture using appropriate grass species. These areas are characterised by:

- Low gradient slopes and flat areas.
- Proximity to existing land used for agricultural purposes.
- Access to Mount Pleasant Operation supporting infrastructure that could potentially remain in place to support intensive agricultural use (e.g. rail loop, water storages, high capacity water pumps and pipelines, electrical infrastructure and other services).



LEGEND

Mining Lease Boundary (Mount Pleasant Operation)

Final Landform Contour (10 m interval)

Secondary/Post-mining Land Use Domains

Domain A - Final Void

Domain C - Agricultural Land

Domain D - Native Woodland/Grassland

Potential High Intensity Agriculture Area

Bengalla Mine Conceptual Final Landform *

Project Boundary (Appendix 2 of Development Consent SSD-5170) (Dated 23 December 2016)

** Digitised from Appendix 9 of Development Consent (SSD-5170) and amended in the Mount Pleasant Operation CHPP area.*

Source: MACH (2020); Bengalla Mine (2016); NSW Spatial Services (2020); Department of Planning and Environment (2016) Orthophoto: MACH (2020)

Note: Light vehicle access roads and upslope diversions associated with minimising the catchment of the final void and Fines Emplacement Area are not shown.

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Conceptual Final Land Use Areas

Figure 9

MACH would decommission and remove all Project infrastructure unless a suitable post-mining use is identified for the infrastructure in consultation with the Resources Regulator and Muswellbrook Shire Council.

In addition to beneficial biodiversity conservation outcomes, the proposed native woodland and grassland areas associated with the mine landforms could provide regional tourism opportunities associated with proximity to native wildlife (e.g. bird watching) and/or active uses of the Project final landform, including activities that could make use of the rehabilitated Eastern Out-of-Pit Emplacement (e.g. walking or mountain biking trails).

The proposed final void would gradually fill with water until it reaches an equilibrium level (Section 5.2.3). Given the void would act as a groundwater sink, final void salinity levels would increase slowly as a result of evapo-concentration (Appendix D of the EIS). Over the life of the Project, MACH would continue to consider potential alternative and feasible beneficial uses of the final void, including:

- Opportunities for renewable energy projects (e.g. floating solar facility and/or pumped hydro), including consideration of advancements in renewable energy technology that may occur over the life of the Project.
- The potential application of evaporative controls to maintain water quality suitable for productive use and/or to provide a significant off-river storage of supplementary water flows in the Hunter River.
- Waste disposal, taking advantage of the final void sink to avoid the migration of any related contaminants off-site.

These potential final void beneficial uses would be subject to separate assessments and approval, and do not form part of the Project. It is noted that the application of evaporative controls in combination with fresh water inputs from runoff or Hunter River extraction may facilitate long-term beneficial use outcomes and minimise evapo-concentration of salts.

5.4 ALTERNATIVES CONSIDERED

Integrated Waste Rock Emplacement

The originally approved Mount Pleasant Operation final landform included three large out-of-pit waste emplacements:

- the Eastern Out-of-Pit Emplacement – constructed up to approximately 250 m AHD in the early part of the mine life;
- the South West Out-of-Pit Emplacement – constructed up to approximately 320 m AHD in the early part of the mine life; and
- the North West Out-of-Pit Emplacement – constructed up to 320 m AHD in the latter part of the mine life.

The North West Out-of-Pit Emplacement would not be developed in the currently approved mine life (based on mining to December 2026 only).

The revision to the waste emplacement strategy associated with Mod 3 provided MACH with the opportunity to improve the Mount Pleasant Operation final landform design in comparison to the landform originally approved in 1999. In particular, the emplacement extension (approximately 67 ha) allowed MACH to avoid construction of the approved South West Out-of-Pit Emplacement.

Further to the improvements associated with Mod 3, MACH has identified that the optimal Mount Pleasant Operation open cut development profile is to develop three contiguous pits that advances westwards and extract all economic coal seams to the Edderton Seam floor. This leads itself to consolidation of the Project open cut development on the eastern side of ML 1645 and avoids the need to develop the North West Out-of-Pit Emplacement.

Initial mine planning completed for the Project produced an engineered Eastern Out-of-Pit Emplacement landform that was angular, with steep slopes that required engineered drop structures to facilitate surface water drainage. However, consistent with MACH's approach to Mount Pleasant Operation landforms in Mod 3, an extensive landform re-design was undertaken to produce a final landform that integrates with the surrounding natural landforms and improves long-term drainage stability.

The landform design process has involved application of geomorphic design principles and iterative testing of long-term landform stability by static erosion risk assessment and Landscape Evolution Modelling (i.e. the University of Newcastle SIBERIA model).

Final Void

The originally approved Mount Pleasant Operation final landform included two final voids associated with the North Pit and South Pit open cuts and a smaller third final void located in a low-lying area between the two larger final voids (Figure 2-5a of the EIS).

Variations to the final landform associated with Mod 3 did not significantly alter the original EIS final void concepts. However, only the South Pit would be developed in the currently approved mine life (i.e. the North Pit is not planned to be developed by MACH before 2026). Therefore, the 2026 final landform includes one final void in South Pit (Figure 2-5b of the EIS).

The development of the Mount Pleasant Operation open cut as three contiguous pits that advance in parallel provides the opportunity to emplace more waste material in-pit, rather than relying on additional out-of-pit emplacements (i.e. the approved SouthWest Out-of-Pit Emplacement and North West Out-of-Pit Emplacement). As a result, the Project would only leave one final void.

Initial mine planning completed for the Project resulted in a residual final void that spanned the full length of the western side of the Project open cut. The initial final void was based on full mined-out strips to the base of the Edderton Seam and was rectangular in shape. However, in response to feedback from regulatory and community stakeholders, MACH has re-designed the final void to:

- backfill approximately 1.5 km of the northern part of the final void;
- reduce the depth of the final void in the North and Central Pit areas and decrease the slope of the internal batters;
- apply geomorphic design concepts to parts of the Project landform that drain to the final void; and
- push down the western highwall to an overall angle of approximately 18°.

As a result of the above, the final void is considered safe, geotechnically stable and minimises the catchment reporting to the void whilst maintaining geomorphic design concepts (i.e. providing sufficient slope length to improve post-mining stability and reduce long-term erosion risk).

Muswellbrook Shire Council's input to the Project SEARs requests that the EIS considers a Project design/mining sequence that would result in no final voids.

As described above, the Project would result in a single final void as opposed to the three final voids associated with the originally approved Mount Pleasant Operation final landform.

MACH has undertaken a comprehensive mine planning review of a Project scenario that would result in no final void (i.e. backfilled landform to natural surface so that it drains freely to the north of the Project). The analysis considered mining efficiency, operational costs and environmental implications relative to the proposed Project final landform.

The rehabilitation costs for the no-void option would increase by over $1 billion relative to the rehabilitation costs associated with the Project final landform. These additional rehabilitation costs would render the Project uneconomic.

In addition to the significant additional rehabilitation costs, the no-void scenario would result in the following:

- Mining inefficiencies and environmental risks associated with rehandling emplaced coal rejects and potentially acid forming (PAF) material associated with the Wynn Seam.
- Delays to the establishment of woodland rehabilitation until emplacement areas reach the final landform surface.
- Storage of topsoil for extended periods of time, reducing its value for rehabilitation.

The proposed final void would act as a groundwater sink, drawing groundwater from the in-situ strata, Eastern Out-of-Pit Emplacement and Fines Emplacement Area towards the final void. As a result, seepage from the Fines Emplacement Area and Eastern Out-of-Pit Emplacement is predicted to primarily report to the Project and Bengalla Mine final voids (Section 5.2.3).

AGE Consultants (2020b) has also assessed the implications on the groundwater system if the void were to be backfilled (Attachment 3). This involved the following updates to the existing numerical groundwater model described in Appendix C of the EIS:

- The hydraulic properties in the modelled void were updated to reflect the emplacement of waste rock (spoil).
- The boundary condition representing the final void recovered pit level was removed.
- The area to which 'spoil rate' recharge is applied was increased to cover the full mined pit.

The groundwater modelling indicates that, if the void were to be backfilled, the increased recharge associated with the spoil is expected to result in groundwater mounding in the backfilled spoil material and groundwater migrating away from the Mount Pleasant Operation final landform (i.e. increased seepage of water from the backfilled waste rock material to the Hunter River alluvium) (Attachment 3). This would be inconsistent with the rehabilitation objectives for final voids in Condition 53, Schedule 3 of Development Consent DA 92/97, which require Mount Pleasant Operation final voids to be designed as long term groundwater sinks to maximise ground water flows across back filled pits to the final void.

MACH recognises that a no-void scenario would have some environmental benefits by restoring additional land to potential productive post-mining use, removing a potential long-term saline water body from the landscape and restoring free-draining catchment to the Hunter River. However, the additional operational costs and environmental consequences described above are considered to significantly outweigh these potential benefits.

Representatives of the Resources Regulator queried whether MACH had also considered a Project scenario that involves partial backfilling of the final void (Section 3.1.3). The objective of partial backfilling is typically to backfill the void to a sufficient depth that eliminates the final void water body.

The groundwater modelling completed by AGE for the no-void scenario indicates that the increased recharge associated with the spoil is expected to result in groundwater mounding (Attachment 3). As a result, partial backfilling of the final void would not eliminate the final void water body.

The negative environmental consequences associated with the no-void scenario would also be relevant to partial backfilling. Accordingly, partial backfilling of the final void is not considered to provide a material environmental benefit that would justify the additional operational costs and environmental consequences.

MACH would continue to consider final void options over the life of the Project, including potential beneficial uses of the final void (e.g. for off-river storage of supplementary water flows in the Hunter River) (Section 5.3).

Final Land Use

MACH would establish open woodland communities across the majority of the Mount Pleasant Operation final landform. This remains the preferred final land use for the majority of the Project landform given:

- These communities will assimilate with the open woodland communities within the surrounding environment over time.
- It is consistent with the planned revegetation of the eastern face of the Bengalla Mine landform, improving the visual integration of these landforms when viewed from Muswellbrook.
- The majority of the slopes on the Project final landform are not conducive to high-intensity agricultural use (e.g. likely to only support low-intensity grazing).

MACH has identified parts of the Project final landform that would be conducive to high-intensity agricultural use (e.g. mine infrastructure areas).

MACH recognises that government and community stakeholders may identify final land uses that provide greater net benefits to the locality. MACH would encourage and be supportive of other community and government proposals or initiatives for the use of MACH land or infrastructure that can co-exist with the Project. These alternative final land uses would be subject to separate assessments and approval, and do not form part of the Project.

6 REHABILITATION DOMAINS AND OBJECTIVES

6.1 REHABILITATION DOMAINS

The provisional primary and secondary domains for the Project are outlined in Table 5.

Table 5
Provisional Rehabilitation Domains

Code	Primary Domain	Code	Secondary Domain
1	Infrastructure Area	A	Final Void
2	Fines Emplacement Area	B	Water Infrastructure and Storage
3	Water Management Area	C	Rehabilitated Area – Agricultural Land
4	Active Void	D	Rehabilitated Area – Native Woodland/Grassland
5	Overburden Emplacement Area		

Based on the above, the rehabilitation domains for the Project would include:

- Domain 1C – Infrastructure Area rehabilitated to Agricultural Land;
- Domain 1D – Infrastructure Area rehabilitated to Native Woodland/Grassland;
- Domain 2C – Fines Emplacement Area rehabilitated to Agricultural Land;
- Domain 3B – Water Infrastructure and Storage retained post-mining;
- Domain 3D – Water Management Area rehabilitated to Native Woodland/Grassland;
- Domain 4A – Final Void;
- Domain 5C – Overburden Emplacement Area rehabilitated to Agricultural Land; and
- Domain 5D – Overburden Emplacement Area rehabilitated to Native Woodland/Grassland.

6.2 DOMAIN REHABILITATION OBJECTIVES

The rehabilitation objectives for the provisional domains identified in Section 6.1 are described in Table 6.

6.3 PERFORMANCE INDICATORS AND COMPLETION CRITERIA

The MOP Guidelines (DRE, 2013) defines performance indicators and completion criteria as follows:

- A Performance Indicator is an attribute of the biophysical environment (e.g. pH, slope, topsoil depth, biomass) that can be used to approximate the progression of a biophysical process. It can be measured and audited to demonstrate (and track) the progress of an aspect of rehabilitation towards a desired completion/relinquishment criterion. The indicator may be aligned to an established protocol and used to evaluate changes in a system.
- Completion Criteria (or Relinquishment Criteria) are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. These are the standards that are to be met by successful rehabilitation. These criteria will generally be in the form of a numerical value that can be verified by measurement of the indicators selected for the rehabilitation objectives. They may include an element based on time.

Rehabilitation objectives, performance indicators and completion criteria for the Mount Pleasant Operation have been developed in the Approved MOP. These would be reviewed and updated for the Project as part of future MOPs.

Table 6
Provisional Domain Rehabilitation Objectives

Code	Domain	Objectives
All Domains		
N/A	All primary domain areas	Final landforms are safe, stable and non-polluting. Final landforms are stable and sustainable for the intended post-mining land use/s. Final landforms are integrated with surrounding natural landforms. Ensure public safety.
Primary Domains		
1	Infrastructure Area	Surface infrastructure not required for future use post-mining is decommissioned and removed (as agreed with relevant regulatory authorities). Area to be rehabilitated in accordance with relevant Secondary Domain rehabilitation objectives.
2	Fines Emplacement Area	Decommission and remove Fines Emplacement Area infrastructure (e.g. pumps, pipelines). Area to be rehabilitated in accordance with relevant Secondary Domain rehabilitation objectives.
3	Water Management Areas	Clean water will be diverted around operational areas, where practical. Mine water dams and sediment dams are to be decontaminated and decommissioned and removed from the final landform (except for permanent water management structures and storages agreed to be retained in the final landform). Sediment dams and associated water management structures will remain in place until the catchment is rehabilitated and discharge water quality is suitable for receiving waters and fit for aquatic ecology and riparian vegetation. Area to be rehabilitated in accordance with relevant Secondary Domain rehabilitation objectives.
4	Active Void	Backfilled open cut void is safe, profiled for long-term stability and non-polluting.
5	Overburden Emplacement Area	Overburden Emplacement Areas are safe, stable, and non-polluting. Constructed slopes to be consistent with geomorphic design principles. Mining plant and equipment associated with the construction of the Eastern Out-of-Pit Emplacement will be dismantled, decommissioned and removed from site. Maximise surface water drainage to the natural environment (excluding final void catchment).

Table 6 (Continued)
Provisional Domain Rehabilitation Objectives

Code	Domain	Objectives
Secondary Domains		
A	Final Void	Final void is safe, stable and non-polluting. Final void design to ensure the final void does not spill. Final void land use to be developed in consultation with relevant stakeholders. Final void shaped to be consistent with the surrounding natural environment and to avoid an engineered profile. Final void designed as long-term groundwater sink to maximise groundwater flows across back filled pits to the final void. Minimise to the greatest extent practicable: • the size and depth of final voids; • the drainage catchment of final voids; • any high wall instability risk; and • the risk of flood interaction.
B	Water Infrastructure and Storage	Clean water diversion banks on the Eastern Out-of-Pit Emplacement will be retained to divert water away from fill areas. Permanent water management structures will be designed and constructed prior to disturbance, in accordance with best practice guidelines, including Landcom (2004) *Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition* and DECC (2008) *Managing Urban Stormwater: Soils and Construction Volume 2*. Water retained on the site is fit for the intended post-mining land use/s, including potential long-term source of water for nearby intensive land uses (subject to obtaining relevant regulatory approvals). Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation.
C	Rehabilitated Area – Agricultural Land	Infrastructure would be decommissioned and removed (unless the NSW Resources Regulator agrees otherwise). Landform is functional and indicative of a landscape on a self-sustaining trajectory. Establish/restore grassland areas to support sustainable agricultural activities. Achieve the nominated land capability classification.
D	Rehabilitated Area – Native Woodland/ Grassland	Establish native vegetation comparable to suitable reference/analogue sites. Landform is functional and indicative of a landscape on a self-sustaining trajectory. Habitat features are salvaged and re-used in rehabilitation areas to provide fauna habitat resources. Restore self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area. Establish areas of self-sustaining: • riparian habitat, within any diverted and/or re-established creek lines and retained water features; and • potential habitat for threatened flora and fauna species.

7 REHABILITATION PRACTICES AND MEASURES

Rehabilitation activities for the Project would continue to be undertaken progressively according to the following phases defined in the MOP:

- Phase 1 – Decommissioning – removal of hard stand areas, buildings, contaminated materials, hazardous materials.
- Phase 2 – Landform Establishment – incorporates gradient, slope, aspect, drainage, substrate material characterisation and morphology.
- Phase 3 – Growing Media Development – incorporates physical, chemical and biological components of the growing media and ameliorants that are used to optimise the potential of the media in terms of the preferred vegetative cover.
- Phase 4 – Ecosystem and Land Use Establishment – incorporates revegetated lands and habitat augmentation; species selection, species presence and growth together with weed and pest animal control/management; and establishment of flora.
- Phase 5 – Ecosystem and Land Use Sustainability – incorporates components of floristic structure, nutrient cycling recruitment and recovery, community structure and function, which are the key elements of a sustainable landscape.
- Phase 6 – Relinquished Lands – land use and landscape is deemed as suitable to be relinquished from the ML.

A description of the progressive rehabilitation methods implemented at the Mount Pleasant Operation in relation to Phases 1 to 5 is provided in the following sub-sections. Phase 6 (relinquishment) is discussed in Section 8. These methods would continue to be applied to the rehabilitation of the Project, with adaptive management and improvement to techniques as applicable.

Plates 5 to 13 show the progressive development of a portion of the Eastern Out-of-Pit Emplacement from December 2017 (pre-mining) to July 2020 (vegetation establishment).

7.1 DECOMMISSIONING OF INFRASTURCTURE

Infrastructure not required for future use post-mining would be decommissioned and removed (as agreed with relevant regulatory authorities). This would involve:

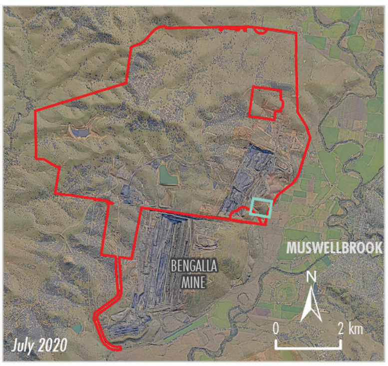
- Demolishing and removing infrastructure from the site, including buildings and fixed plant, ROM and product stockpiles, bitumen carparks, waste oil/lubricant storage areas, rail load-out facility and rail loop. Demolition work would be carried out in accordance with *AS 2601-2001: The Demolition of Structures* or its latest version.
- Relevant plant and equipment would be dismantled, decommissioned and removed from the site.
- Internal haul roads, access tracks and hardstands would be removed when no longer required.
- Water management structures that are not to be retained in the final landform decommissioned (i.e. dam walls removed, drained and decontaminated). Sediments accumulated in mine water and sediment dams would be removed from the dam floor and emplaced in the final void. Mine water dams would be emptied and discharge water disposed of in final void.
- Pipelines, pumps and related Fines Emplacement Area infrastructure would be removed.
- A Land Contamination Assessment would be undertaken and any contaminated soils removed and area remediated in accordance with *NSW Contaminated Land Management Act 1997*.


PLATE 5
Pre-mining Landform
(July 2017)


PLATE 6
Clearing
(December 2017)

PLATE 7
Waste Rock Emplacement
(April 2019)

MAC-18-02 SSD_EIS_Rehab_002A



LEGEND
Mining Lease Boundary (Mount Pleasant Operation)
Rehabilitation Progression Area

Source: MACH (2020)

MACHEnergy

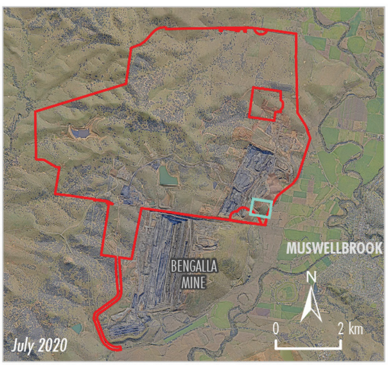
MOUNT PLEASANT OPTIMISATION PROJECT

Rehabilitation Progression

Plates 5 to 7

MAC-18-02 SSD_EIS_Rehab_003B

Source: MACH (2020)



LEGEND
Mining Lease Boundary (Mount Pleasant Operation)
Rehabilitation Progression Area

MACHEnergy
MOUNT PLEASANT OPTIMISATION PROJECT
Rehabilitation Progression

Plates 8 to 10

PLATE 11
Topsoil Placement
(October 2019)

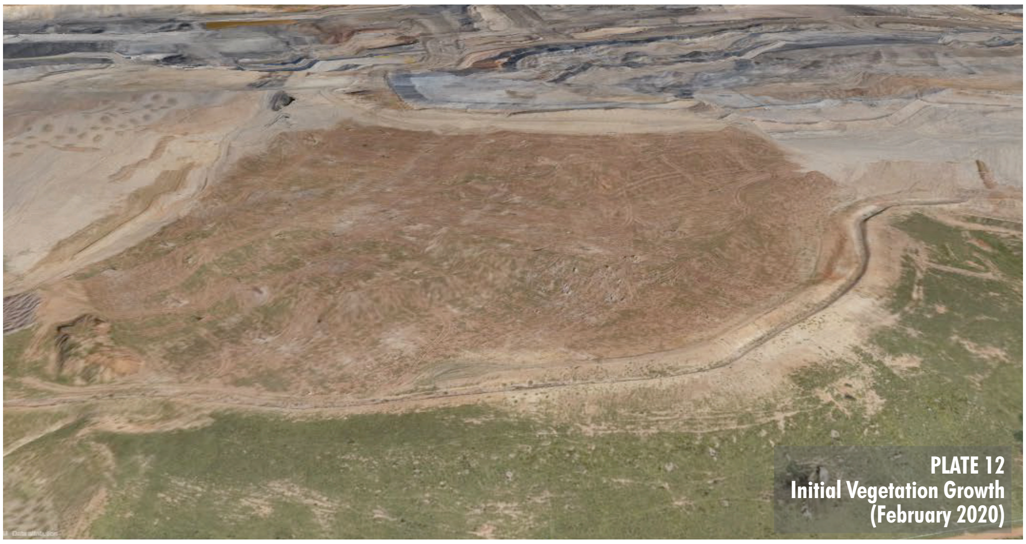


PLATE 12
Initial Vegetation Growth
(February 2020)

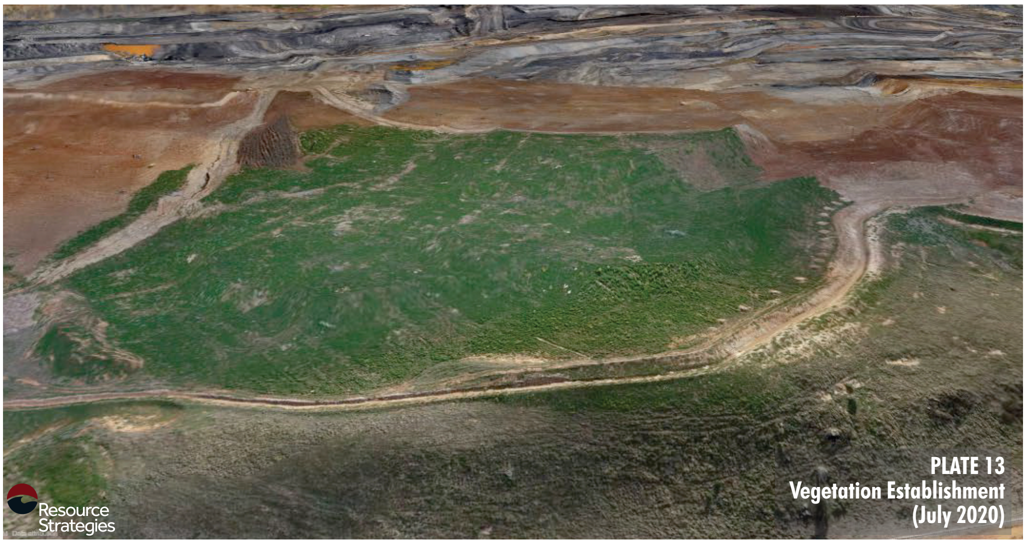
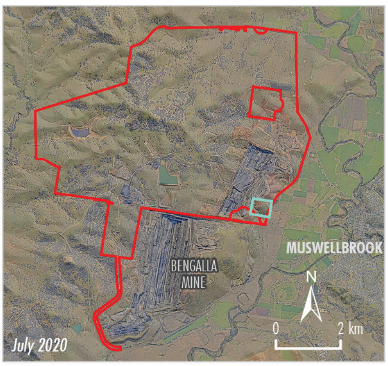


PLATE 13
Vegetation Establishment
(July 2020)

MAC-18-02 SSD_EIS_Rehab_004B



LEGEND
Mining Lease Boundary
(Mount Pleasant Operation)
Rehabilitation Progression Area

Source: MACH (2020)

MACHEnergy

MOUNT PLEASANT OPTIMISATION PROJECT

Rehabilitation Progression

Plates 11 to 13

7.2 REHABILITATION MATERIALS

MACH would undertake measures to retain as much material as practicable from the pre-mining landform and surrounds to use during rehabilitation of the Project. Such measures would include:

- Implementing a vegetation clearance protocol which would identify and retain material for rehabilitation including habitat material (e.g. tree hollows, stag trees, coarse woody debris and rocks) and seeding vegetation for seed collection prior to clearing.
- Seed collection and propagation using the on-site Seed Harvesting Facility or external provider.
- Rehabilitation material characterisation in order to:
  - identify any physical or chemical deficiencies or limiting factors;
  - develop selective placement strategies or develop soil amelioration techniques;
  - identify material for use in the root zone, which is capable of supporting vegetation establishment;
  - identify materials that limit plant growth or which may contaminate surface or groundwater (e.g. salinity), and hence may require special handling, treatment or disposal; and
  - identify any propensity for spontaneous combustion.
- Topsoil and subsoil stripping (guided by soil mapping) and management in designated stockpiles.

Soil management procedures that would be implemented for the Project are summarised in Section 7.4.

7.3 LANDFORM ESTABLISHMENT

The following summarises the methodology developed by MACH at the Mount Pleasant Operation to develop geomorphological landforms.

The emplacement landform is typically developed in approximately 10 m lifts to enable more rapid establishment of the final surface levels. Using this methodology, waste rock placement progresses more rapidly than the alternative of construction in 20 m emplacement lifts that takes significantly longer to develop, and also require more dozer hours to reshape to the final surface level. Larger lifts may be used in some circumstances based on local variation of the underlying topography or design constraints.

The final landform surface designed in accordance with geomorphic design principles (Section 5.2) is used to develop bench designs for the waste emplacement that minimise the amount of cut and fill by dozers. The bench designs are loaded into dozer GPS software that then guides dozer operators on how much cut and fill is required to achieve the design surface (Plates 14 to 16).

MACH's Inspection and Test Plan procedures are conducted both during the landform design phase and after landform construction to verify the landform has been developed consistent with the design. A summary of the landform shaping activities and acceptance criteria included in the Inspection and Test Plan is provided in Table 7.

To confirm compliance of the as-built emplacement with the geomorphic design surface, Light Detection and Ranging (LiDAR) data of the as-built landform is compared to the design surface to confirm construction variations are within:

- 100 mm on drainage lines; and
- 300 mm elsewhere on the emplacement.

These landform establishment tolerances apply at the time of construction. Over time, the landform may develop outside of these tolerances due to natural processes and differential settlement would also be expected post-construction.

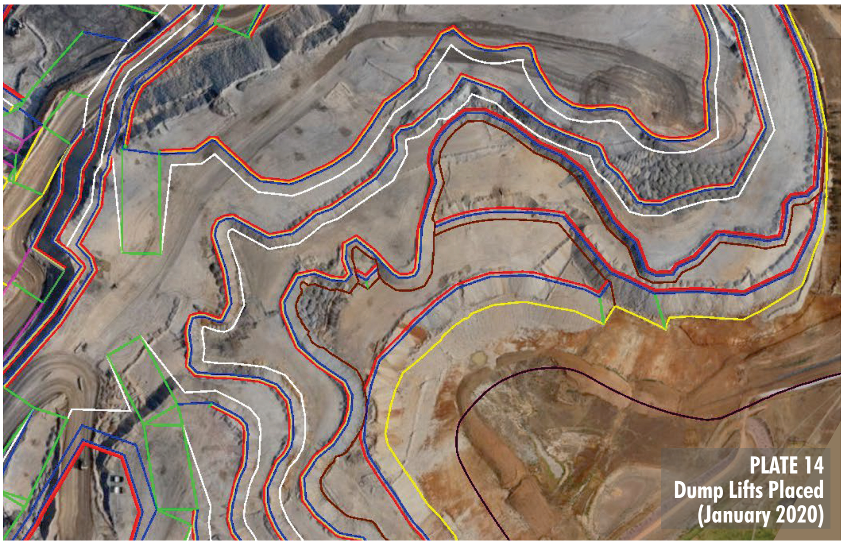


PLATE 14
Dump Lifts Placed
(January 2020)

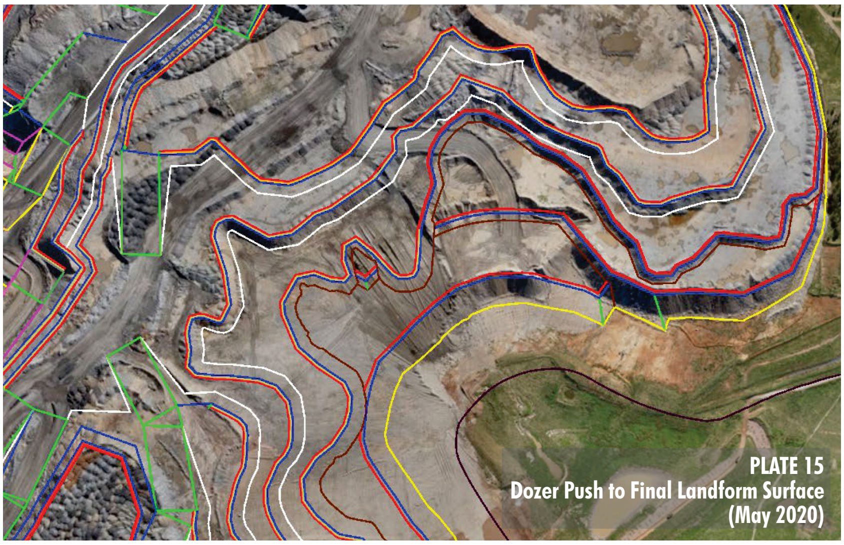


PLATE 15
Dozer Push to Final Landform Surface
(May 2020)

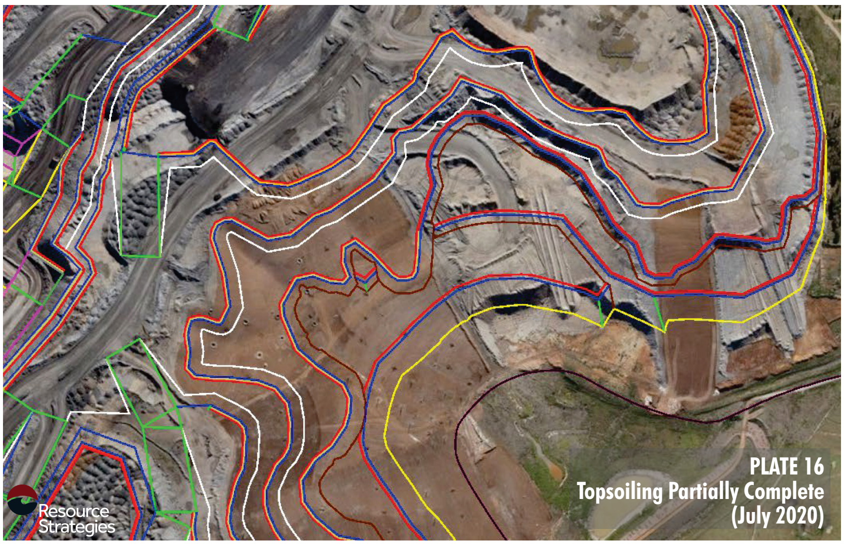
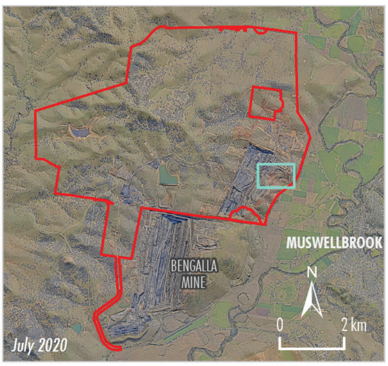


PLATE 16
Topsoiling Partially Complete
(July 2020)

MAC-18-02 SSD_EIS_Rehab_015A



LEGEND
Mining Lease Boundary
(Mount Pleasant Operation)
Snapshot Area

Source: MACH (2020)

MACHEnergy

MOUNT PLEASANT OPTIMISATION PROJECT

Waste Emplacement
Construction Methodology

Plates 14 to 16

Table 7
Waste Rock Emplacement Final Surface Shaping Process

Item	Activity	Acceptance Criteria
1	Design Approval	• A Landform Design Inspection and Test Plan has been completed and approved by MACH and the geomorphological design representative, prior to commencing profiling works.
2	Pre-Start	• Operators and supervisors have received all relevant information and training relevant to the Inspection and Test Plan, including landform design surfaces and dozer GPS files.
3	Survey	• Surveyors peg out landform crest, toe boundaries and any other requirements to achieve the approved rehabilitation design.
4	Profiling	• The following records are maintained during profiling: – progressive survey pickups/scans; – progressive photographs; and – progress tracking and reporting (e.g. volume moved, area completed, etc.). • Profiling works have been completed to within required tolerances in accordance with the supplied rehabilitation design. • Final survey confirms compliance to design, or rectification required.
5	Approval	• MACH approves the landform profiling conforms to the geomorphic design and agrees to proceed to the next rehabilitation phase.

7.3.1 Geochemistry of Waste Rock and Reject Material

An assessment of the geochemical characteristics of the waste rock material associated with the development of the Project is provided in the Geochemistry Assessment (Appendix K of the EIS) prepared by RGS Environmental. A summary of the assessment is provided below.

Geochemical tests were conducted on 83 samples to identify any geochemical implications for waste rock management. The test work included acidity, EC, sodicity, acid base accounting, and element enrichment and solubility test work (RGS Environmental, 2020).

Acidity, Salinity and Sodicity

The Geochemistry Assessment (RGS Environmental, 2020) concluded that the waste rock materials generated from the Project would typically be neutral to slightly alkaline and generally non-saline.

The waste rock is expected to be moderately sodic (RGS Environmental, 2020). The management of sodic material in rehabilitation is discussed in Section 7.4.3.

Acid Base Accounting

The Geochemistry Assessment (RGS Environmental, 2020) concluded the waste rock materials generated from the Project would generally be expected to be non-acid forming (NAF).

The acid base accounting test work indicates, however, that a small portion of waste rock materials, namely the Archerfield sandstone interburden materials, would be PAF.

The management of PAF waste rock material is described below.

Metal Enrichment and Solubility

Multi-element analyses were conducted on 10 composite waste rock samples and compared to average crustal abundance values. Results of this test work indicated none of the samples were enriched compared to median crustal abundance (RGS Environmental, 2020).

The analysis of water extracts from selected waste rock samples indicated metals would be relatively insoluble under the prevailing neutral to slightly alkaline pH conditions (RGS Environmental, 2020). However, one small portion (the Archerfield sandstone interburden) is classified as PAF and may have the potential to generate elevated concentrations of aluminium, arsenic, cadmium, cobalt, copper, iron, manganese, nickel, selenium and zinc (RGS Environmental, 2020).

Consideration of the potential for mobilisation of metals is provided in the Groundwater Assessment (AGE Consultants, 2020c) and Surface Water Assessment (Hydro Engineering and Consulting, 2020), which are included in Appendices C and D of the EIS, respectively.

PAF material would be either well blended with NAF or acid consuming waste rock, producing an overall NAF material, or encapsulated within NAF waste rock.

NAF material would be placed on the outer 5 m of the Eastern Out-of-Pit Emplacement and outer 2 m of any backfilled areas of the mine void.

If PAF material is exposed in the floor of the final void, it would be either:

- covered with NAF waste rock material to a minimum depth of 5 m;
- excavated and disposed of as PAF waste rock material (as described above); or
- flooded with water from the site water management system.

The risk of incorrect management of acid forming material resulting in rehabilitation failure and potential off-site water quality issues was assessed as low in the rehabilitation risk assessment with the implementation of appropriate controls (Section 4.1).

7.3.2 Material Prone to Spontaneous Combustion

A Spontaneous Combustion Management Plan has been developed for the Mount Pleasant Operation and would be reviewed and updated to incorporate the Project. Spontaneous combustion at the Project would continue to be managed in accordance with the following objectives:

- minimise spontaneous combustion outbreaks;
- endeavour to identify potential areas that may be prone to spontaneous combustion before an outbreak occurs;
- provide for all carbonaceous material to be placed in such a manner that reduces the possible occurrence of spontaneous combustion (carbonaceous material will be placed on lower levels of the overburden emplacements, at a minimum of 5 m from the face of the emplacement);
- if longer term spontaneous combustion problems do occur, instigate the Spontaneous Combustion Management Plan to deal with these; and
- creation of final rehabilitation that is free from spontaneous combustion.

Minor spontaneous combustion has been encountered at the neighbouring Bengalla Mine and Mt Arthur Coal Mine. Seams that were found to be more susceptible, when exposed in a normal mining sequence, were the Vaux, Bayswater and Wynn Seams.

Mining at the Project would encounter these same seams. To date, occurrences of spontaneous combustion have occurred at the Mount Pleasant Operation, within a ROM coal storage area and within an in-pit dump area. The Spontaneous Combustion Management Plan includes details of factors that influence self-heating and spontaneous combustion and identifying signs to look for during inspections. The Plan also includes procedures for excavation and management of identified hot material. MACH also conducts reactive ground testing at the Mount Pleasant Operation to assist with identifying reactive materials.

The risk of a spontaneous combustion incident that affects rehabilitation has been assessed as low considering that carbonaceous material is placed at a minimum of 5 m from the face of the emplacement, which is consistent with industry best practice (Australian Coal Association Research Program [ACARP], 2008).

7.4 SOIL PLACEMENT AND GROWING MEDIA DEVELOPMENT

Following confirmation that the landform construction and shaping has been undertaken in accordance with the geomorphic landform design, soil placement and growing media development would be undertaken. This would typically involve:

- spreading topsoil mixed with relevant ameliorants onto rehabilitation areas at a minimum depth of 100 mm;
- deep ripping along the contour to a minimum depth of 500 mm to encourage infiltration;
- seeding with a native seed mix include native grass, shrub and tree species and temporary cover crop species;
- installation of habitat features including habitat/stag trees, log piles and rock piles;
- planting of tubestock, including ground, middle and upper stratum species, of the target Plant Community Types (PCTs) when suitable climatic conditions prevail; and
- installation of signage to restrict access and minimise the potential for disturbance of the rehabilitated area.

MACH would target reshaping to final surface level and initial revegetation seeding of the majority of outer emplacement batter lifts of the Eastern Out-of-Pit Emplacement within 6 months of each subsequent dump panel lift being completed (subject to potential delays associated with localised design constraints or climatic extremes when soil placement and revegetation works may need to be delayed).

7.4.1 Soil Resources

Soil management is fundamental in successful land management and rehabilitation of the Mount Pleasant Operation. The key objectives for managing the soil landscape (in context of vegetative cover and soil stability) include:

- minimising bare soil patches which could potentially be affected by wind and water movement; and
- maintaining favourable nutrient, infiltration and stability characteristics.

Analysis of the soil management units present in the Project area has been undertaken by GT Environmental (2020) as part of the *Mount Pleasant Optimisation Project – Soil Resource Assessment*. This included evaluation of 138 soil observation sites in or adjacent to the Project area.

Soil management units have been classified in accordance with the *Australian Soil Classification* (Isbell, 2002) and grouped according to soil morphology, position in the landscape, and parent material (GT Environmental, 2020).

7.4.2 Management of Soil during Stripping

Topsoil stripping activities would continue to be undertaken in accordance with the erosion and sediment control provisions in the Water Management Plan. The areas cleared in advance of mining would be delineated to minimise the potential for accidental additional vegetation clearance and potential impacts to fauna. Where required, the areas would also be deep ripped to alleviate compaction and watered to minimise dust generation, prior to stripping. Following these activities, vehicle movement will be kept to a minimum on areas/soils proposed to be stripped.

Topsoil and subsoil would be stripped and salvaged to maximise its value for re-use in rehabilitation, this process would be guided by soil mapping and the suitable soil stripping depths described in GT Environmental (2020). Where practicable, soil will be stripped when moist (but not saturated) to reduce air quality impacts, and where possible, will be transported directly to areas available for rehabilitation.

7.4.3 Soil Stockpile Management

Where direct placement of topsoil on rehabilitation areas is not possible, soil would be stockpiled away from active transport corridors and on level or gently sloping ground, where available, to minimise erosion and potential soil loss. Topsoil and subsoil (including alluvial soils) would be stockpiled separately where practical.

Both short-term and long-term topsoil and subsoil stockpiles would be managed to minimise soil loss and maintain the viability of the soil. Long-term topsoil and subsoil stockpiles (i.e. stockpiles that will remain for longer than six months) would be managed to maintain soil viability, seed reserves and microbial soil associations.

Soil stockpiles would be sign-posted to identify the stockpile and to minimise accidental disturbance.

Soil Replacement on Rehabilitation Areas

Soil conditioning activities would be undertaken with the aim of increasing moisture and organic content and to buffer surface temperatures to improve germination. Activities may involve the application of dust suppressant to minimise dust generation and the application of soil ameliorants (as required) such as gypsum, or organic materials such as wood and mulch. Soil testing would be undertaken prior to soil replacement to inform amelioration requirements, including the required rate of ameliorant application.

Amelioration measures that may be applied to soils to improve suitability for use in rehabilitation, particularly when reinstating agricultural land, may include (GT Environmental, 2020):

- Agricultural lime to acidic soils to raise pH levels.
- Gypsum ameliorants to reduce dispersive attributes of subsoils.
- Organic matter to improve water holding capacity, reduce erosion, reduce nutrient leaching and improve soil structure.
- Phosphorous fertilizers, such as single super and double super would be applied to increase phosphorus levels if required for post-mining land use.
- Nitrogen based fertilizers to increase levels. These may include low percentage fertilizers such as calcium nitrate, sodium nitrate to moderate percentage fertilizers such as ammonium nitrate and calcium ammonia nitrate.

Soil amelioration would be applied in woodland areas where it is required to restore natural soil characteristics that are required to support the growth of native vegetation communities in the vicinity of the Project.

In addition to the above, replaced soil sourced from stockpiles greater than 3 m in height, would be inoculated with Mycorrhizal fungi and rhizobia bacteria to ameliorate any anaerobic conditions that may have developed during storage. Topsoil stockpiles would also be mixed during spreading to redistribute nutrients which may have leached to the base of the stockpiles (Nussbaumer, et. al., 2012).

Symbiotic microbes can have a dramatic influence on plant establishment, growth and survival. For example, Mycorrhizal fungi are instrumental in soil aggregation, which leads to better soil structure with all its benefits of increased water infiltration and holding capacity, seedling emergence, root penetration and gas exchange. There are two main types of mycorrhizae, ectomycorrhizae and endomycorrhizae (also known as arbuscular mycorrhizae) (Nussbaumer, et. al., 2012).

MACH would also conduct microbial sampling to understand the current diversity within stockpiled topsoil and soil respread on rehabilitation areas (prior to respreading) to understand possible microbial losses and inoculation requirements. The nutrient cycling soil microbes which "naturally build nutrient pools, especially for nitrogen and phosphorus, in both the standing vegetation and the soil" (Nussbaumer, et. al., 2012), would be introduced, as required, into the rehabilitation areas to assist with maintaining long-term sustainability of the topsoil resource at the Project.

Soil would typically either be placed at the top of the slope and spread down the slope or placed at the base of the slope and spread up-slope. The soil would then be spread at a minimum depth of 100 mm across the contour of the slope. Replaced soil, and any applied ameliorants, would then be deep-ripped (see Plate 17) to a depth of approximately 500 mm to alleviate any soil compaction during landform construction and create a rough surface tilth for vegetation establishment and increase infiltration and reduce runoff (Plates 18 to 19) (Section 5.2.1).

Soil re-spreading would not be undertaken during excessively wet days, to avoid compaction of the landform surface from machinery movement, or on excessively windy days, to minimise dust generation and soil loss.

Topsoil and Subsoil Budget

GT Environmental (2020) has reviewed the topsoil available for use in Project rehabilitation based on recommended stripping depths for each Soil Management Unit. This review indicates that there is sufficient topsoil available to meet rehabilitation requirements. There is also additional subsoil that can be made available for rehabilitation with the application of appropriate amelioration measures.

MACH would continue to maintain a Topsoil Register for the Project to track stockpile volumes, locations, stockpile type and treatments applied to the stockpiles (e.g. whether a stockpile has been seeded). This Register is updated regularly to reflect stockpile use and soil management actions applied.

PLATE 17

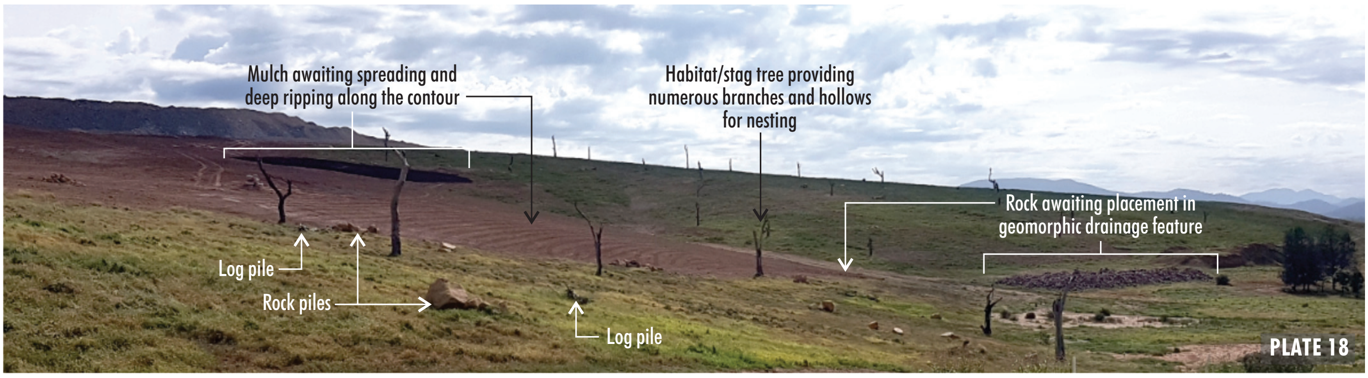


PLATE 18

PLATE 19

MAC-18-02 SSD_EIS_Rehab_008C

Resource Strategies

Source: MACH (2020)

MACHEnergy

MOUNT PLEASANT OPTIMISATION PROJECT

Eastern Out-of-pit Overburden Emplacement
Outer Batter Rehabilitation

Plates 17 to 19

7.5 REINSTATING NATIVE WOODLAND ECOSYSTEMS

The majority of the Project area has been cleared and used for agricultural grazing purposes for well over 100 years. The landform in the Project area consists of undulating hills with open paddock grazing land and intermittent creeks and unnamed ephemeral drainage lines.

Hunter Eco (2020) has assessed the following in the Project area and surrounds:

- native vegetation;
- occurrence of threatened ecological communities listed under the BC Act and EPBC Act;
- vegetation integrity; and
- presence of threatened flora species and populations.

The flora surveys were undertaken across multiple seasons in accordance with the BAM (OEH, 2017) and the *Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method* (DPIE, 2020).

The surveys by Hunter Eco (2020) included sampling of vegetation integrity plots, collection of rapid data points, identification of PCTs and targeted searches for threatened ecological communities, species and populations. Hunter Eco (2020) also reviewed the results of previous flora surveys within the Project area and surrounds conducted by ERM Mitchell McCotter (ERM) (1997), Cumberland Ecology (2006, 2007, 2009, 2010 and 2015), Eco Logical Australia (ELA) (2016) and Hunter Eco (2017a and 2017b).

Future Ecology (2020) undertook targeted searches for threatened fauna species listed under the BC Act and/or EPBC Act that were known, or likely to occur, in the Project area and surrounds.

Seven PCTs were identified within the Project area and surrounds (Appendix E of the EIS). Several of these PCTs were present in both woodland form and derived native grassland form (Plates 20 and 21). Two threatened ecological communities listed under the BC Act and two threatened ecological communities listed under the EPBC Act were identified within the Project area and surrounds:

- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (listed under the BC Act).
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (listed under the BC Act)[3].
- Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (listed under the EPBC Act).
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community (listed under the EPBC Act)[3].

Biodiversity Management Strategies

The impacts of the Project on biodiversity are summarised in Appendix E of the EIS.

MACH currently manages impacts to biodiversity by implementing the following management plans, programs and strategies:

- the Biodiversity Management Plan, which includes Vegetation Clearance Protocol and a Ground Disturbance Permit system;
- weed and pest control programs (refer Section 7.8);
- a MOP, including rehabilitation monitoring program;
- the overarching Mount Pleasant Operation Rehabilitation Strategy; and
- the approved EPBC Act Offset Management Plan (required by EPBC Act 2011/5795).

These management plans, programs and strategies (or relevant equivalents) would be updated and implemented for the Project in accordance with the conditions of the Project Development Consent.

[3] Herein referred to as the *Box-Gum Woodland CEEC.*

PLATE 20
Grey Box - White Box Grassy Woodland (PCT 483)

PLATE 21
Derived Native Grassland (PCT 483)

MAC-18-02 SSD_EIS_Rehab_013A

Resource Strategies

Source: Hunter Eco (2020)

MACHEnergy

MOUNT PLEASANT OPTIMISATION PROJECT

Examples of Vegetation Communities in the Project Area

Plates 20 and 21

Open Woodland Rehabilitation

Rehabilitation of woodland at the Project would continue to focus on flora species endemic to the local area, while acknowledging that seed supply may be a limiting factor. In this case, other appropriate native species that have performed well in the region would also be considered. Subject to seed and seedling supply availability and suitability, flora species to be used in rehabilitation would aim to include those typical of the *Box-Gum Woodland CEEC*.

Where relevant, management practices described in the *National Recovery Plan – White Box – Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (Department of Environment, Climate Change and Water [DECCW], 2011) would continue to be used as the basis for the re-establishment of grassy woodland areas on-site.

The Mount Pleasant Operation EPBC Act 2011/5795 requires development of a Threatened Ecological Community Mine Site Rehabilitation Plan to guide the re-establishment of *Box-Gum Woodland CEEC* across the Project area, including rehabilitated mine landforms. The Threatened Ecological Community Mine Site Rehabilitation Plan was approved by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) on 22 October 2020. This plan would be reviewed, and if necessary updated, to incorporate the Project.

7.6 REINSTATING AGRICULTURAL GRASSLAND AREAS

Consultation with Muswellbrook Shire Council indicated a preference for intensive agricultural/industrial post-mining land uses that provide employment for the local community. Consequently, rehabilitation of the Project would consider both low and high intensity agricultural land uses.

Low intensity agriculture would consist of reinstating grazing use and high intensity agriculture may include activities such as feedlots, poultries or agricultural processing facilities. However, until such a time as a specific proposal is developed for such intensive uses, planning for all non-woodland areas would target low intensity agriculture.

The Project final landform areas proposed for agriculture are shown on Figure 9 and would be prepared to accommodate agricultural activities such as sustainable/managed livestock grazing. The objective would be to establish areas to be classified as Land Capability Class 4, Class 5 or Class 6 lands, which are suitable for grazing, but not cropping or other high intensity uses.

The definitions of Land Capability Class 4, 5 and 6 lands (as defined by the OEH [2012] *The Land and Soil Capability Assessment Scheme: Second Approximation - A general rural land evaluation system for New South Wales*) are as follows:

- **Class 4 – Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
- **Class 5 – Moderate to low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
- **Class 6 – Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

It should be noted that although the definitions of Land Capability Class 5 and 6 lands include land uses such as forestry and nature conservation (in addition to grazing), MACH does not propose to establish forestry on the rehabilitation areas proposed for agricultural use.

Agricultural rehabilitation areas would be cultivated and then broadcast sown with pasture species. The species mix would be developed in consultation with an agronomist, and depend on the growth media available and environmental conditions at the time of rehabilitation. Species selection would also take into consideration potential for species to encroach on rehabilitation areas with native ecosystem re-establishment.

Improved pasture species commonly present in the surrounding grazing country that would be considered for rehabilitation of low intensity agricultural areas include:

- Subterranean clover (*Trifolium subterranean*).
- White Clover (*Trifolium repens*).
- Lucerne (*Medicago sativa*).

- Green Panic (*Panicum maximum*).
- Kikuyu Grass (*Pennisetum clandestinum*).
- Perennial Rye (*Lolium perenne*).
- Phalaris (*Phalaris aquatica*).
- Oat (*Avena sativa*).

Native grass species would also be considered in pasture species such as *Cynodon dactylon* (Couch), *Austrodanthonia* spp. (Wallaby grasses) and *Austrostipa* spp. (Spear grasses) which have been shown to develop well in post mining landscapes of the Hunter Valley (Huxtable, Koen and Waterhouse, 2005).

Highly competitive exotic grasses (e.g. Rhodes Grass [*Chloris gayana*]) and non-local Australian species (e.g. Golden Wreath Wattle [*Acacia saligna*]) would not be used.

7.7 FINES EMPLACEMENT AREA REHABILITATION

The overarching objective for rehabilitation of the Fines Emplacement Area is to establish a safe, stable and non-polluting landform with a sustainable surface cover that minimises erosion (to prevent exposure of the underlying fines material) and sustains grassland vegetation in the long-term.

The Fines Emplacement Area would be capped with a layer of inert overburden material and then a layer of topsoil. MACH would continue to maintain capping and topsoil material proximal to the Fines Emplacement Area that would be sufficient to rehabilitate the area of fines to be emplaced during the relevant operational period.

MACH operates the Fines Emplacement Area using sub-aerial deposition which involves an extended period of air drying that maximises *in-situ* fine rejects densities and in turn maximises the storage efficiency of the facility as well as providing a more competent fines surface for future rehabilitation purposes. Other advantages of sub-aerial deposition include earlier facilitation of final rehabilitation due to a more competent fines surface and rapid recovery of water for reuse in the plant process. Secondary flocculation of fine rejects would also continue to occur in order to improve fine coal reject density at the Fines Emplacement Area.

MACH would continue to develop the final landform rehabilitation concepts which will be informed by the results of future tailings characterisation testwork and research project results and will be guided by relevant industry guidelines, including ANCOLD's *Guidelines on Tailings Dams* (July 2019).

MACH has entered into a collaboration agreement with the University of Newcastle on the ACARP Project "Tailings to topsoil" (#C29042) which commenced in January 2020 and is anticipated to be completed by December 2022 (refer Section 7.10.1).

7.8 MANAGEMENT OF WEEDS AND PESTS

The key weed and pest species on the Mount Pleasant Operation landscape include: African Boxthorn (*Lycium ferocissimum*); St John's Wort (*Hypericum perforatum*); feral dogs; foxes; and feral pigs. Ongoing management activities are undertaken to control the presence of these species.

Weed management at the Mount Pleasant Operation would continue to be undertaken in accordance with advice from the Upper Hunter Weeds Authority, and in accordance with the *Biosecurity Act 2015*. The Mount Pleasant Operation also has a weed management procedure which would be reviewed and updated for the Project. The procedure includes a description of the Weeds of National Significance, priority and environmental weed species which pose a threat to the site. Monitoring of weed presence, extent and other factors which may contribute to growth/decline of populations would continue to occur regularly.

Existing weed management measures that would continue to be implemented for the Project (but are not limited to):

- Regular inspections of MACH-owned lands to identify areas requiring the implementation of weed management measures.
- Regular inspections and maintenance of topsoil stockpiles.
- Management of cattle movement to mitigate the risks associated with the control of weeds in manure, around stockyards, and key access corridors.
- Consultation with neighbouring land owners and the relevant government stakeholders, such as the Upper Hunter Weeds Authority, regarding regional weed management strategies.

- Implementation of appropriate weed management measures, which may include mechanical removal, application of approved herbicides and biological control.
- Control of noxious weeds, or plants identified as key threatening processes on MACH-owned land in accordance with the relevant DPI control category and the regional Weed Management Plan.
- Identification of weed infestations adjacent to or within the proposed disturbance area during pre-clearance surveys.
- Follow-up inspections to assess the effectiveness of the weed management measures implemented and the requirement for any additional management measures.

The outcomes of these weed and pest management activities would continue to be reported in the Annual Review over the life of the Project.

7.9 REHABILITATION MONITORING

Rehabilitation is an iterative process which incorporates refinement/improvement of methods throughout the lifetime of the mine. Monitoring of rehabilitation allows for application of adaptive management to be applied in subsequent and later years. It will also assist with continuous improvement in the site's performance in terms of landscape and land use. An example of an iterative, continual improvement approach to mine site rehabilitation which may be implemented is shown in Figure 10 (based on Nichols, 2005).

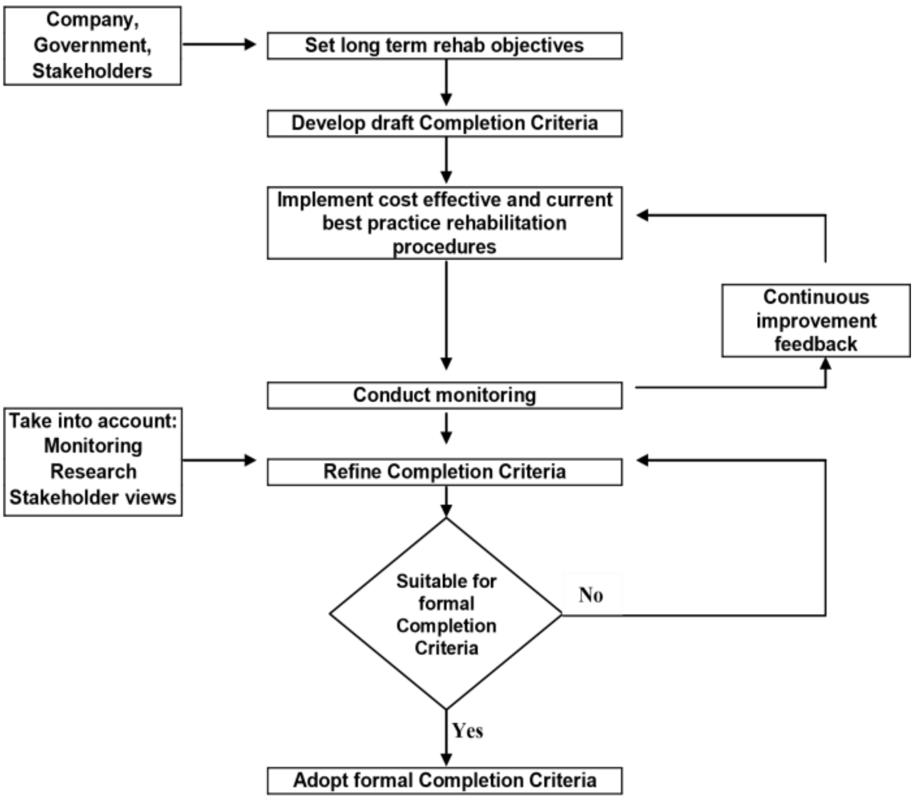


Figure 10: Continuous Improvement including Monitoring and Review Processes
Source: After Nichols (2005).

The rehabilitation monitoring program would include:

- Ecosystem monitoring (Section 7.9.1);
- Rehabilitation Verification Inspections (Section 7.9.2);
- Visual Inspection Monitoring (Section 7.9.3); and
- Low intensity agriculture monitoring programme (Section 7.9.4).

Rehabilitation monitoring sites would be established progressively as mining and waste emplacement areas are rehabilitated. Monitoring sites would be documented progressively in MOPs.

7.9.1 Ecosystem Monitoring

The objective of this component of the monitoring program is to evaluate the progress of rehabilitation towards fulfilling long-term land use objectives and completion criteria. Monitoring of rehabilitation areas would be undertaken annually to:

- compare monitoring results against rehabilitation objectives, performance indicators and completion criteria;
- identify possible trends and areas for improvement;
- link to records of rehabilitation to determine causes and explain results;
- assess effectiveness of environmental controls implemented;
- where necessary, identify modifications required for the monitoring program, rehabilitation practices or areas requiring research;
- compare flora species present against original seed mix and/or reference sites;
- assess vegetation health;
- assess vegetation structure (density of upper, mid and lower storey); and
- where applicable, assess native fauna species diversity and the effectiveness of habitat creation for target fauna species.

Where necessary, rehabilitation procedures would be amended based on rehabilitation monitoring results to continually improve rehabilitation standards, or as more data becomes available regarding reference sites or the targeted vegetation community, completion criteria can be updated to ensure rehabilitation is improving on the right trajectory.

Analogue Monitoring Sites and Rehabilitation Monitoring

Analogue monitoring sites would be established in areas of the relevant PCTs to be targeted for establishment in Project rehabilitation.

Four analogue monitoring sites were established in 2019 in areas of PCT 483 (Grey Box x White Box Grassy Woodland) within the existing Mount Pleasant Operation Development Consent boundary. Additional analogue monitoring sites in other vegetation communities are currently being established.

MACH has collaborated with Ausecology Pty Ltd to develop a monitoring program for rehabilitation at the Mount Pleasant Operation. A preliminary version of the program has been developed, with a finalised version currently in preparation. The aim is to guide rehabilitation monitoring at the Mount Pleasant Operation so rehabilitation monitoring can be consistently replicated year to year, and produce statistically robust and consistent data.

The monitoring program for rehabilitation would be progressively updated to describe current Project rehabilitation objectives, performance indicators and completion criteria, and the rehabilitation monitoring methodologies and monitoring parameters. The program includes a Rehabilitation Verification and Inspection Checklists that would be used to track rehabilitation performance towards completion criteria and document whether a rehabilitation area requires any corrective actions to improve performance.

Permanent monitoring transects would continue to be progressively established in completed Mount Pleasant Operation rehabilitation areas over the life of the Project.

7.9.2 Rehabilitation Verification Inspection

In addition to ecological monitoring, MACH would continue to implement an annual Rehabilitation Verification and Inspection to evaluate how successful rehabilitation works have been. The scope of the inspection is to include all existing and recently completed rehabilitation areas on-site. Post-closure, monitoring may be undertaken at an alternative frequency if a suitably qualified and experienced person considers that annual monitoring is not warranted due to the advanced/mature condition of the rehabilitation.

As part of the monitoring program for rehabilitation, Rehabilitation Verification and Inspection Checklists have been developed relevant to whether a rehabilitation area is in the Growth Media Development phase (i.e. Phase 3), or in either the Ecosystem and Land Use Development or Sustainability phase (i.e. Phases 4 or 5). The checklist forms include the Phase 3, 4 and 5 rehabilitation criteria (Section 6), and determination of whether the area is Not Compliant, Not Yet Compliant, Near Compliant or Compliant with the criteria.

The Rehabilitation Verification and Inspection Checklist form also requires evidence of, or a description of justification for, the level of compliance rating and notation of the level of corrective actions required to improve the compliance level (e.g. if the area requires rework, or rectifying measures, or to continue existing maintenance and monitoring measures).

The Rehabilitation Verification and Inspection information is then combined with the annual ecological monitoring results, to provide a comprehensive description of the progress of rehabilitation against the relevant completion criteria within the annual rehabilitation monitoring report.

7.9.3 Visual Inspection Monitoring

Visual Inspection Monitoring of existing and recently completed rehabilitation areas would continue to be undertaken monthly. A Visual Inspection Monitoring form would be developed for the Project as part of the monitoring program for rehabilitation, and would be designed so that the monitoring can be undertaken by Mount Pleasant Operation personnel.

The Visual Inspection Monitoring form is anticipated to include notation of:

- erosion presence, including type (e.g. rill, gully, tunnel), dimension and active state of the erosion;
- weed presence, including species, infestation area (m^2), and cover (%) or count; and
- groundcover description; and
- comments and photo numbers to provide additional information on the status of the area, and if the area requires any remediation measures.

The Visual Inspection Monitoring process allows comparison between different rehabilitation sites and over time. It also allows the identification of areas requiring remediation.

7.9.4 Low Intensity Agricultural Land Monitoring

Monitoring of areas proposed for agricultural end land uses (i.e. grazing) would include a range of parameters including soil, water supply and pasture parameters and may include livestock parameters (when adequately advanced).

Parameters that would be monitored in Project agricultural rehabilitation areas include:

- **Soil**: pH, phosphorus, nitrogen, sulphur, potassium, calcium, EC/Salinity, Sodicity, Cation Exchange Capacity, Organic Carbon, and some trace elements (e.g. copper) on advice from Agronomist.
- **Water Supply**: pH, EC/Salinity, and potentially toxic elements on advice from Agronomist (e.g. iron, magnesium and nitrates).
- **Pasture**: Dry matter yield, pasture quality (e.g. Protein, Digestibility, Metabolisable Energy), ground cover, species composition and LFA indices.
- **Livestock** (when adequately advanced): Weight, health (i.e. blood testing).

7.10 RESEARCH AND TRIALS

The rehabilitation program at the Mount Pleasant Operation aims to incorporate management practices that have resulted from industry research into the establishment of woodland and grassland communities across mined landscapes, and in particular in the Hunter Valley region.

MACH is currently collaborating with the University of Newcastle on two rehabilitation related research projects:

- a research project that aims to integrate treated fines material with topsoil material to create a usable soil resource for crop production or native vegetation establishment (this project is being conducted by ACARP) (Section 7.10.1);
- a research project that measures the erosion performance of constructed waste emplacement landforms at the Mount Pleasant Operation and informs future input into the SIBERIA software program to support ongoing geomorphic landform design modelling over the life of the Project (Section 7.10.2); and
- a topsoil stockpile trial to assess the characteristics of emplaced soil (Section 7.10.3).

Over the life of the Project, MACH proposes to build on industry research results and conduct various research studies and trials to inform the most suitable practices that would enable the re-establishment of woodland and grassland areas on final mine landforms and disturbed areas of the Mount Pleasant Operation. Details of the research may include:

- Potential variables impacting on rehabilitation programs and causes of localised rehabilitation failure.
- Assessing rehabilitation strategies that have successfully reinstated woodland communities (or rehabilitation with species typical of various communities) on other mine sites, including:
  - establishing appropriate soil substrate: direct application of topsoil; stockpiled native topsoil; raw overburden and interburden material plus addition of biosolids/organic growth medium; addition of other organic material; rehabilitation trials on fines material;
  - establishment of the grassy understorey: grass species suitable for mine rehabilitation; low and high photosynthetic pathway species; establishing native herbs and forbs;
  - establishing the shrubby understorey;
  - establishing the overstorey;
  - seed distribution methods: hand-broadcasting; brush-matting; hydro-mulching; spreading seed-bearing hay; direct seeding; air seeding; and
  - progressive rehabilitation strategy: pre-stripping requirements; sequence of rehabilitation strategies.

7.10.1 ACARP Tailings to Topsoil Research Project

MACH has entered into a collaboration agreement with the University of Newcastle on the ACARP Project "Tailings to topsoil" (#C29042) which commenced in January 2020 and is anticipated to be completed by December 2022. The project involves collaboration between MACH (and other NSW coal mining operations), University of Newcastle, Muswellbrook Shire Council, JORD International, and NSW Department of Primary Industries Soils Unit.

The project methodology involves four major processes:

1. Characterisation and pre-treatment of tailings;
2. Delivery of tailings slurry to the trial site via a high-efficiency solids separation mobile tailings handling plant;
3. De-watering of tailings via a mobile dewatering plant; and
4. Integrating the upgraded tailings with the existing soil profile at the trial site to improve soil resources for crop production or native vegetation establishment.

The project aims to optimise existing tailings processes and technologies and provide a commercially viable system for tailings utilisation. MACH has committed cash contributions and in-kind support in addition to engaging a PhD student as part of the project. MACH has also offered a trial site for the project to be established at the Mount Pleasant Operation.

As the research project progresses, and results from the research project become available, MACH may review and update rehabilitation concepts for the Fines Emplacement Area.

7.10.2 Rehabilitated Landform Erosion Monitoring

MACH has entered into an agreement with University of Newcastle to establish a field data collection program to support landform design and rehabilitation practices at the Mount Pleasant Operation site over the life of the Project.

Rehabilitation monitoring sites would be established in representative rehabilitation and analogue locations. Each monitoring site would consist of a flume to measure surface water runoff and soil erosion rate and a weather station that records rainfall (pluviograph), air temperature, incoming and outgoing radiation as well as soil moisture. This allows both surface and subsurface hydrology to be quantified. Deeper soil moisture and temperature probes may be added depending on the depth of the soil material.

Data from each monitoring site would be used to quantify and understand:

- Plot hydrology, water quality and sediment transport both for individual rainfall events as well as performance over the life of the Project.
- Vegetation response.
- Calibrate and validate the SIBERIA landscape evolution model.
- Potential completion criteria for long-term erosional stability.

Data from the rehabilitation monitoring sites would be reviewed on an annual basis and used to inform future rehabilitation monitoring and adaptive management of the geomorphic landform design. Information would also be made available to the community via presentations to the CCC, conference presentations and/or periodic research papers jointly published by MACH and the University of Newcastle.

7.10.3 Topsoil Stockpile Investigation

Topsoil and subsoil resources would be managed in accordance with the measures described in Section 7.4. In addition, the University of Newcastle is conducting microbial sampling to understand the current microbial diversity within stockpiled topsoil and soil respread on rehabilitation areas (prior to respreading) to understand possible microbial losses and inoculation requirements.

The topsoil stockpile trial is being undertaken at two locations constructed to a height of 5 m. The trial will assess the effectiveness of the stockpile management and placement practices at the Mount Pleasant Operation and would include soil testwork and microbial sampling.

A detailed design for the trial is being developed in consultation with suitably qualified and experienced persons and the NSW Resources Regulator. The trial design would include a clearly defined trial aim and trial objectives, a monitoring program including parameters relevant to measuring the success of the management practices proposed and criteria against which success of the trial would be measured.

Progress reports would be prepared detailing the monitoring program results and would include an analysis of the results against the trial criteria. Results from the trial would be progressively reported in the Annual Review. Rehabilitation irrigation trials may also be commissioned as part of this project, subject to weather conditions and water availability.

The outcomes of the rehabilitation trials would be used to refine the rehabilitation program for the Project.

8 MINE CLOSURE PLAN

A Mine Closure Plan would be developed for the Project in consultation with relevant regulatory authorities and community stakeholders. The Mine Closure Plan would be developed over the Project life, with more detailed measures developed closer to Project completion.

The Mine Closure Plan would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure.

Upon cessation of mining operations, it would be expected that tenure of the MLs would be maintained by MACH until such time as ML and other statutory approval relinquishment criteria were satisfied. These criteria would be formulated and prescribed in consultation with relevant regulatory authorities and stakeholders. MACH would transfer to the relevant regulators any documents required to preserve the history of the site, once closed, to facilitate future land use planning.

It is anticipated that mine relinquishment criteria would include, but not necessarily be limited to, the following:

- decommissioning and removal of infrastructure, where appropriate and required;
- landform stability and public safety;
- establishment of self-sustaining vegetation in previously cleared areas;
- quality of surface water runoff is comparable to the surrounding environment; and
- fulfilment of ML and other statutory approval conditions.

Lease relinquishment criteria would be detailed in the Mine Closure Plan.

The Strategic Framework for Mine Closure published by the ANZMEC-MCA (2000) (or its contemporary version) would be used as a guide for mine closure.

MACH operates within the NSW Government's stated policy that the people of NSW should not incur a financial liability as a result of coal, mineral and petroleum exploration and production activities (DRG, 2017a). Therefore, all titleholders engaged in mining activities are required to lodge a security deposit. The security deposit covers the NSW Government's full estimated costs in undertaking rehabilitation in the event of default by the titleholder.

A security deposit is currently held by the Government for rehabilitation activities at the approved Mount Pleasant Operation in the form of a bank guarantee.

Prior to the commencement of any activities under a MOP for the Project, MACH would lodge a revised security deposit in accordance with the following relevant guidelines (or their contemporary versions):

- *ESP1: Rehabilitation security deposits* (DRG, 2017a); and
- *ESG1: Rehabilitation Cost Estimate Guidelines* (DRG, 2017b).

9 FORWARD WORK PLAN

As described in Section 1.1, this Addendum has been prepared to satisfy the rehabilitation requirements of the SEARs, regulatory input to the SEARs and relevant rehabilitation guidelines.

The dynamic nature of closure planning requires regular and critical review to reflect changing circumstances (ANZMEC-MCA, 2000). Accordingly, concepts presented in this Addendum would be progressively reviewed and updated throughout the life of the Project. A forward work plan, summarising key activities to be undertaken with respect to rehabilitation and mine closure planning, is provided in Table 8.

Table 8
Forward Work Plan

Phase	Activities	Responsible
Application Assessment/ Determination	• Review Development Application and EIS on public exhibition and provide comments, including on proposed landform and land use.	Relevant government agencies, Muswellbrook Shire Council and Community
	• Review comments provided by regulators, Muswellbrook Shire Council and community and provide responses. Amend proposed landform and land use if required.	MACH
	• Review public comments and MACH responses and determine Project.	NSW Minister for Planning or Independent Planning Commission
Pre-mining	• Prepare updated MOP and other associated management plans required under the Development Consent in consultation with relevant stakeholders. • Engage suitably qualified and experienced rehabilitation/biodiversity experts to review the proposed final landform to confirm final land uses and rehabilitation objectives. • Undertake detailed review of rehabilitation objectives, performance indicators and completion criteria, including identification of any required rehabilitation investigations/trials.	MACH
	• Review MOP and provide comments.	Stakeholders specified in Development Consent
	• Update MOP to address stakeholder feedback.	MACH
	• Review and approve updated MOP.	NSW Resources Regulator
During Mining	• Undertake progressive rehabilitation, monitoring, research and trials. • Review and update rehabilitation methodology based on outcomes of monitoring, research and trials. • Review and update geomorphic landform design and SIBERIA modelling to reflect outcomes of monitoring, research and trials. • Prepare updated MOPs as mining progresses.	MACH
	• Review and approve updated MOPs (any substantial changes to MOPs would be undertaken in consultation with stakeholders defined in the Development Consent).	NSW Resources Regulator
Pre-closure	• Prepare a detailed Mine Closure Plan (expanding on the plan in the operational MOPs) in consultation with relevant stakeholders.	MACH
	• Review Mine Closure Plan.	Stakeholders specified in Development Consent
	• Review and approve updated Mine Closure Plan.	NSW Resources Regulator
Post-closure	• Implement approved Mine Closure Plan. • Conduct regular Closure Committee meetings for a period of at least five years following post-closure.	MACH
	• Attend Closure Committee meetings.	Stakeholders specified in Mine Closure Plan

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ATTACHMENT 1

MOUNT PLEASANT OPTIMISATION PROJECT – GEOMORPHIC LANDFORM DESIGN NOTES

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REPORT

Mount Pleasant Optimisation Project

Geomorphic Landform Design Notes as input to the EIS

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Distribution List

MACH Energy

Golder

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1.0 INTRODUCTION

The following notes have been compiled by Golder Associates Pty Ltd (Golder) in support of an Environmental Impact Statement which has been prepared to accompany a Development Application for the Mount Pleasant Optimisation Project (the Project) in accordance with Part 4 of the *Environmental Planning and Assessment Act, 1979*.

2.0 GEOMORPHIC DESIGN APPROACH

Landform design methodologies tend to fall into three distinct categories. In broad terms, these are:

- **Empirical type design approaches**, using historically proven stable slopes or designs. These designs tend to use linear slopes combined with engineering interventions such as contour banks and/or drop structures.

  Empirical methods have largely fallen out of favour in the Hunter Valley due to several factors. These include instances of poor performance of contour banks without ongoing maintenance, particularly in dispersive soils, and community resistance to highly linear engineered features within the post mining landscape. Regulators and community stakeholders have also expressed concerns around the long-term maintenance of the contour banks and drop structures post closure.

- **Analogue methods**, typically using the characteristics of relevant stable natural landforms in the local environment and applying these characteristics to the design of new landforms of similar materials. Examples of this approach are found in publications by Swatsky and Beersing, or the Geofluv™ methodology developed by Bugosh. The Geofluv™ method uses stable alluvial landforms in the local area and has commercially available software (Natural Regrade®) in support of the design. These landforms typically have dendritic drainage of an appropriate drainage density (or number of drains) and is integrated hydrologically with the natural environment.

  Challenges with the analogue method is that it does not necessarily reflect the site-specific nature of the soils being used on site, assuming the analogue and new landform have soils with a similar erosion risk. It also does not provide guidance erosion risks of the unvegetated landform, the analogue being the vegetated final form.

- **Erosional based methods** that focus on the erodibility of soils to be used on the outer surface. At the simplest level, the approach may rely on methods such as the Revised Universal Soil Loss Equation (RUSLE). More commonly on larger projects in Australia, two-dimensional analysis such as that used in the Water Erosion Prediction Project (WEPP) model is used to develop a non-linear concave landform. Alternatively, more complex three-dimensional landforms with drainage lines can be modelled using Landscape Evolution Models (LEMs) such as Siberia or CAESAR.

  While erosional methods are sometimes used as a design tool, it is an iterative process and while the approach can generate a stable final landform, the extent to which the landform is similar to appropriate natural landforms will be dependent on the parameters used and the specific modelling method and assumptions.

The landform approach used by Golder is based on an approach developed in the Hunter Valley, NSW since 2012. The approach uses:

- Analogue methods for the design of the larger catchments using alluvial analogues as far as is practical, based on the Geofluv™ methodology.

  These landforms do not (in theory) require any rock armouring. This has been applied to upper flat surface at Mount Pleasant draining to the north and south via hydraulically flat drainage lines, averaging around 5%. In some areas rock is required as a precautionary measure, and erosion risk is also computed to limit the risk prior to substantive vegetation cover.

- Analogue and erosionally based methods for areas steeper than alluvial analogues, typically the sides of the Eastern Out-of-Pit Emplacement at the Mount Pleasant Operation. These areas have a dendritic drainage system with the landform shaped to suit the unarmoured landform with rock armouring in the drainage lines where required.

3.0 LANDFORM DESIGN

The key requirements for the landform are that it should be safe and stable. In addition to these base conditions, the landform needs to achieve fitness for use, integrate with the hydrology and functionality of the surrounding landscape, and be visually acceptable to the adjacent communities. Some of these aspects are discussed below.

3.1 Initial Designs

The initial area of the Eastern Out-of-Pit Emplacement that is currently being constructed is shown schematically in Figure 1 and Figure 2. The landform incorporates drainage density, and has varied crest elevations to avoid presenting as a linear feature in the landscape.

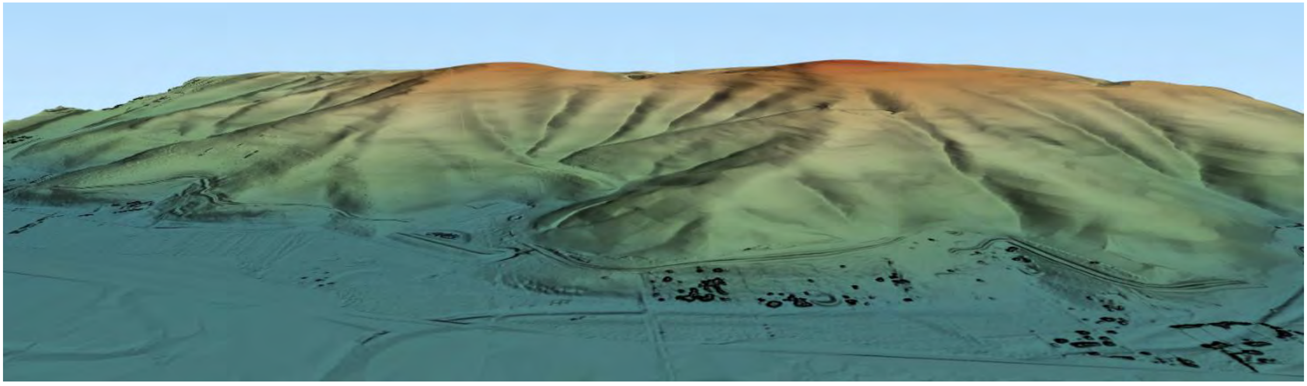

Figure 1: View of Landform from East

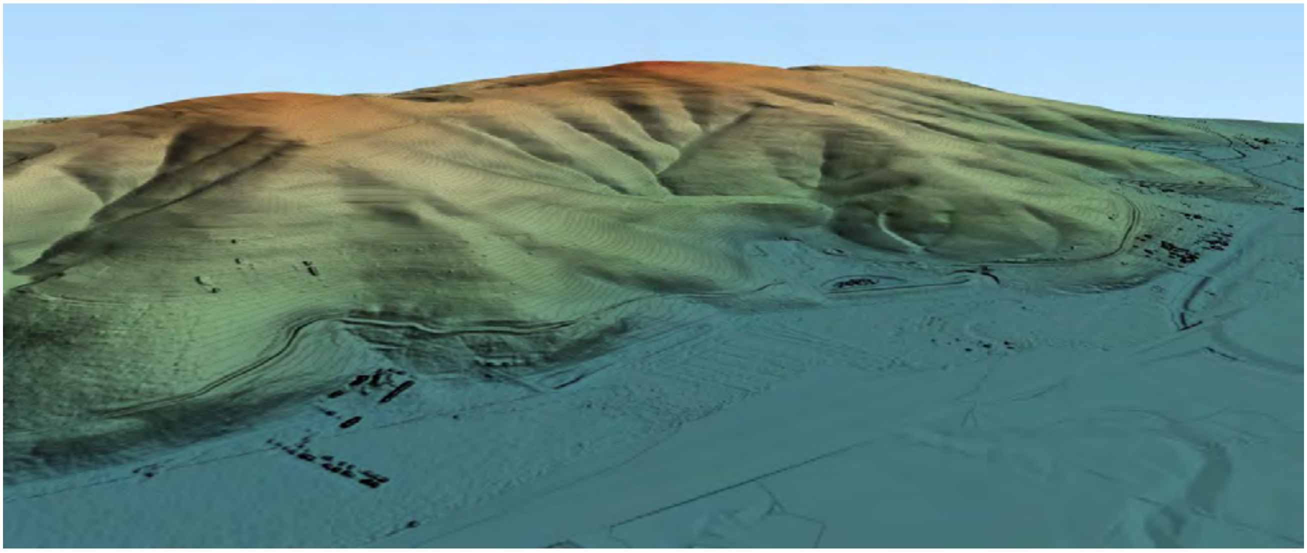

Figure 2: View of Landform with Contours from South-east

3.2 Constructability

From experience constructing these landforms since 2012, it is preferred that the maximum slopes are 33% or flatter (18°), and that where these slopes exist, they are limited in height and extent. Typically, having an area adjacent to a drainage lines that is slightly steeper allows equipment to traverse off steeper areas where required. However, it is also important that the landform shed runoff sideways. Flattening of slopes can result in long overland flow paths with an increase in erosion risk. The design is therefore a compromise between the average slope (to maximise the volume of overburden in the landform), the curvature in the surface to shed flow sideways, and the maximum slope.

Slopes for the southern portion of the landform are shown in Figure 3.

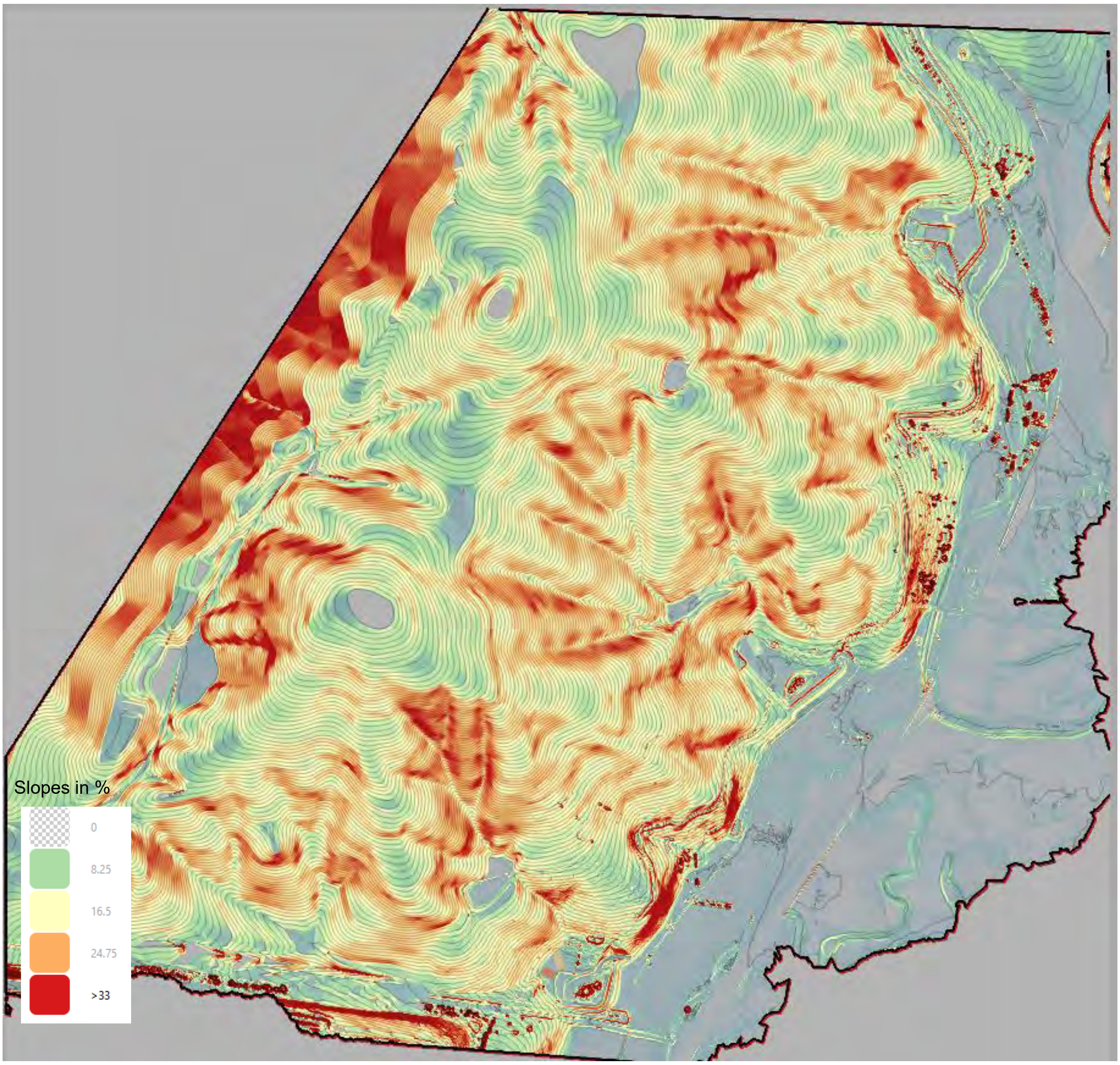

Figure 3: Slopes (in %)

There are still some areas where the conceptual final landform slopes are at the maximum slope, although these slopes make up a small proportion of the total surface area. Golder has recently developed new software to assist with the smoothing and shaping of the landform to minimise steep slopes, and further refinements to these designs will be developed over the life of the Project and presented in Mining Operations Plans (or similar).

3.3 Erosional Stability

The erosional stability has been assessed in two ways, namely:

- Firstly, a static erosion risk assessment was undertaken as part of the design process.
- Secondly, portions of the landform have been modelled in the SIBERIA LEM both to determine the likely long-term erosion rates for the surface, and to assess how well the static erosion risk assessment predicted areas of erosion risk.

These processes are discussed further in the following subsections.

3.3.1 Static Erosional Risk Assessment

The static erosion risk assessment for the southern portion of the proposed final landform is shown in Figure 4. The values and meaning are explained in the text box overleaf. Two of the areas evaluated using SIBERIA are also indicated in Figure 4.

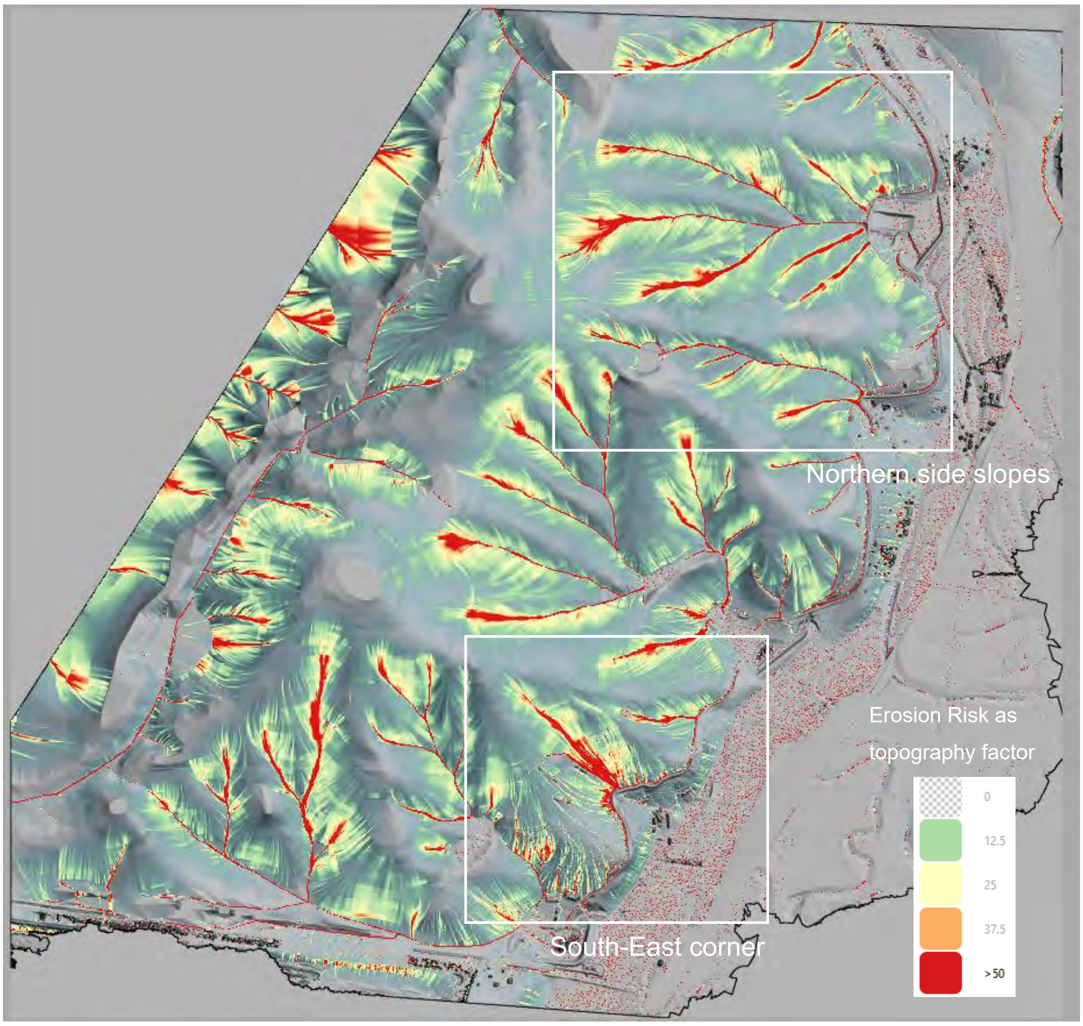

Figure 4: Erosion Risk (topography factor)

Notes on static erosion risk assessment

The values in Figure 4 are derived using the Einstein-Brown equation (which is part of the SIBERIA (LEM)) for estimating the fluvial sediment transport capacity, this being relevant to areas with incision associated with flow concentration. The Topography Factor (TF) relates erosion risk to catchment area and slope, which is a non-linear relationship.

The output is a simplistic first order assessment which can be used if there is an understanding of the soils erodibility such as is obtained using the Water Erosion Prediction Project (WEPP) model and soils testing, or from experience on a particular site or adjacent sites with similar soils.

Experience with existing landforms in the Muswellbrook area over the last four years has led us to adopt a precautionary TF value of 50 for surfaces without rock armouring. This value allows for the possibility that vegetation may not be established quickly (such as in periods of drought) and limits rilling under these conditions. However, if the deep rip lines are lost before substantive vegetation is established, there remains the possibility of some rilling.

From experience, we also expect that areas with higher TF values are likely to need rock as a permanent feature, although the exact value is very soils and vegetation dependent.

In summary, areas shown in red are considered to need rock armouring primarily where there is flow concentration, but also in more diffuse areas where gravel mulch or similar is required to limit the risk of rilling.

Key points to note are that:

- The surface is designed to be stable once vegetated based on typical soil parameters for the area. The erosion risk pre-vegetation is to be managed by deep ripping to increase infiltration.
- Rock armouring is required in most of the drainage lines and is currently a permanent feature of the landform (see discussion in Section 3.3.2.4).
- There are some localised areas of erosion risk outside of the drainage lines. While the design aims to minimise these, there are a few areas requiring gravel mulch or suitable alternatives to limit the risk of erosion pre-vegetation. The actual measures applied in these areas can be adjusted to suit available materials at the time of construction.

3.3.2 SIBERIA Erosional Risk Assessment

The initial modelling of the landform using SIBERIA by Prof Greg Hancock is not detailed, but a summary of the outputs is given below. The parameters used are generic Hunter Valley parameters and assuming a good (but not outstanding) vegetation cover, this being found to be more conservative than indicated by the on-site materials measurements. The modelling is precautionary, which is considered a reasonable approach for the initial assessment.

Due to limitations in the aerial extent that can be incorporated into SIBERIA for any one analysis, three representative areas were modelled. The location of two of these is indicated in Figure 4:

- South East Corner: Representative of the steeper slopes and drainages on the eastern face of the out-of-pit emplacement. Contains areas identified in the static erosion risk assessment with a TF of greater than 50.
- Northern Side Slopes: Similar to the South East Corner, but slightly flatter and more typical of the other side slope areas (e.g. those areas on the northern face of the out-of-pit emplacement and the final void low wall).

- Upper Surface: Representative of the flatter top of the waste emplacement. Largely contains areas identified in the static erosion risk assessment with a low TF further to the north in the final landform.

3.3.2.1 South-east Corner

This represent the likely erosion off some of the steeper parts of the proposed landform, particularly where it is tying into existing linear surfaces. The images shown are the starting landform (on the left) and the final landform after 500 years of modelling.

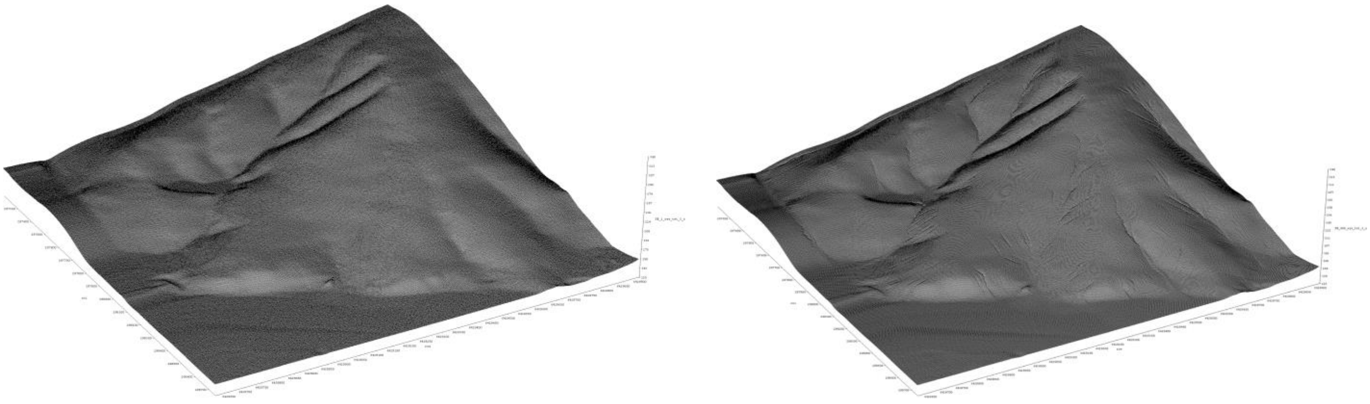

Figure 5: SIBERIA Modelling – South-east Corner

The average erosion rate at 500years was estimated to be 4.4t/ha/year, although with a higher initial erosion rate. The maximum erosion depth was 3.3 m occurring in the drainage lines.

The current planning is to place rock in the areas where the modelled rill depths and indicated tractive stresses indicate that it is warranted. The use of rock will limit the erosion depth to far less than 3.3 m. Provision has also been made for the use of gravel mulch on wider areas, that is, areas where flow is not that concentrated, but a risk of rilling exists.

3.3.2.2 Northern Side Slopes

This area is similar to the south-east but is slightly flatter and more typical of the slopes on the outer edges facing to the east. The images shown are the starting landform (on the left) and the final landform after 500years of modelling.

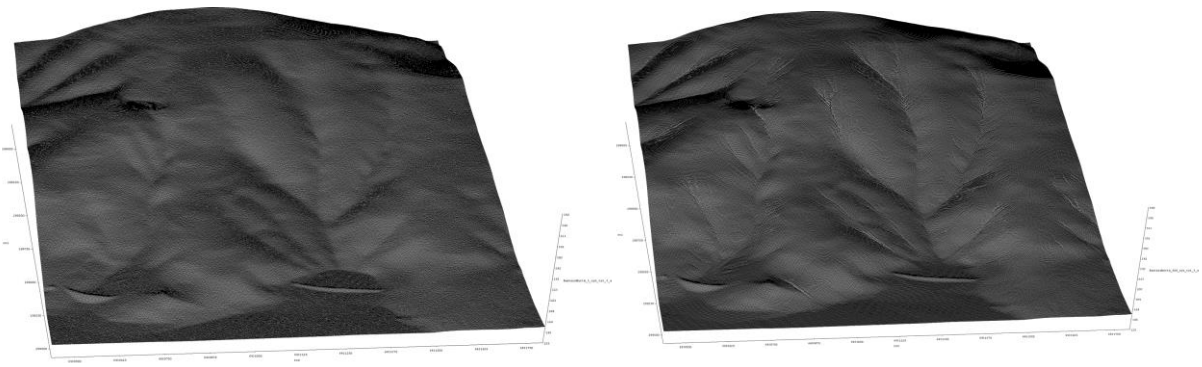

Figure 6: SIBERIA Modelling – Slopes Further North

The average erosion rate at 500 years was estimated to be 3.5 t/ha/year, although with a higher initial erosion rate. The maximum erosion depth was 3.4 m, very similar to the previous modelling. Again, the use of rock armouring will significantly reduce the depth of rilling even in the long term.

3.3.2.3 Upper Surface

The upper surface uses alluvial analogues and is less likely to need rock armouring than the other areas. The images shown are the starting landform (on the left) and the final landform after 500 years of modelling.

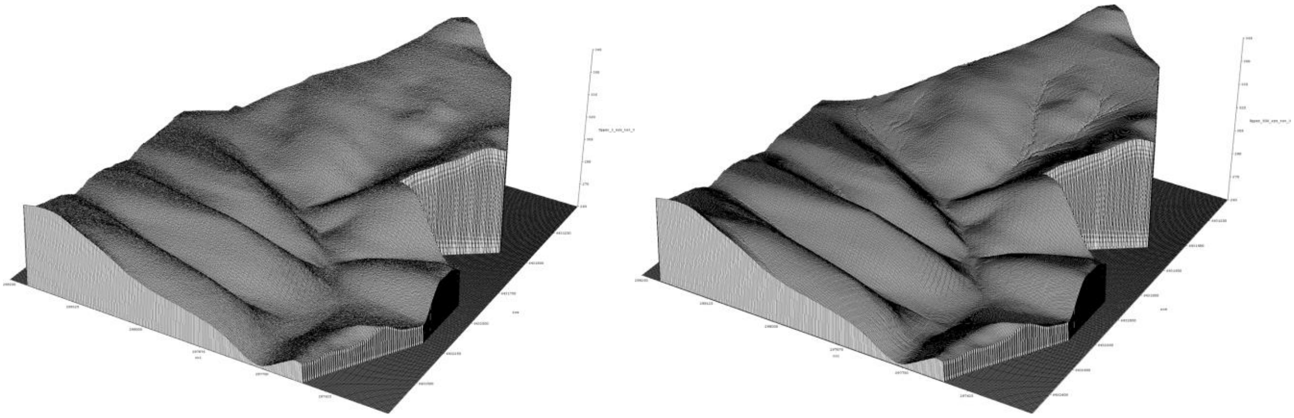

Figure 7: SIBERIA Modelling – Upper Surface

The average erosion rate at 500 years was estimated to be 3 t/ha/year, although with a higher initial erosion rate. Without rock armouring the maximum erosion depth was 5.0 m, but mainly on the steeper upper slopes. There are options here to either widen these valleys or incorporate some rocky armouring as part of ongoing development of the final landform using data collected from rehabilitation monitoring over the life of the Project.

3.3.2.4 Predicted Erosion Rates

The predicted erosion rates are shown in Figure 8.

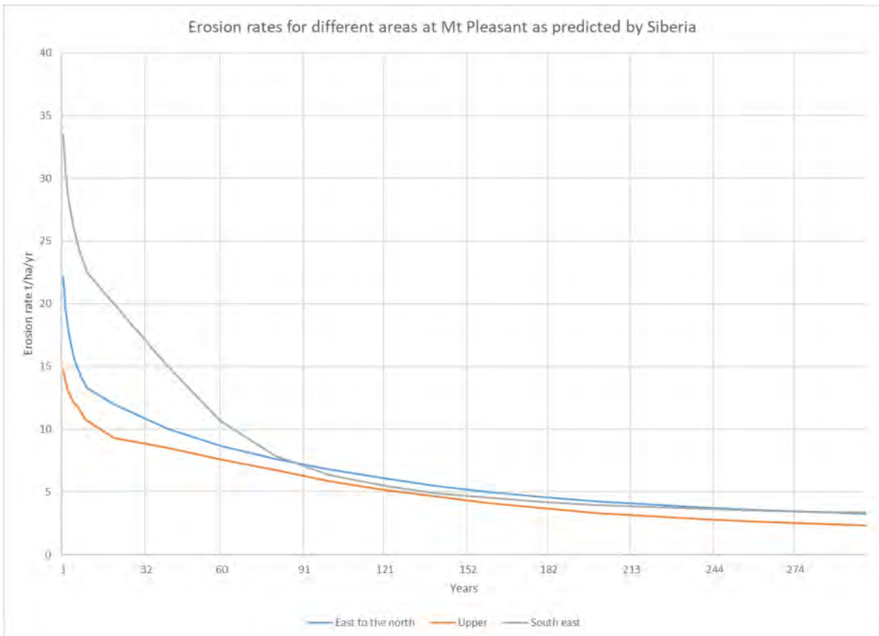

Figure 8: Predicted Erosion Rates

As might be expected, the greatest erosional risk is in the first few years' post construction prior to the native vegetation ecosystem reaching maturity.

The SIBERIA modelling has indicated some opportunities to optimise and improve the overall design. Importantly, it was found that:

- The predicted areas of erosion risk from the static analysis aligned extremely well with the outputs of the SIBERIA modelling, which gives confidence to the use of the static analysis to guide improvements to the landform design.
- If the analysis used the material properties as derived from the site sampling rather than the generic Hunter Valley values, the predicted average erosion rates are significantly lower, namely:
  - South East Corner: 2.7 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr at 500 years.
  - Northern Side Slopes: 2.8 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr by 500 years post-mining.
  - Upper Surface: 2.2 t/ha/yr at 100 years post-mining, reducing to 1.3 t/ha/yr by 500 years post-mining.

These values are comparable to natural systems in the area as noted by Prof Greg Hancock as part of the SIBERIA modelling.

The relatively low erosion rates overall and (in some cases) relatively small variation between landforms assessed with rock armouring and those without suggests that the need for rock armouring in all the drainage lines can be re-evaluated over the life of the Project as more data is collected from rehabilitation monitoring programmes.

It is important to qualify this statement in that:

- The rock sizing is based on the predicted tractive stresses and velocities during specific extreme rainfall events, taken as the 1% Annual Exceedance Probability (AEP) storm event. This is a different approach to the SIBERIA modelling which looks at annual average erosion rates. While this “annual erosion rate” does include extreme rainfall events, they are not modelled as a singular event, but captured in the average rates. The impact of specific storms is thus a separate assessment.
- Some methodologies use rill depths and not average erosion rates to assess long term performance. In that respect, a low average erosion rate may not be sufficient to demonstrate long term landform stability if there are significant rills, and the use of rock may be necessary to limit the rill depths.

4.0 CONSTRUCTION NOTES AND REHABILITATION MANAGEMENT

This section details some key learnings over the past eight years on the construction of geomorphic landforms. It also sets out some thoughts on the long-term rehabilitation management.

4.1 Key Learnings

4.1.1 Bench Placement Controls

The outer slopes at the Project will require temporary benches to be placed, which are then dozed down to form the final surface. If the bench crests and toes are placed correctly, both in terms of plan view and elevation, the final surface shaping is a simple matter of dozing downslope.

GPS guided dozer equipment is critical to getting the benches right, and this is the key issue to the overall land forming.

4.1.2 Shaping and Surface Tolerances

The geomorphic landforms can tolerate reasonable variations compared to the design surface. Typically, we would recommend being:

- Within +_100 mm on the drainage lines.
- Within +_300 mm on the ridge lines.

Where the drainage lines are rock lined, the need for smooth profiles is less critical than for unlined drains, but long steep cascades or sudden changes in grade or width should be avoided since the rock sizing is based on the slopes and widths of the designed surface.

For ridge lines, the two key parameters to be managed are ensuring:

- Slopes do not exceed the target maximum, which is 1V:3H or 18°.
- The erosion risk is not changed significantly. The erosion risk can be increased if the landform ridges are flattened resulting in flow not being sufficiently towards the drainage line, but rather running more parallel to the drainage lines increasing the flow length and catchment area. Alternatively, steepening of slopes can also increase the risk, particularly if there is a substantial catchment upslope of the area being steepened.

Where variations are of concern, a simple check of the erosion risk and slopes can be undertaken to assess whether the surface will function as expected.

4.1.3 Rock Placement and Specifications

The notes below are in support of the design. Detailed notes on the rock lining are included in the drawings provided to site.

4.1.3.1 General Sequence and Notes

It is key that the rock be placed into the landform, that is, that water is shed into the rocky drains and does not flow next to the drain.

On most sites, the approach is to:

- Do the bulk earthworks shaping.
- Then cut in the rock drainage lines, the depth of excavation being based on the size of rock as set out in the drawings. Material from the excavation can be spoiled adjacent to the drainage line, provided that it is shaped to blend into the surface.
- The geotextile is then placed (see notes on the drawings about the use of geofabric), and rock armouring placed over that.
- Rock is then tipped into the drainage line.
- Topsoil is then placed.

It is important that the material underlying the rock drains is not dispersive, and if it is, the dispersive material should be excavated out and replaced with non-dispersive materials.

4.1.3.2 Practical Issues

Inspection of the rock is required – a good blend of smaller and larger material will result in the geofabric not being visible. The rock size should also be evenly distributed to avoid pockets of smaller rock exposed between the target rock size, as this can result in localised washouts. One aspect that sites often battle with is getting the correct thickness of the rock layer – this is important to achieve interlocking of the rock layer.

Care also needs to be taken where there are larger boulders than required – this may need a thicker layer of rock. Large boulders should not be placed protruding above the channel invert in a way that will force water to one side or another, that is, if there are large boulders, they should be relatively isolated or buried into the rock drain.

It is also important that the D_{50} or median rock size is adhered to since smaller rock can result in washing out of rock. When completed, the drain should appear to be regular in terms of the finished surface and rock grading, and integrated to the edges of the topsoiled surface so that there is no windrow on the edge of the drain potentially resulting in flow on the edge of the rock lining. It is sometimes beneficial to take the topsoil slightly over the rock to further reduce the possibility of water flow under the geofabric on the edges of the drain.

The sequence of placing the rock before topsoiling can create challenges in the haulage and placement of topsoil, and sites that are making use of the drainage lines as access routes may haul and tip the topsoil prior to rock placement, and then dozing the topsoil down after rock placement.

Where topsoil is stockpiled on the landform, normally areas flatter than 1V:4H are targeted for stockpiling. This is perfectly acceptable, but topsoil must not be placed across drainage lines and if there is a significant upslope catchment, localised drainage around the stockpile areas may be required.

4.1.3.3 Rock Specifications

In terms of rock specifications, the main requirement is that the rock be sufficiently durable to have integrity in the long term. Typically, this rock has a metallic ring when hit with a geological hammer, is difficult to scratch or break, and does not present with an earthy odour when broken.

In terms of laboratory testing, the material should ideally have:

- A recommended specific gravity of 2.5 or greater (average value from 10 samples must exceed 2.3)
- Maximum recommended allowable water absorption of 2.0% (an average value from 10 samples not to exceed 0.5%)
- Although freeze thawing may not be that critical for this site, the sodium sulphate soundness test can be used with a maximum allowable weight loss of 10%.

Please note that there are a range of rock requirements for the different areas of the landform, and for some of the smaller catchments, some degradation of rock may not be that critical.

We have also found that some sites place small piles of rock on the surface purely from an environmental benefit to create habitat diversity. These small rock piles can result in localised rilling if placed on steep slopes, as they tend to concentrate flow on the outer edge of the rock piles. It is suggested that these rock piles be used preferably on flatter areas with a low erosion risk, or that gravels be used on the edges to limit the rilling risk and to spread the flow downstream of the rock piles.

4.1.4 Water Management

Two key issues of which to be aware in terms of water management are:

- Flow from the benches above rehabilitated areas or shaped areas should be prevented from flowing on to the surface other than at the drainage lines.
- Rock armouring should follow as closely as possible to the final shaping to limit the risk of erosion should an extreme rainfall event occur.

4.2 Long-term Rehabilitation Management

The landform design is a dynamic process on most sites. Some changes are part of the ongoing mining optimisation as additional data is obtained or economic circumstance change resulting in the need to revise a Mine Plan. Others can relate to construction issues such as incorrect placement of material or poor controls.

What is often overlooked, however, is that at the design stage there is typically limited information on the erodibility of the topsoil to be used, the details around vegetal cover and available materials for rock armouring. Data at the start of mining is also limited to that collected for the various environmental studies, and some of this information will need to be updated as mining progresses, especially in terms of the topsoil availability and sequencing and where this material will be placed on the final surface.

The Mount Pleasant Operation is in a relatively unique position, with the geomorphic landform design having started quite early in the mine construction, the design methodology being more robust now after some eight years of progress, and being one of the few mines with a SIBERIA model set up early in the mine life.

There are clearly opportunities to refine and optimise both the design and the use of armouring on the landform as the project progresses and additional information becomes available.

Signature Page

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https://golderassociates.sharepoint.com/sites/103816/deliverables/007 - geomorph as input to eis/19116801-007-r-rev0 mt pleasant_geomorphic landform design inputs to eis.docx

ATTACHMENT 2

MOUNT PLEASANT OPTIMISATION PROJECT – SIBERIA PARAMETERISATION AND MODELLING

Mount Pleasant Optimisation Project SIBERIA Parameterisation and Modelling, Muswellbrook NSW

METHODS REPORT

The information contained in this document is solely for the use of the Client.

Disclaimer: All care and due diligence has been exercised in testing, interpreting data and the development of recommendations presented in this report. The monitoring and testing has been undertaken in a professional manner according to accepted practices.

A landscape is not uniform and because of this non-uniformity, no monitoring, testing or sampling technique can produce completely precise results for any site. Any conclusions based on the monitoring, testing and/or sampling presented in this report can therefore only serve as a 'best' indication of the environmental condition of the site at the time of preparing this document. It should be noted that site conditions can change with time. Specific circumstances and research findings after the date of publication of this report may influence the accuracy of the data and recommendations within this report.

The information contained in this report should only be used within the limitations stipulated in this report. The supplier does not accept any risks and responsibilities for losses, damages, costs and other consequences resulting from using any information, material and recommendations in this report.

Cover
Reshaped Mt Pleasant hillslope with overburden (tan) and topsoil (red) before ripping (December 2019).

17 November 2020

Version: Revision 1a

1 INTRODUCTION

This report presents results for a flume assessment on material erodibility and parameter derivation of surface material for the Mount Pleasant Operation. A basic material characterisation and assessment was also conducted to assist in this.

The information here was used to determine input parameters for the SIBERIA landscape evolution model (Willgoose et al., 1991a-c; Hancock and Willgoose, 2018).

This report also presents the results of the SIBERIA landscape evolution modelling using the site-specific input parameters derived from the flume assessment, as well as results using a second set of generic Hunter Valley parameters.

2 METHODS

2.1 Material preparation

Material was collected from a shaped and topsoiled area in the south-east corner of the site (Figure 1). The site had been dozer ripped, and the resultant surface material was a mix of waste rock and topsoil. The site and material selected was deemed to be representative of existing rehabilitation in the south-east corner of the Mount Pleasant Operation Eastern Out-of-Pit Emplacement.

10 x 20 litre containers were collected and transported to the University of Newcastle soils laboratory.

The material was removed from the containers and mixed on the laboratory floor with a sample then randomly selected for analysis.

2.2 Basic material analysis

Basic material analysis was conducted – Electrical Conductivity, pH, % sand, silt and clay by hydrometer, sieve analysis (<2mm and >2mm size fraction) and bulk density (Tables 1 and 2).

Infiltration rate was calculated from quantifying the groundwater leaving the flume (see below).

2.3 Flume design and operation

The flume and its operation follows that of Hancock and Wells (2020).

The flume was constructed of a box 3m long, 0.3m wide and 0.4m deep. In the base a galvanised mesh frame was placed 0.05m above the base which was covered in geotextile material. 50mm of river sand was placed on top of this base which was then covered in geotextile material. This provided a free-flowing porous base which did not impede the infiltration of soil water and through which any infiltration (soil water) could exit. At the base of the box at the lower end a 20mm diameter pipe allowed any infiltration to exit. Flume dimensions are a compromise between the space required, volume of material to fill the flume, time to place and remove the material.

A header tank at the top of the box supplied runoff across the width of the flume (0.2m) at a constant rate. Runoff was based on 1:2 year storm IFD (Intensity Frequency Duration) data for the site obtained from the Bureau of Meteorology (www.bom.gov.au).

Figure 1. Material being collected from the south-east corner by Mount Pleasant Operation staff.

The design of the flume was such that a specified discharge could be applied at the top of the slope and all water and sediment could be measured including infiltration (collected) at the outlet. Water was also free to infiltrate through the material and be collected and quantified.

The flume was mounted in a steel frame. Slope of the flume was able to be adjusted to any angle between 0 and 35%.

Water to the flume was provided by a header tank which provided an even distribution of water across the full width. Flow was adjusted by a valve which allowed discharge to be regulated from 0 to 20 l/min. Flow was quantified (checked) twice. Once by checking the flow entering the header tank (pre-test) and also by measuring what exited the flume both by surface water and infiltration volume at the outlet. Infiltration was measured by collecting the water exiting the base of the flume. This measurement regime allowed a full water balance assessment. For all runs potable water was used.

The apparatus and method follows that of Hancock and Wells (2000).

Here, the flume runs were set at 5%, 15% and 25% slope.

2.4 Material placement

Upon arrival the material was soil-like with few large rocks/peds. The material was mixed and passed through a 32mm sieve to remove any large material.

The material was packed in the flume in a series of layers, wet, and gently compacted and smoothed with a flat plate with particular emphasis along the edges so that there were no preferential flow paths or unevenness.

The material was placed in the flume to a maximum depth of 150mm.

Once the maximum depth had been reached the surface was smoothed with a straight edge to provide a uniform surface (Figure 2).

The material was allowed to sit for approximately 3 months before the start of the run. Vegetation had established during this period (Figure 3).

Figure 2. Emplaced material in the flume with germinating vegetation January 2020.
.

Figure 3. Mt Pleasant material at the start of the 25% slope run.

2.5 Flume operation

Each run was commenced with a low flow (low intensity, long duration storm) so to allow the material to slowly wet up and runoff to commence. This was continued until a constant runoff and infiltration discharge occurred. Water flows were increased to represent different rainfall/runoff rates. An adjustment period of approximately 5 minutes for each new flow allowed runoff and infiltration to equilibrate for the new input flow.

Water and sediment samples were collected with both time of sample collected and the number of seconds to fill the container recorded. Surface flow and infiltration exiting the flume were independently measured for each flow rate.

Each water/sediment sample was captured in pre-weighed containers which were then weighed when full (~2000ml in volume). These samples were then placed in an oven at 70 degrees Celcius to drive off all water (for approximately 7 days) with the bottles containing the dried sediment then reweighed. Using the gravimetric method allowed both volume of runoff and mass of sediment to be calculated. This data was then used to determine SIBERIA model parameters (Hancock and Wells, 2020).

3 RESULTS

3.1 Description

Soil like material, with a some rock (soft siltsone/mudstone) with sandy/silt loam texture (by hand). Small rocks present. Red/brown colour.

3.2 Material general characteristics

Table 1. Mount Pleasant Operation site-specific material properties

EC (µS)	1027μS cm^{-1}
pH	7.5
Moisture (%)	4%
Particle size and texture	
<2mm (%)	58
>2mm (%)	42
%Sand*	43
%Silt*	29
%Clay*	28
Infiltration**	<5mm/hr
Material classification	Silty loam
K (RUSLE)	0.055

*<2mm material
**calculated from infiltration flow rates from base of flume

Table 2. Mount Pleasant Operation site-specific material particle size distribution

Size (mm)	percent by mass	cumulative percent by mass
>31	28	100
>16	8	72
>8	8	64
>5	11	55
>4	2	44
>2	9	43
<2mm	34	34

3.2 Erosion results and process

Erosion process - Sheetwash and rilling (Figures 3 and 4).

A low erosion risk material. There is potential for gully formation with concentration flow.

No infiltration exited the flume (nil infiltration).

Material suitable for a wide range of slopes.

Observation suggests fluvial erosion parameters of m_1~1 and n_1~1 – 1.5 (Kirkby, 1971; Willgoose, 2018).

Figure 4. Mt Pleasant material at the completion of the 25% slope run.

4 MODEL PARAMETERS

4.1 Parameter determination

The SIBERIA fluvial sediment transport equation is (q_{sf}):

$$q_{sf} = \beta_1 Q^{m_1} S^{n_1} \quad (1)$$

where Q represents the discharge per unit width (m^3/s/m width), S is the slope in the steepest downslope direction (m/m) while n_1, β_1 (soil erodibility) and m_1 are calibrated parameters which in combination will represent sheetwash, rilling or gullying.

The SIBERIA parameter determination was a multiple regression for the β_1, m_1 and n_1 for runoff, sediment load and each slope until the parameter combination was optimised (Figure 6).

4.2 SIBERIA parameters

The best fit parameters are listed in Table 3.

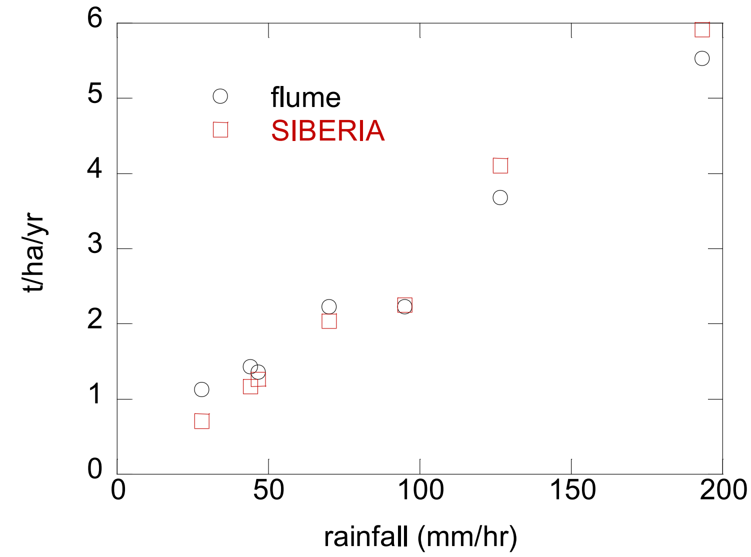
The values of m_1 and n_1 match the observation of erosion by sheetwash and rilling providing confidence in these results (Kirkby, 1971).

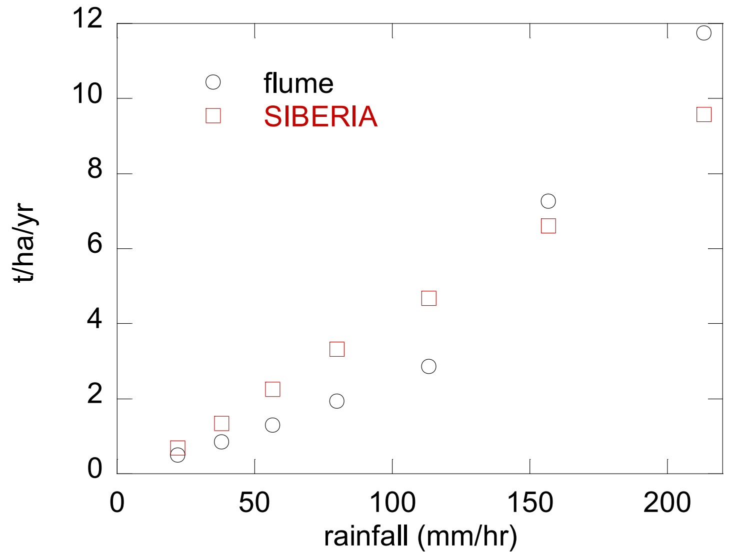
However, these results are representative of the selected site and will produce low erosion rates and are an optimised outcome for the site. The waste rock and topsoils used across the site are likely to be more erodible than that tested here. At the time of sampling there were no other soils available from which model parameters could be determined. To assess how the proposed landscape would perform with different, albeit higher erosion potential a 2nd set of generic Hunter Valley mine parameters previously found to be applicable for the Hunter Valley was also employed (Sheridan et al., 2000; Hancock et al., 2007).

These generic parameters produce a higher rate of erosion than those generated by the flume assessment and are therefore more conservative. The generic parameters are also used in the SIBERIA simulations.

Table 3. SIBERIA parameters

Parameters	β_1	m_1	n_1	β_3	m_3
Site-specific	0.001	1.045	1.50	1	1
Generic Hunter Valley	0.0003	1.5	2.0	1	1





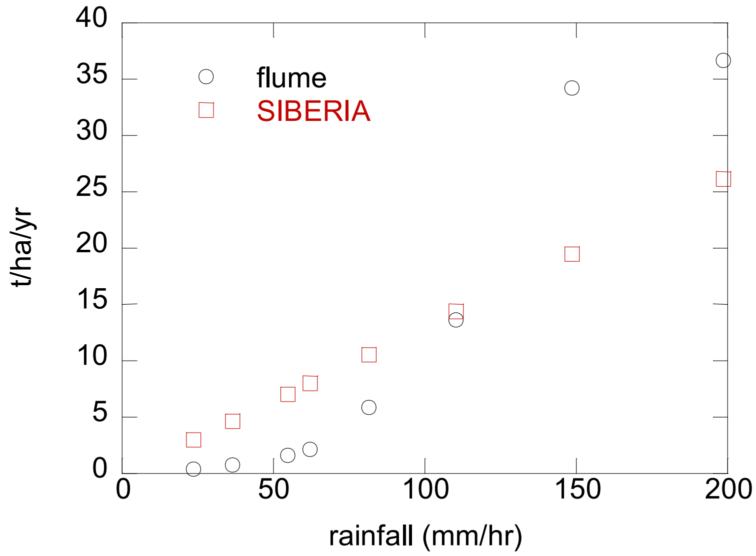


Figure 6. Flume sediment output and SIBERIA predicted sediment output from 5 (top), 15 (middle) and 25% slope (bottom).

4.2 SIBERIA modelling results

Three representative areas of the Project final landform were modelled using SIBERIA:

- South East Corner: Representative of the steeper slopes and drainages on the eastern face of the out of pit emplacement.
- Northern Side Slopes: Similar to the South East Corner, but slightly flatter and more typical of the other side slope areas (e.g. those the northern face of the out-of-pit emplacement and the final void lowwall).
- Upper Surface: Representative of flatter areas of the waste emplacement.

SIBERIA modelling was completed using both sets of parameters (i.e. to test a scenario where the site-specific parameters were unable to be achieved across the entire final landform).

The outcomes of the modelling are shown on Figures 7 to 9.

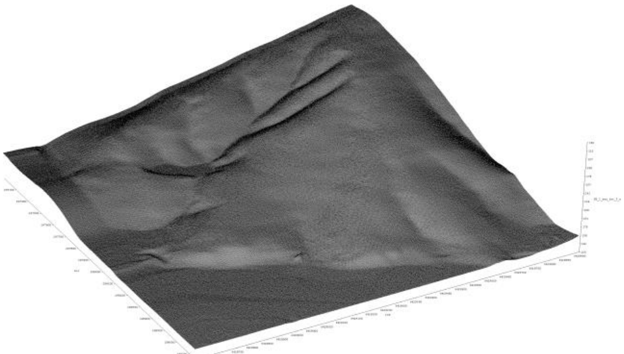
The modelled erosion rates over time, using the generic Hunter Valley parameters, are shown in Figure 10. Modelled erosion rates for the site-specific parameters are lower, but follow a similar trend (i.e. reduce sharply in the initial years and then asymptote with time).

SIBERIA modelling completed with the reference site data indicates the greatest erosional risk is in the first few years, before stabilising at a long-term erosion rate of approximately 3 to 4 tonnes per hectare per year (t/ha/year). Application of the site-specific parameters results in long-term erosion rates of the following:

- South East Corner: 2.7 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr at 500 years post-mining.
- Northern Side Slopes: 2.8 t/ha/yr at 100 years post-mining, reducing to 1.6 t/ha/yr by 500 years post-mining.
- Upper Surface: 2.2 t/ha/yr at 100 years post-mining, reducing to 1.3 t/ha/yr by 500 years post-mining.

The predicted long-term erosion rates are similar to erosion rates predicted for a natural hillslope in the local area (2.1 t/ha/year) (Hancock and Wells, 2020).

Generic Parameters

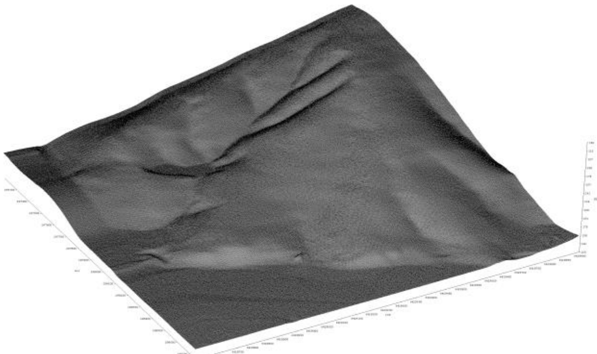


Year 0 (staring landscape).

100 years post-mining.
Max erosion depth = 1.6m
Erosion rate = 9.5 t/ha/yr

500 years post-mining.
Max erosion depth = 3.31m
Erosion rate = 4.4 t/ha/yr

Site Specific Parameters



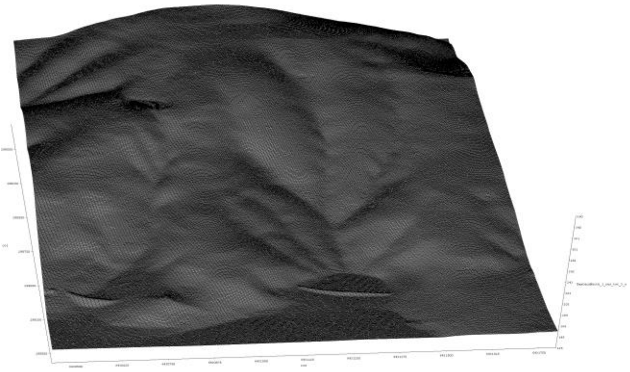
Year 0 (staring landscape).

100 years post-mining.
Max erosion depth = 1.33m
Erosion rate = 2.7 t/ha/yr

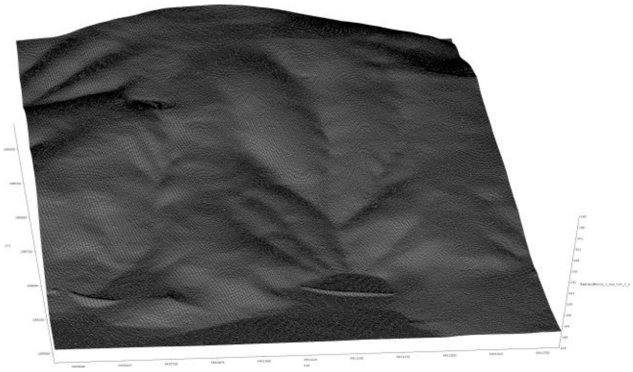
500 years post-mining.
Max erosion depth = 2.85m
Erosion rate = 1.6 t/ha/yr

Figure 7. SIBERIA outputs for South East Corner.

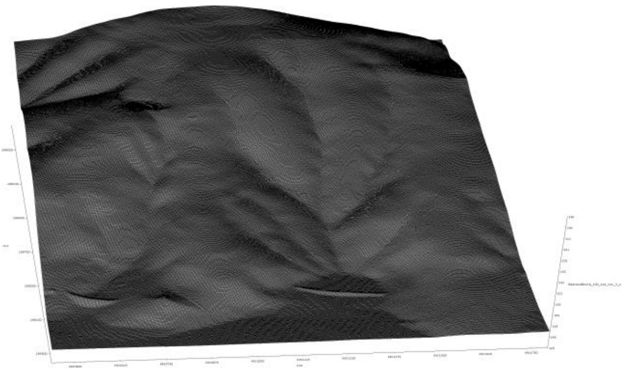
Generic Parameters | **Site Specific Parameters**



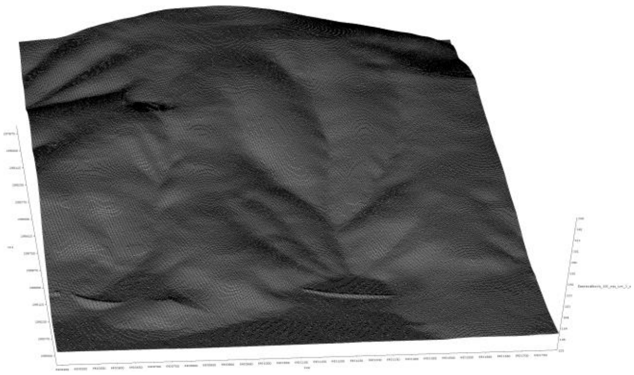
Year 0 (staring landscape).



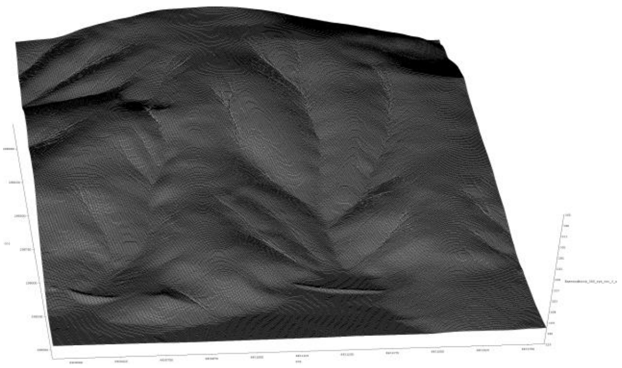
Year 0 (staring landscape).



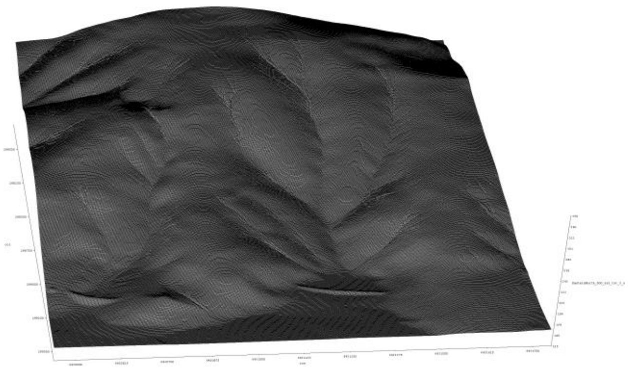
100 years post-mining.
Max erosion depth = 1.63m
Erosion rate = 7.2 t/ha/yr



100 years post-mining.
Max erosion depth = 0.88m
Erosion rate = 2.8 t/ha/yr



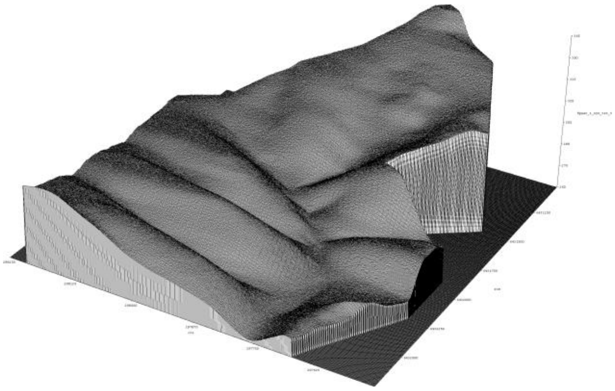
500 years post-mining.
Max erosion depth = 3.5m
Erosion rate = 3.5 t/ha/yr



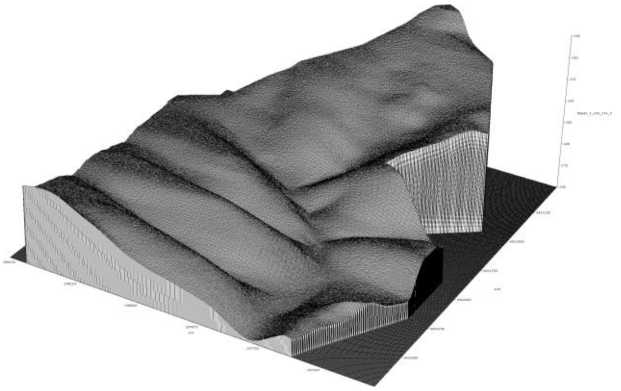
500 years post-mining.
Max erosion depth = 1.88m
Erosion rate = 1.6 t/ha/yr

Figure 8. SIBERIA outputs for Northern Side Slopes.

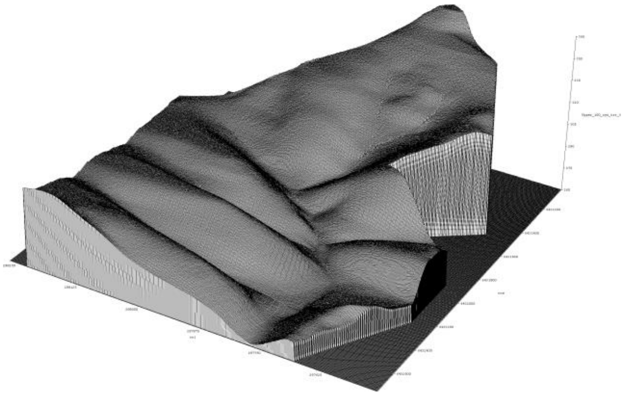
Generic Parameters | **Site Specific Parameters**



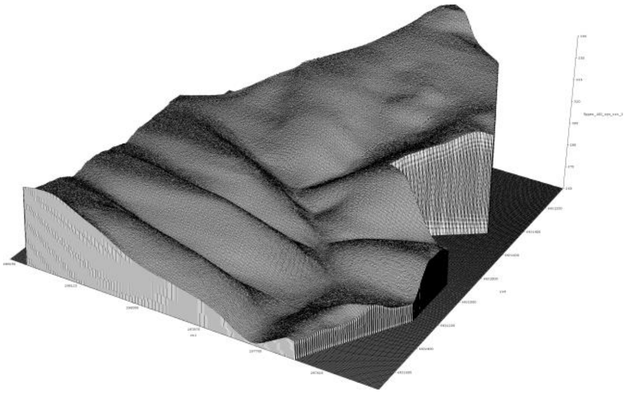
Year 0 (staring landscape).



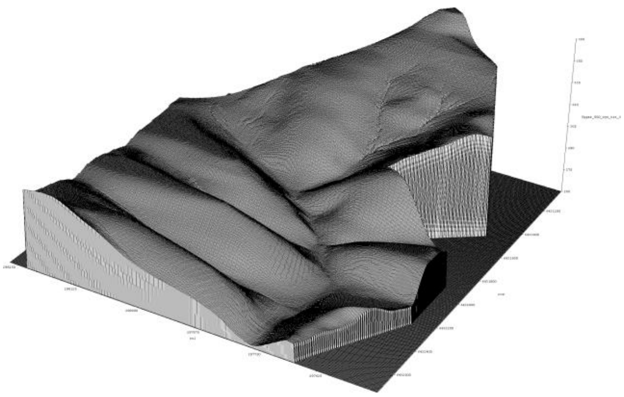
Year 0 (staring landscape).



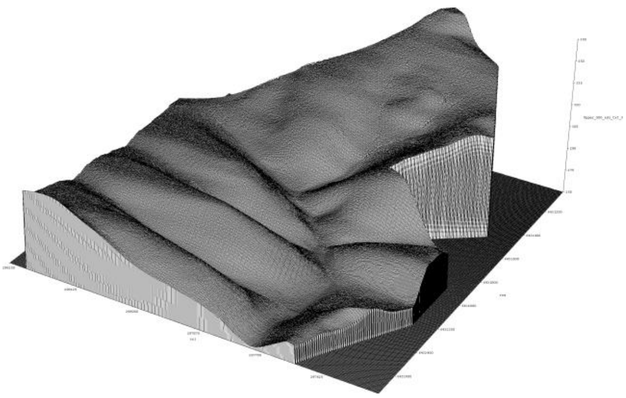
100 years post-mining.
Max erosion depth = 2.85m
Erosion rate = 6.3 t/ha/yr



100 years post-mining.
Max erosion depth = 2.3m
Erosion rate = 2.2 t/ha/yr

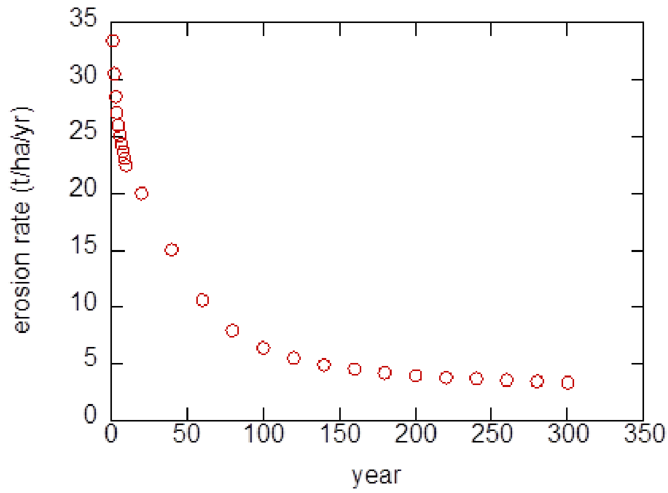


500 years post-mining.
Max erosion depth = 5.0m
Erosion rate = 3.0 t/ha/yr

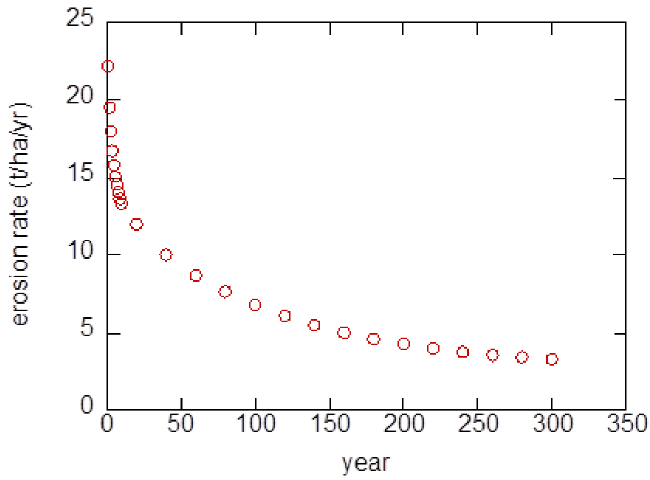


500 years post-mining.
Max erosion depth = 4.1m
Erosion rate = 1.3 t/ha/yr

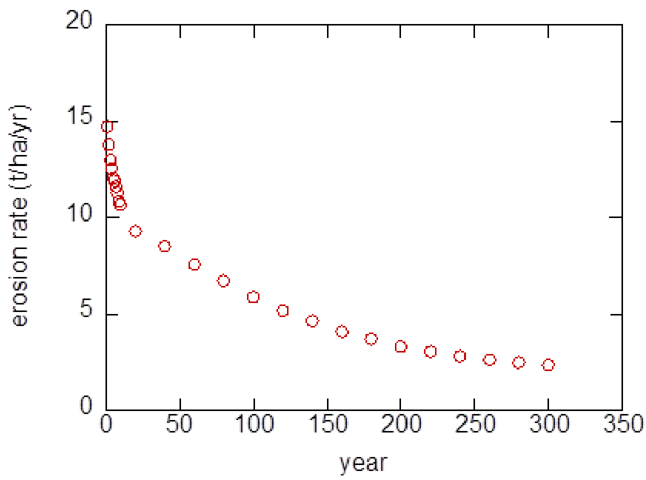
Figure 9. SIBERIA outputs for Upper Surface.



South East Corner



Northern Side Slopes



Upper Surface

Figure 10. SIBERIA Modelled erosion rates – Generic Hunter Valley Parameters.

5 STUDY LIMITATIONS

1. All materials were supplied by the Mount Pleasant Operation upon guidance of being representative of existing rehabilitation and there can be no guarantee that they are representative of the entire final landform.
2. The erosion parameters obtained represent materials with a vegetation cover developed over an approximate 3 month period with limited environmental exposure. Parameters could change if exposed for longer periods.
3. The compaction and surface roughness of the materials in the flume may be different to that of the mine site. Erosion parameters may differ under mine site conditions.
4. The flume was run at a range of slopes which represent the proposed final landform slopes. How the material performs at alternate slopes is unknown.

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ATTACHMENT 3

MOUNT PLEASANT OPTIMISATION PROJECT – NO FINAL VOID GROUNDWATER REVIEW

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20 November
2020

MACH Energy Australia Pty Ltd
PO Box 2115
Dangar, NSW, 2309

Attention: Chris Lauritzen
via email: Chris.Lauritzen@machenergy.com.au

Dear Chris,

RE: Mount Pleasant Optimisation Project No Final Void Groundwater Review

1 Background

To support the evaluation of alternative final landform options for the Mount Pleasant Optimisation Project (the Project), MACH has requested that AGE Consultants undertake additional groundwater modelling to simulate an option to backfill the proposed final void so it would be free-draining.

Muswellbrook Shire Council's input to the Secretary's Environmental Assessment Requirements for the Project (dated 4 February 2020) requires that the Environmental Impact Statement (EIS) for the Project consider a design/mining sequence that would result in no final voids. This has potential implications for the way the groundwater system recovers, and to what level it may recover.

AGE has used the numerical groundwater model developed for the Project to assess these implications, comparing the proposed final landform (containing a void) to an alternate landform that has the void backfilled to be free-draining.

A full description of the development and calibration of the numerical groundwater model is provided in *Mount Pleasant Optimisation Project - Groundwater Assessment* (AGE, 2020). The following changes were made to the groundwater model to evaluate the no-void scenario:

- The hydraulic properties in the modelled void were updated to reflect the emplacement of spoil.
- The boundary condition representing the final void recovered void waterbody was removed.
- The area to which 'spoil rate' recharge is applied was increased to cover the full mined pit.
- Particle tracking was undertaken and pathlines were generated for the two alternative post mining landforms (i.e. Project and no-void) utilising the recovered equilibrium water levels.

- It was assumed that the neighbouring mines of Dartbrook and Bengalla remained as they were simulated for the Mount Pleasant Optimisation Project – that is, a void maintained for Bengalla and continuing care and maintenance for Dartbrook.

2 Predicted Drawdown in Edderton Seam (model layer 18)

Following 1000 years of post-mining recovery, the simulated drawdowns in the Edderton seam (model layer 18) differed considerably between the two final landform options. With the void in place, a void waterbody level of 90 mAHD was maintained in the void through the balance of groundwater inflow and recharge to the pit area against the 'extraction' through evaporation from the pit lake surface. The final void would remain a groundwater sink in perpetuity, resulting in a residual drawdown continuing as shown on Figure 1a.

When the void was backfilled with spoil, the hydraulic sink provided by the void water level was removed and the simulated water table recovered to a maximum of 180 mAHD, which exceeds pre-mining groundwater levels. This is because of the presence of spoil which has higher rates of infiltration and recharge over a significantly larger area, relative to the pre-mining recharge rates of the *in-situ* strata or the Project final landform. This mounding results in the water table rising to the backfilled land surface along the eastern extent of the disturbed area. The extent of mounding under this scenario is shown in Figure 1b. The mounding would result in groundwater gradients that indicate increased potential for groundwater to migrate from the site and this is explored in the next section.

3 Predicted particle pathlines post mining

The particle tracing software MODPATH was used to evaluate potential directions of groundwater flow for the two scenarios. 82 particles were placed in model layer 1 around the MPO mine pit and TSF, then traced from 500-1000 years post-mining (Figure 2). This period was chosen as water levels reach equilibrium within 500 years for both final landform options. The particles simulated the movement of recharging groundwaters following recovery to the post-mining condition.

With the void in place, most of the particles flowed toward the void (Figure 2a). Particles placed around the TSF to the west of the MPO pit also travelled toward the void at Bengalla, while several particles placed to the north of the MPO pit reported to the Dartbrook underground workings.

When the void was backfilled to be free-draining, none of the particles released terminated within the backfilled landform. The particles placed to the south west of the MPO pit were intercepted by Bengalla and Dartbrook rather than MPO (Figure 2b). The particles placed to the north and east of MPO travelled toward the Hunter River alluvium. Several particles placed to the north west of MPO initially travelled toward MPO, before reversing as the mounded groundwater induced flow away from the backfilled pit. These particle paths show that groundwater within the pit shell would most likely migrate away from the MPO site, if the void is backfilled.

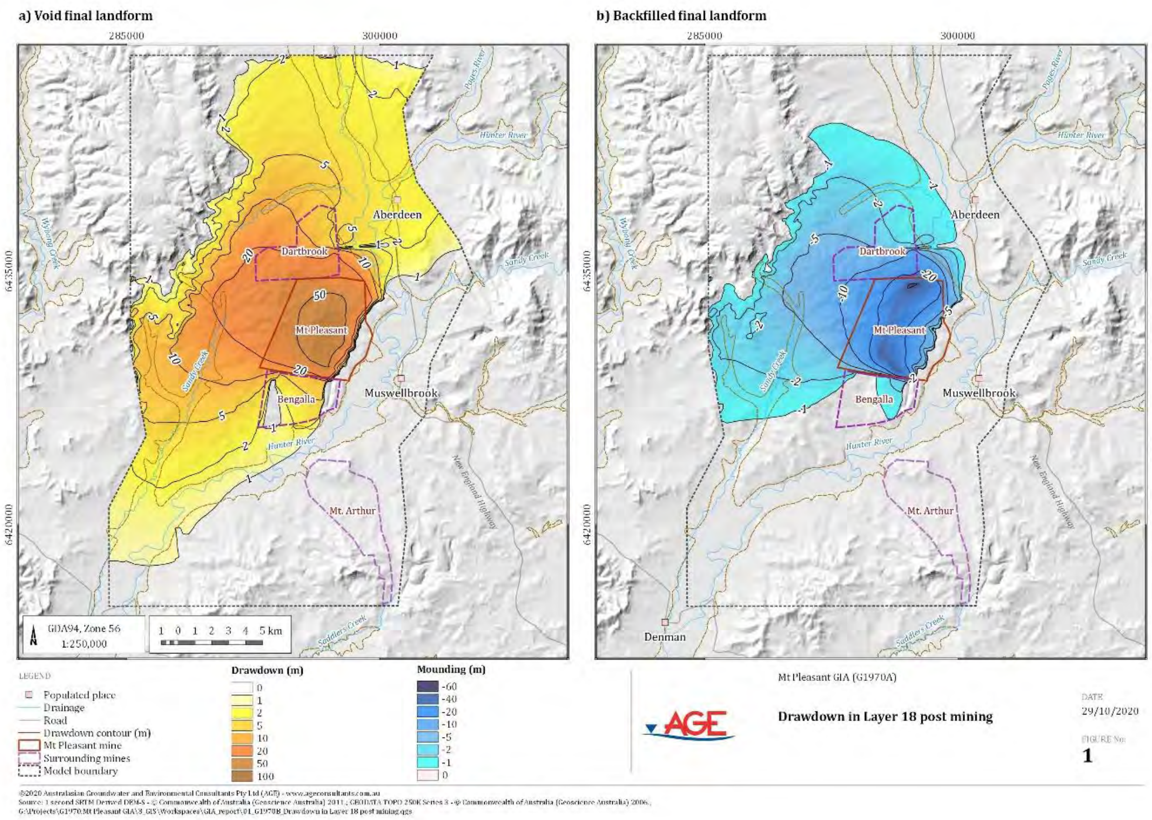

Figure 1 Drawdown in Layer 18 post mining

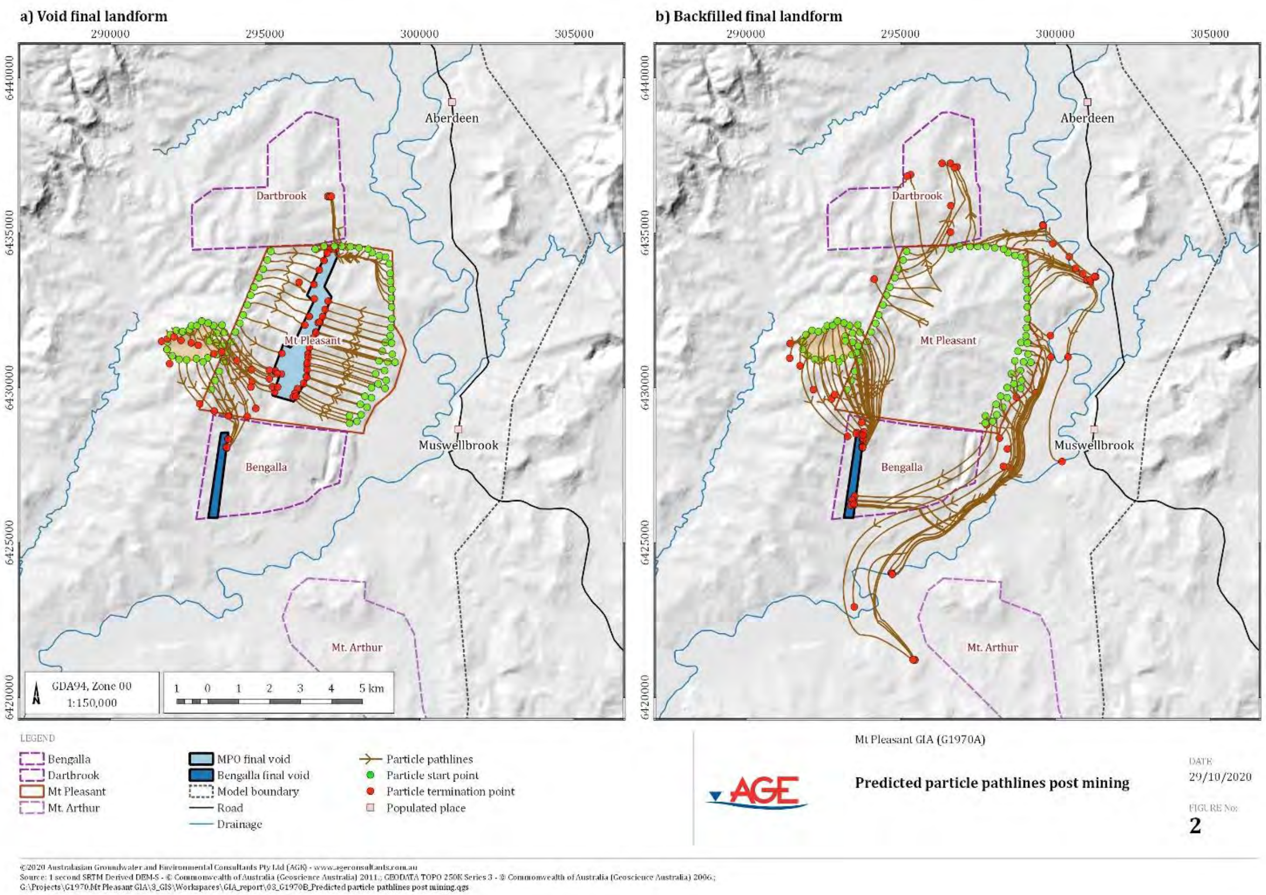

Figure 2 Predicted particle pathlines post mining

4 Concluding remarks

The calibrated numerical groundwater model for Mount Pleasant Optimisation Project was used to explore two final landform options. The landform options varied by the inclusion or not of a final void.

When a void is included in the final landform, a pit lake forms and the void acts as a groundwater sink.

If the void were to be backfilled, the increased recharge associated with the spoil is expected to result in a groundwater mound forming in the backfilled spoil material and groundwater within the pit shell would most likely migrate away from the MPO site.

If you have any queries, please do not hesitate to call.

Yours faithfully,

Andrew Durick
Director and Principal Groundwater Modeller
Australasian Groundwater and Environmental Consultants Pty Ltd