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Project Amendment Report

Prepared for Tahmoor Coal Pty Ltd

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Amendment Report

Tahmoor South Project

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Glossary of Terms

Term	Definition
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, song lines, and places) cultural practices and traditions associated with past and present-day Aboriginal communities.
Project Amendment Report	This Project Amendment Report has been prepared to document changes made to the proposed development in response to submissions from Government agencies and the community.
Archaeological site	A site with material evidence of past Aboriginal or non-Aboriginal activity in which evidence of past activity is preserved.
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.
Assessment Background Level	The Assessment Background Level (ABL), as defined by the NSW Industrial Noise Policy 2000, is a measure of the background level for noise, representing discrete assessment periods (i.e. day, evening or night) for each day. It is determined by calculating the 10th percentile (lowest 10%) background noise level over a 90-minute period (LA90).
Background noise level	The NSW Industrial Noise Policy 2000 defines the background noise level as the ambient sound-pressure noise level in the absence of the sound under investigation exceeded for 90% of the measurement period. Normally equated to the average minimum A-weighted sound pressure level.
Catchment	The area from which a surface watercourse or a groundwater system derives its water.
Clearing	The removal of vegetation or other obstacles at or above ground level.
Critically Endangered Ecological Community (EEC)	An ecological community identified by the Biodiversity Conservation Act 2016 that is facing an extremely high risk of extinction in Australia in the immediate future, as determined in accordance with criteria prescribed by the regulations made under the Act.
Discharge	A release of water from a source.
ecologically sustainable development	As defined in the *Protection of the Environment Administration Act 1991*, requires the effective integration of economic and environmental considerations in decision making processes including: • The precautionary principle; • Inter-generational equity; • Conservation of biological diversity and ecological integrity; and • Improved valuation, pricing and incentive mechanisms (includes polluter pays, full life cycle costs, cost effective pursuit of environmental goals).
Ecology	The study of the relationship between living things and the environment.
Ecosystem	As defined in the *Environment Protection and Biodiversity Conservation Act 1999*, an ecosystem is a 'dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.'
Emission	The discharge of a substance into the environment.

Term	Definition
Endangered Ecological Community (EEC)	An ecological community identified by the *Biodiversity Conservation Act 2016* that is facing a very high risk of extinction in New South Wales in the near future, as determined in accordance with criteria prescribed by the regulations under the Act and is not eligible to be listed as a critically endangered ecological community.
Environment	As defined within the *Environmental Planning and Assessment Act, 1979*, all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings.
Extraction Plan (EP)	An Extraction Plan governs the management of subsidence impacts to natural and built features from longwall mining by: • Providing an overview of the planned coal resource recovery methods; • Identifying and characterisation of the natural and built features within the Extraction Plan Area; • Identifying the predicted subsidence impacts and/or environmental consequences within the Extraction Plan Area associated with the planned coal recovery; • Identifying, and implementing as appropriate, a monitoring and management regime to control the identified subsidence risks; and • Implementing a review and auditing process to provide feedback. Extraction Plans replace the function of Subsidence Management Plans. On 1 July 2014 a consolidated Extraction Plan (EP) Process replaced the NSW Division of Resources and Geosciences' former Subsidence Management Plan process. Under the Extraction Plan, mine subsidence would be jointly regulated by the NSW Resource Regulator (responsible for compliance and enforcement of the EP) and Planning Services Division of the Department of Planning Industry & Environment (DPIE) (responsible for compliance and enforcement of the EP as it relates to the Development Consent).
Goaf	The goaf is the part of a longwall mine from which the coal has been removed. After longwall mining is complete, typically, the roof collapses filling the void.
Greenhouse gases	Gases with the potential to contribute to the greenhouse effect which in turn is one of the principal drivers for climate change (e.g. methane, carbon dioxide and others listed in the *National Greenhouse and Energy Reporting Act 2007*).
Habitat	The place where a species, population or ecological community lives (whether permanently, periodically or occasionally).
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Longwall	A system of coal mining, where the coal seam is extracted from on a broad front or long face.
Mine roof	The layer that lies over the coal seam.
Overburden	The geological units and material above the coal seam proposed or being mined.
Panel	The mining unit that has previously been extracted or is currently being extracted.
Revegetation	Direct seeding or planting (generally with native species) within an area in order to re-establish vegetation that was previously removed from that area.

Term	Definition
Run of Mine (ROM)	Raw coal production that contains coal and rock.
Seam	Layer or bed of coal.
Sensitive receiver	A location where a person works or resides, including residential, hospitals, hotels, shopping centres, playgrounds, recreational centres or similar.
Stockpile	Stored materials such as product coal, soil, sand, gravel and spoil/waste.
Strain	The change in horizontal distance between two points at the surface after mining, divided by the pre-mining distance between the points and usually expressed in mm/m.
Subsidence	The vertical lowering, sinking or collapse of the ground surface.
Surface Facilities Area	The surface components of the mine containing infrastructure related to mining operations.
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
Vulnerable	As defined under the *Biodiversity Conservation Act 2016*, a species that is facing a high risk of extinction in New South Wales in the medium-term future.
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere.
Watercourse	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).

Executive Summary

Introduction

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW) and within the Wollondilly Local Government Area (LGA). Tahmoor Coal is seeking approval for the Tahmoor South Project, being an extension of underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing Surface Facilities Area (the Project).

Coal extraction of up to 4 million tonnes of Run of Mine (ROM) coal per annum is proposed with up to 43 million tonnes of ROM coal proposed over the life of the Project. Longwall mining would be used to extract from the Bulli seam within the bounds of Consolidated Coal Lease 716 (CCL716) and Consolidated Coal Lease 747 (CCL747). This technique for coal extraction has been used by Tahmoor Mine for over 30 years.

Once the coal has been extracted and brought to the surface, it would be processed at Tahmoor Mine's existing CHPP and coal clearance facilities, before being transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla, and from time to time, Newcastle for Australian and international markets. Up to 0.2 million tonnes per annum of either product coal or reject material is proposed to be transported to customers via road.

The Project seeks to extend the life of underground mining at the Tahmoor Mine until approximately 2035. The Project would enable mining to be undertaken within the southern portion of Tahmoor Coal's (and its wholly owned subsidiary Bargo Collieries Pty Ltd) existing mining lease areas, and operations and will continue the employment of close to 400 people for approximately a further 13 years.

An Environmental Impact Statement (EIS) has been prepared for the Project. The EIS was placed on public exhibition from 23 January 2019 to 5 March 2019, to allow Government agencies, local councils, organisations and community members the opportunity to comment on the Project and the findings of the EIS by lodging a submission with the Department of Planning, Industry and Environment.

Tahmoor Coal understands that there will be community concerns, and as a part of the community, it takes its role to inform, support and rectify issues that are raised seriously. Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, the associated subsidence impacts, greenhouse gas emissions and the extent of vegetation clearing required for the extension of the rejects emplacement area (REA). In response to these and other issues raised in submissions, Tahmoor Coal made the decision to revise the Project in order to reduce impacts of the Project while protecting the commercial viability of the Project and economic benefit to the state.

Purpose of this Project Amendment Report

This Project Amendment Report (Report) has been prepared to document changes made to the Project in response to submissions, as well as to report on the environmental impacts of the Amended Project. The key findings and recommendations of this Report are supported by technical reports prepared by specialists in a range of areas.

Technical reports have been prepared for those environmental issues likely to be affected by the amendments to the Project and are provided in **Appendices A** to **Q**. Issues for which the Project amendments would not result in a change in impacts, compared to those reported in the EIS are addressed in the relevant sections and appendices of the EIS. These environmental reports remain unchanged within the Project Amendment Report and where relevant are referred to throughout this report.

Project Amendments

A summary of the Project amendments is provided in **Table 1**. A summary of the resultant changes in impacts is provided in **Table 2**.

By amending the Project, Tahmoor Coal has sought to address and resolve matters raised in submissions in order to reduce the overall impacts of the Project. The Amended Project would result in direct and indirect economic benefits to the local community and has been considered in accordance with the principles of Ecologically Sustainable Development (ESD). The site is suitable for the development and the Project would enable the extraction of a high-quality coking resource using existing infrastructure, at a site where coal mining has been undertaken for over 40 years. Further, the Project has received broad support from the community, with around 88% of community submissions in support of the Project.

Table 1 Summary of project amendments

Element	Original Project	Amended Project
Mine plan	• Establish 9 longwalls to the south of Tahmoor Mine, within the Central Domain. Dimensions of the longwalls include: - Approximately 305 m wide and up to 2.85 m in height - The gate roads would be approximately 5.2 m wide and at a height of up to 3 m • Extraction of up to 48 Mt ROM coal over the life expectancy of the Project.	• Removal of LW109, which was directly beneath Dog Trap Creek; • Reconfiguration of the longwall layout to comprise two series of shorter longwall panels (refer **Figure 2-1**); • Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; • Reduction in the height of extraction within longwall panels from up to 2.85 m to up to 2.6 m; and • Extraction of up to 43 Mt ROM coal over the life expectancy of the project.
Rejects extension	• Expected volume of rejects to be generated is approximately 14.3 Mt; • Increased maximum height of the REA would be increased from RL 300 m to 305 m; and, • The extension area would cover 43 ha.	• The estimated volume of rejects to be generated by the Project is now 11.6 Mt; • Increased height of the REA from RL 305 m to RL 310 m to optimise the REA footprint; and • Reduction in the REA extension area to 11.06 ha.
REA Operations	• Operation of REA 24 hours a day seven days a week, consistent with the working hours of the current operations at Tahmoor Mine.	• Operation of haulage production hours from 24 hours to occur during the daytime and evening hours (7 am to 10 pm) only; • Transport rejects via conveyer to the load out point where rejects would be stockpiled for haulage to the REA during daytime and evening hours; and • Updated operations to include an additional haul truck (for a total of two trucks) and a front-end loader to transport rejects during the day, to replace night-time haulage of rejects.
Power line easement	• Location for powerline easement for 66 kV overhead powerline from the REA to the ventilation shaft not confirmed and not included as part of the Project.	• Inclusion of a 66-kV overhead powerline easement from the pit top to the proposed ventilation shafts.
Mine Ventilation	• Partial use of the existing mine ventilation upcast shaft T2 in emergency situations only.	• Continuation of existing upcast shaft (T2), with operation reducing usage from two fans to one fan.

Table 2 Summary of impacts as a result of the amended project description

Environmental aspect	Change in impact	Change resulting from Project
Subsidence	Reduced impact	• Reduction in the maximum predicted subsidence, tilt and curvature by approximately 15%; and • Reduction of the maximum total conventional subsidence, upsidence and closure movements to waterways.
Groundwater	Similar impact	• Improved calibration performance to groundwater levels; • Groundwater related processes have been updated; and • Results remain mainly consistent with the EIS with slight increases in drawdown at some locations.
Surface Water	Similar impact	• Improvements in streamflow for Dog Trap Creek, Eliza Creek and Bargo River; • Increased groundwater inflow to the underground mine; • Increased discharge via LDP1; • Increased discharge via the LOPs to Tea Tree Hollow; • Reduced predicted peak of simulated annual release to Bargo River from dam S11 based on the 95th percentile results; and • The underground water storage is predicted to increase from 2025 and is likely to near the storage capacity by 2032.
Terrestrial Ecology	Reduced impact	• Shale Sandstone Transition Forest: reduced clearing from 43.4 ha to 23.57 ha (approximate 46% reduction); • *Persoonia bargoensis*: avoided removal of 96 individuals, leaving eight individuals that would be impacted by the Amended Project; • *Grevillea parviflora* subsp. *Parviflora*: avoided removal of 2,324 individuals, leaving 491 individuals that would be impacted by the Amended Project; and • *Pomaderris brunnea*: avoided removal of approximately 40 individuals, leaving one individual that would be impacted by the Amended Project.
Aquatic Ecology	No material change	• No material change.
Aboriginal Cultural Heritage	Minor reduction	• There are three Aboriginal cultural heritage sites (comprising stone artefacts) that are now outside of the limit of subsidence; and • An addendum to the ACHA been prepared to address the additional archaeological test excavation and assessment identified one ironbark tree with scarring within the Project area, however specialist assessment concluded the scar was relatively modern and of European origin.
Non-Aboriginal Heritage	No material change	• Reduction in subsidence movements at all identified heritage sites within the amended subsidence study area associated with the amended mine plan.
Noise and Vibration	Reduced impact	• Reduced night noise emissions during operation by 2 dB; • Reduction in the number of privately-owned dwellings affected by operational noise emissions more than 5 dB above the relevant project noise trigger level; and • Operational noise at the nearby Anglican Church and School is predicted to be reduced by at least 3 dB.
Air Quality	Minor reduction in impacts	• Reduction in odour levels when one fan is used when compared with two fans at Vent Shaft T2.

Environmental aspect	Change in impact	Change resulting from Project
Greenhouse Gases	Reduced impacts	• Reduction of CO_2-e Scope 1 emissions from 13.5 million tonnes to 12.1 million tonnes; • Reduction of CO_2-e Scope 2 emissions from 1,463,663 tonnes to 1,298,586 tonnes; and • Reduction of CO_2-e Scope 3 emissions from 104,552,998 tonnes to 88,259,920 tonnes
Economic	Increased net benefits	• Increase in net benefit from $699.5 million to $783.8 million.
Visual	No material change	• The amended REA is unlikely to result in a significant visual impact.
Human Health	Increased benefit	• Reduced noise impacts on human health from reduced night-time REA operations.
Land use, Agriculture and Resources	No material change	• Rehabilitation of previously pre-REA Class 6 agricultural land to REA Class 7.
Rejects Disposal	Reduced impacts	• Reduction in extension of REA from 43 ha to 11.06 ha resulting in: - Less surface water runoff; - Reduction in required vegetation clearing; - Changes to the visual environment; and - Reduced noise impacts.
Hazards and Risks	No material change	• No material change.
Rehabilitation	Updated measures	• Updates to the environmental performance objectives including: - Rehabilitate areas that cease to be used for mining; - Revegetate cleared native vegetation; • Update rehabilitation and closure Domains 2 and 6; and • Update rehabilitation and revegetation strategy.
Social	No material change	• The overall social significance of the Project has remained unchanged and would remain consistent with those of the already operational mine.

Project Benefits

Employment and Economic Benefit

Tahmoor Coal has been a major employer in Wollondilly for over 40 years, employing approximately 400 people with around half being local residents. The Project is predicted to generate a net benefit of up to $784 million over its life; $162 million of which would flow through to the local Wollondilly region (in Net Present Value terms).

Carbon Neutral Commitment

Tahmoor Coal recognises the constructive role it can play in reducing the impact of greenhouse gas emissions on climate change as Australia transitions to renewable energy. Tahmoor Coal is a subsidiary of Liberty Steel Group, part of the GFG Alliance, which has made a global commitment to be carbon neutral across its operations by 2030, including its mining activities. This will be achieved through a combination of investment in renewable energy such as solar and pumped hydro as well as process improvements and carbon offsets.

Steel Industry

The type of coal mined at Tahmoor is predominately premium quality coking coal, which is a key ingredient in primary steelmaking. Steel is an important part of society, used in healthcare, telecommunications, transport, infrastructure, construction and agricultural equipment. Tahmoor Coal provides product coal for Australian steel production at Port Kembla and Whyalla, as well as for export.

Community

Tahmoor Coal's commitment to the community and environment is multi-faceted:

- Following feedback from the community and Government during exhibition of the EIS, Tahmoor Coal made the decision to revise the Project in order to reduce the environmental impacts while still protecting the commercial viability of the project and economic benefit to the state.
- Tahmoor Coal and its employees contribute to the local community in numerous ways, including volunteering, fundraising and donations. For example, in September 2018 when a temporary outage forced the mine to cease operations, the decision was made to deploy workers into the community to provide improvement and maintenance assistance to local projects and initiatives across the Wollondilly Shire.

Summary

The Project would allow continuation of mining and employment of around 400 people at Tahmoor Mine for a further 13 years until approximately 2035. Tahmoor Coal is committed to continuing to work constructively with all stakeholders to achieve a balanced outcome for the community, environment and business, as demonstrated by the amendments made to the Project in response to submissions.

Conclusions and Next Steps

This Project Amendment Report presents the amendments made to the Project and provides an updated environmental impact assessment of the Amended Project.

The DPIE will now assess the Amended Project in consultation with other relevant agencies, and the assessment process will include review of the EIS, the Response to Submissions Report and this Project Amendment Report. The DPIE will then prepare a draft assessment report for consideration by the Minister for Planning (Minister) or delegate.

1.0 Introduction

Tahmoor Coal owns and operates the Tahmoor Mine. Tahmoor Coal trades as Tahmoor Coking Coal Operations within the SIMEC Mining Division of the GFG Alliance Group. The Tahmoor Mine is an underground coal mine approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW) (**Figure 1-1**).

Mining at Tahmoor Mine commenced in 1979 and has continued uninterrupted to the present day. Tahmoor Coal is seeking development consent for the Tahmoor South Project (the Project), being the continuation of underground coal mining to the south of the existing Tahmoor Mine surface facilities area. The Project has been amended following public exhibition of the EIS and in response to submissions raised by Government agencies and the community. The Amended Project would continue to be accessed via the existing surface facilities at the Tahmoor Mine, located between the towns of Tahmoor and Bargo.

The Amended Project seeks to extend the life of underground mining at the Tahmoor Mine until approximately 2035. The Project would enable mining to continue within the southern portion of Tahmoor Coal's (and its wholly owned subsidiary Bargo Collieries Pty Ltd) existing mining lease areas and the employment of close to 400 people for approximately a further 13 years.

1.1 Environmental Impact Statement

In accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation), an Environmental Impact Statement (EIS) was prepared to assess the potential environmental, economic and social impacts of the Project (State Significant Development Application 8445). The EIS was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) from 23 January 2019 to 5 March 2019.

On 15 January 2019, the Minister in accordance with Section 2.9(1)(d) of the EP&A Act requested that the Independent Planning Commission (IPC):

1. *Conduct a public hearing into the carrying out of the Tahmoor South project in multiple stages.*
2. *Conduct the preliminary stages of the public hearing as soon as practicable after the public exhibition of the EIS for the Project.*
3. *Consider the following:*
    a. *EIS for the project;*
    b. *Submission of the Project;*
    c. *Any relevant expert advice; and*
    d. *Any relevant information.*
4. *Publish a report on its website, and provide a copy to the Department of Planning and Environment, within 10 weeks of the Department's Preliminary Issues Report being published on the Department's website, unless otherwise agreed with the Planning Secretary, that:*
    a. *Sets out the actions taken by the Commission in conducting the preliminary stage of the public hearing;*
    b. *Summarises the submissions made during public exhibition on the EIS and the preliminary stage of the public hearing, and any other relevant information provided to the Commission during the public hearing; and*
    c. *Identifies the key issues requiring detailed consideration by the Department in preparing its assessment report under the EP&A Act.*

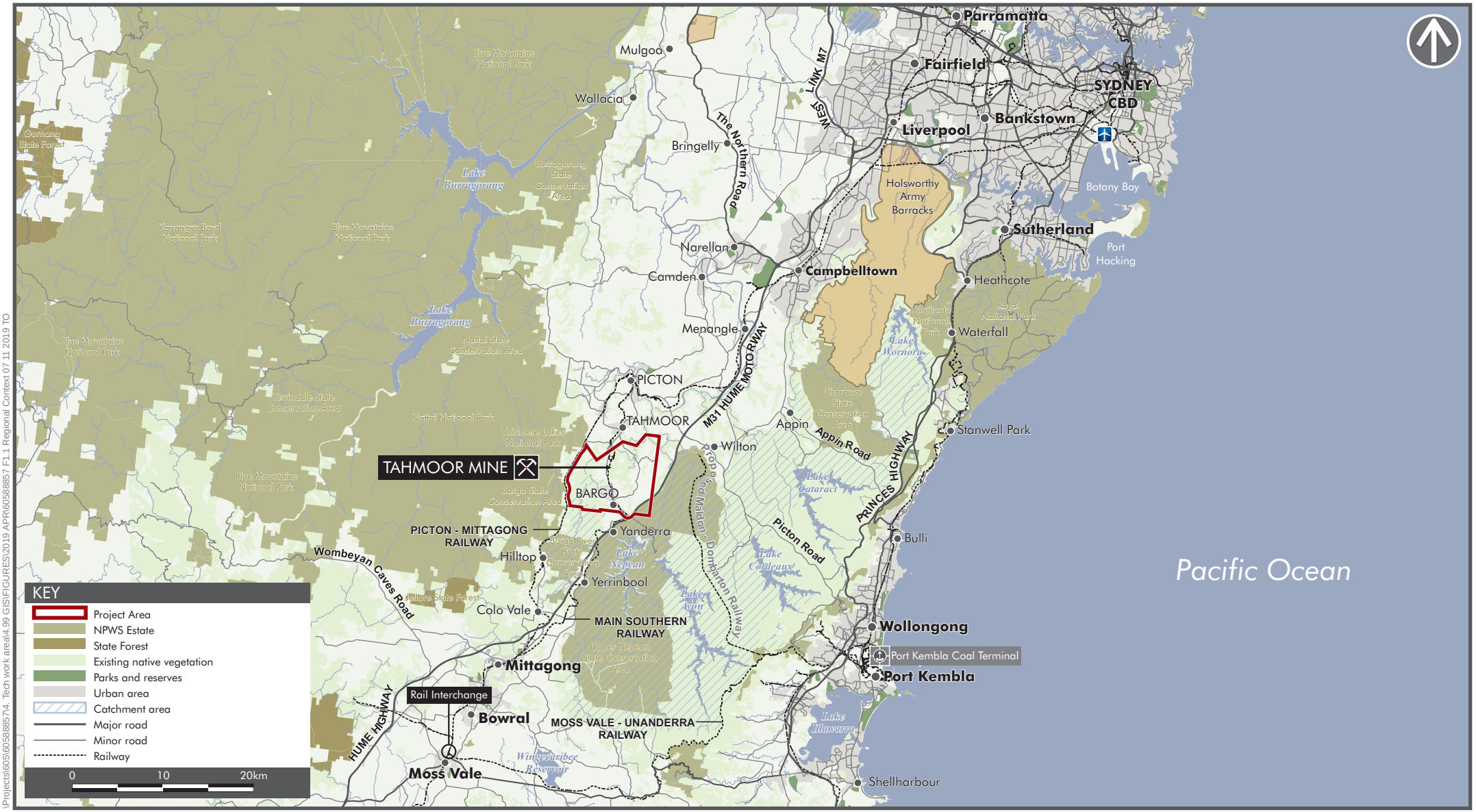
The IPC deferred the public hearing and its review of the Project in July 2019 following confirmation from Tahmoor Coal that the Project would be amended in response to Government agency and community submissions. On 9 July 2019, DPIE requested that Tahmoor Coal respond to the submissions. Tahmoor Coal has since reviewed the submissions received by DPIE, and responses to the issues raised in those submissions are provided in a separate Response to Submissions Report for the Project.

A total of 106 submissions were received in response to the EIS, as summarised in **Table 1-1**.

Each submission has been individually examined with issues collated, and responses to the issues provided in Section 5.0 and Section 6.0 of the Response to Submissions Report.

Table 1-1 Summary of submissions received

Submission group type	Number of Separate submitters*
Commonwealth Government agencies	1 – Commonwealth Independent Expert Scientific Committee
State government agencies	12 - State Government Agencies
Local councils	2 – Wollondilly Shire Council and Wingecarribee Shire Council.
Interest groups / organisations	8- Organisations (1 supporting the Project, 5 objecting and 2 making comments to the Project).
Individual public / community members	83 - Individual/community members made submissions (73 supporting the Project and 10 objecting to the Project).
Total	106



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SIMEC

REGIONAL CONTEXT

Tahmoor South Project
Project Amendment Report

FIGURE 1.1

1.2 Project Amendments

Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, and associated subsidence impacts, greenhouse gas emissions and the extent of vegetation clearing required for the future development of the reject emplacement area (REA). In response to these and other issues raised in submissions, and as a result of ongoing mine planning, several amendments have been made to further reduce the predicted environmental impacts of the Project.

The amendments to the Project, since public exhibition of the EIS, are:

- A revised mine plan (**Section 2.1**), including:
  - An amended longwall panel layout and the removal of LW109;
  - A reduction in the height of extraction within the longwall panels from up to 2.85 metres (m) to up to 2.6m;
  - A reduction in the proposed longwall width, from up to 305 m to approximately 285m;
  - A reduction in the total amount of Run-of-Mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal, comprising;
    - 30Mt of coking coal product (reduced from 35Mt); and
    - 2Mt of thermal coal product (reduced from 3.5Mt).
- A revised REA design (**Figure 2-2**) including:
  - A reduction in the additional capacity required to accommodate the Project;
  - A reduction in the REA extension footprint, from 43ha to 11.06ha; and
  - An increase in the final height of the REA (from RL 305m to RL 310m).
- REA operations - changes to the haulage of rejects to remove night haulage (between 10pm and 7am) of rejects at the REA, and to increase day-time haulage operations from one truck (current operation) to two trucks and a front-end loader (Amended Project operations).
- Power line easement - confirmation of the location and footprint of the power connection easement for ventilation shaft site TSC1 (**Figure 2-3**); and
- Mine Ventilation - revised assessment resulting in the need for continued use of the existing upcast shaft (T2); although, operation will reduce from the two fans that currently operate as part of Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

No amendments have been made to the other aspects of the Project for which approval is sought, such as the proposed annual coal extraction rate, mining method, traffic movements and employee numbers. A detailed description of the Amended Project, in its entirety, is provided in **Section 3.0**.

1.3 Purpose of this Project Amendment Report

This Project Amendment Report has been prepared to document changes made to the Project in response to submissions as well as to report on the environmental impacts of the Amended Project. The key findings and recommendations of this report are supported by a suite of technical reports prepared by specialists.

Technical reports have been prepared for those environmental issues likely to be affected by the amendments to the Project. In circumstances where issues for which the Project amendments would not result in a change in impacts, compared to those reported in the EIS, the technical assessment included as part of the EIS provides the impact assessment for that issue.

1.4 Supporting Documentation

Documentation supporting the Project Amendment Report include:

- **Appendix A** – Reject Management Options Gap Assessment;
- **Appendix B –** Subsidence Assessment Amended Report for Longwalls 101A to 108B;
- **Appendix C** – Groundwater Impact Assessment;
- **Appendix D** – Surface Water Impact Assessment, including an updated Flooding Assessment, Baseline Assessment and Site Water Balance;
- **Appendix E** – Terrestrial Ecology / Biodiversity Impact Assessment Report;
- **Appendix F –** Aquatic Ecology Impact Assessment;
- **Appendix G** – Aboriginal Cultural Heritage Assessment;
- **Appendix H** - Historic Heritage Assessment;
- **Appendix I** – Noise and Vibration Impact Assessment;
- **Appendix J** – Air Quality Impact Assessment;
- **Appendix K** – Greenhouse Gas Assessment;
- **Appendix L** – Economic Impact Assessment;
- **Appendix M** – Visual Assessment;
- **Appendix N** – Human Health Impact Assessment;
- **Appendix O** – Agricultural Impact Statement;
- **Appendix P** – Acid and Metalliferous Drainage and Spontaneous Combustion Assessment (Geo Chemistry);
- **Appendix Q** – Rehabilitation and Mine Closure Strategy: and
- **Appendix R** – Social Impact Assessment Addendum.

Issues for which the Project amendments would not result in a change in impacts, compared to those reported in the EIS are addressed in the relevant sections and appendices of the EIS. These environmental reports remain unchanged within the Project Amendment Report and where relevant are referred to throughout this report.

2.0 Description of Amendments

The Project has been amended as a result of ongoing mine planning and in order to further reduce the predicted environmental impacts of the Project, in response to a range of issues raised in submissions made on the EIS including:

- The extent of longwall mining (mine plan) and magnitude of subsidence impacts; and
- The extent of vegetation clearing required for the extension of the reject emplacement area (REA).

Amendments to the Project are outlined in **Sections 2.1** to **2.5**, with an assessment of impacts for the Amended Project provided in **Chapter 7.0**. Key issues raised in submissions are summarised in Chapter 4 of the Response to Submissions Report.

2.1 Mine Plan

The following amendments have been made to the mine plan to reduce the extent and magnitude of anticipated surface subsidence:

- Removal of LW109, which was directly beneath Dog Trap Creek;
- Reconfiguration of the longwall layout to comprise two series of shorter longwall panels (refer **Figure 2-1**);
- Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m;
- Reduction in the height of extraction within longwall panels from up to 2.85 m to up to 2.6 m.

Notably, the revised longwall geometry (longwall width and height of extraction) now proposed as part of the Amended Project is consistent with the longwall mining undertaken in Tahmoor North.

The updated subsidence assessment undertaken for the Amended Project indicates that the revised longwall extent would reduce predicted levels of subsidence compared to those identified in the EIS. The results of the revised subsidence assessment are detailed in **Section 7.1** and **Appendix B**.

The above changes would reduce the estimated production volume of the Project from approximately:

- 48Mt to 43Mt of ROM coal;
- 35Mt to approximately 30Mt of coking coal product; and
- 3.5Mt to approximately 2Mt of thermal coal product.

The revised economic assessment undertaken for the Project (refer **Section 7.11** and **Appendix L**) demonstrates that the Amended Project would generate significant economic benefits to the local and State economy, with a net benefit of $783.8 million.

2.2 REA extension

During exhibition of the EIS, concerns regarding the proposed management of coal rejects were raised in submissions.

The EIS proposed to extend the existing REA by 43 hectares (ha), which would have required the clearing of a total of 39.7 ha of native vegetation, mainly comprising the Shale Sandstone Transition Forest (SSTF) endangered ecological community (34 ha). Government agency and community concerns related to the impacts of the proposed extension to the REA on native vegetation, and whether alternatives to extending the REA had been sufficiently explored. In response to these concerns, Tahmoor Coal has:

- Amended the Project to reduce the REA extension footprint from 43 ha to 11.06 ha, resulting in a reduced emplacement area of approximately 74% (refer **Figure 2-2**); and
- Undertaken further investigations into alternatives to surface emplacement of rejects.

Changes to the longwall extent as identified in **Section 2.1** have allowed the estimated volume of rejects to be generated by the Amended Project to be reduced from approximately 14.3Mt (Table 11-101 of the EIS) to 11.6Mt. In addition, it is proposed that the height of the REA final landform be increased by 5 m from RL 305 m to RL 310 m to further minimise the REA footprint. These combined changes have resulted in a reduction of the required extension area for the REA from 43 ha to 11.06 ha. This results in a significant reduction in required vegetation clearing and associated terrestrial ecology impacts (including required biodiversity offsets).

The increase in proposed REA height by 5 m (from 305 to 310m AHD within the EIS) has the potential to result in increased amenity impacts (visual, noise and air quality) to some receptors in the vicinity of the REA. These impacts have been assessed in revised technical assessments undertaken for the Amended Project and are discussed further in **Sections 7.8, 7.9 and 7.12**.

Consideration of alternatives to the REA

Tahmoor Coal acknowledges the concerns raised by Government agencies and the community with respect to surface emplacement of coal rejects. In response to concerns regarding the consideration of alternatives to the REA, Tahmoor Coal commissioned a Rejects Management Options Gap Analysis (Palaris, 2019) (**Appendix A**), which involved:

- Review of reject management options presented in the 2014 SKM Reject Strategy Report; and
- A gap analysis to identify technological advancements (areas of new industry knowledge gained from recent work at other coal mine sites) or areas where the 2014 SKM report could be updated.

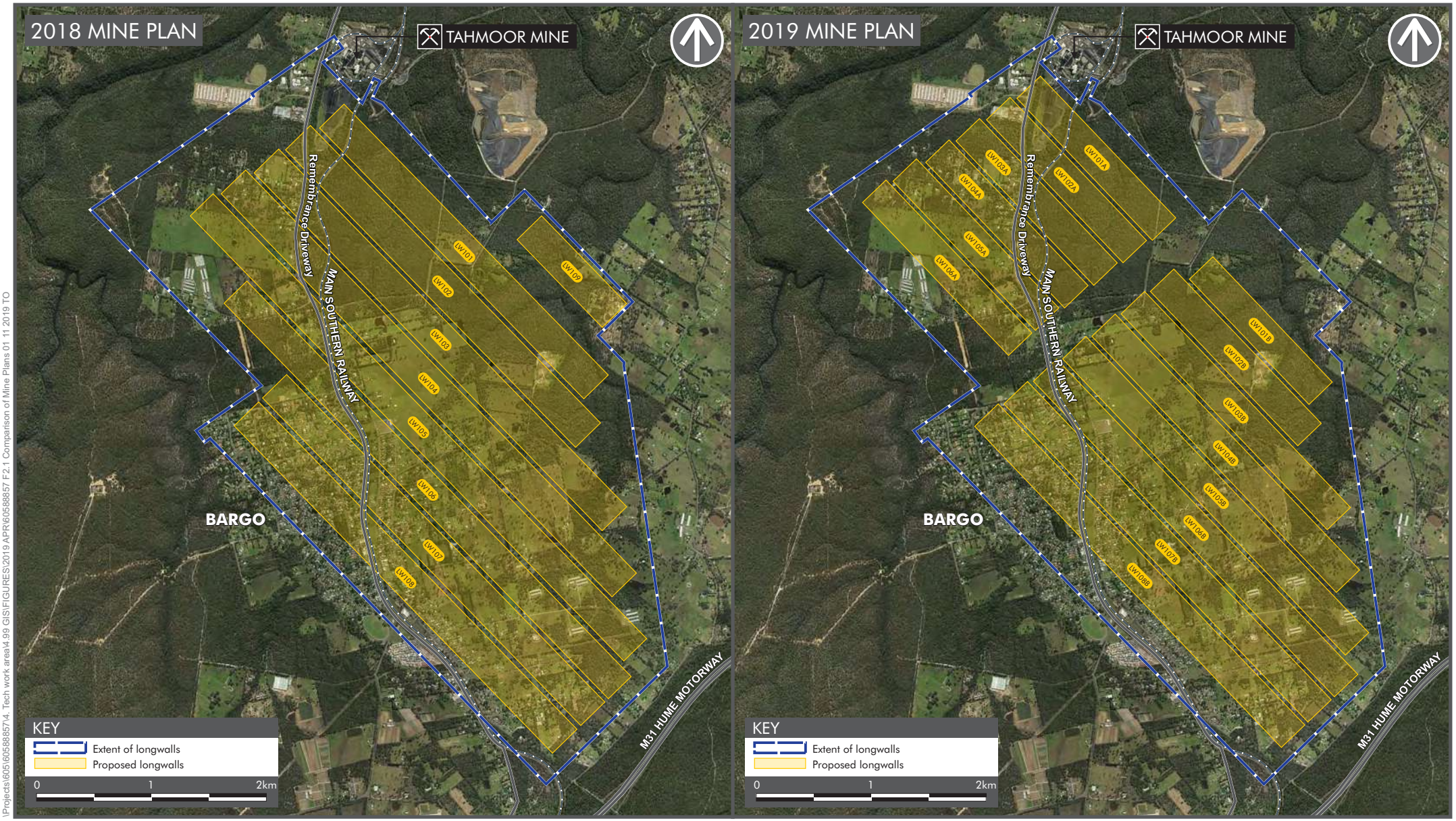
Ultimately, Palaris, determined that the conclusions of the SKM 2014 report remain valid, namely:

- There is unlikely to be enough void space to emplace the material in old workings; and re-entry to sealed parts of the existing mine was assessed to be costly, technically challenging and present an increased operational and safety risk profile; and
- It is not feasible to emplace all the reject material generated by the Project underground in the active longwall goaf, particularly at a product yield of 70-80 %, however, it may be feasible to emplace part of the material in the goaf, under certain conditions (e.g. favourable seam dip directions and goaf conditions).

The Gap Analysis prepared by Palaris (2019) concluded that the only option that could be implemented from a technical point of view in an active longwall goaf setting (requiring favourable geological dip and sufficient goaf porosity) is the underground emplacement of fines and ultrafines (around 20% of rejects) with the surface emplacement of all coarse fractions (around 80% of rejects). In Tahmoor South the Bulli seam dips regionally in a north east direction (perpendicular to longwall retreat direction) and is very flat (between 1-2 degrees) which is unfavourable in achieving effective emplacement of fines and ultrafines. In addition to the uncertainty around whether this option would be feasible for a material volume of fines and ultrafines, an estimated net cost of greater than A$34.7M (2019 dollars) makes this a financially unviable option for the Project.

The total environmental benefits of an option where some 20% of the material is emplaced underground are outweighed by the increase in capital costs of this option alone. This does not consider the additional costs associated with resource sterilisation (of the Wongawilli Seam), plant reliability, increased operational complexity and operating costs arising from underground emplacement. Underground emplacement of rejects has been determined to not be technologically or economically feasible for the Project. However, by amending the proposed mine plan and REA the extension area can be reduced by around 74% from the original EIS design.

Considering these conclusions, Tahmoor Coal has sought to reduce impacts to native vegetation by amending the Project to reduce the size of the REA to the smallest area possible (11.06 ha). Reducing the footprint would require an increase in the height of the REA, resulting in the potential for increased visual impacts (refer to **Section 7.12**). However, the benefits of preserving 31.94 ha of native vegetation are considered to outweigh the visual impacts of increasing the height of the REA. The overall design of the REA carefully considered balancing the impacts between vegetation removal and amenity. This reduction in vegetation clearing also allows Tahmoor Coal to achieve the required offset liability for the Project.



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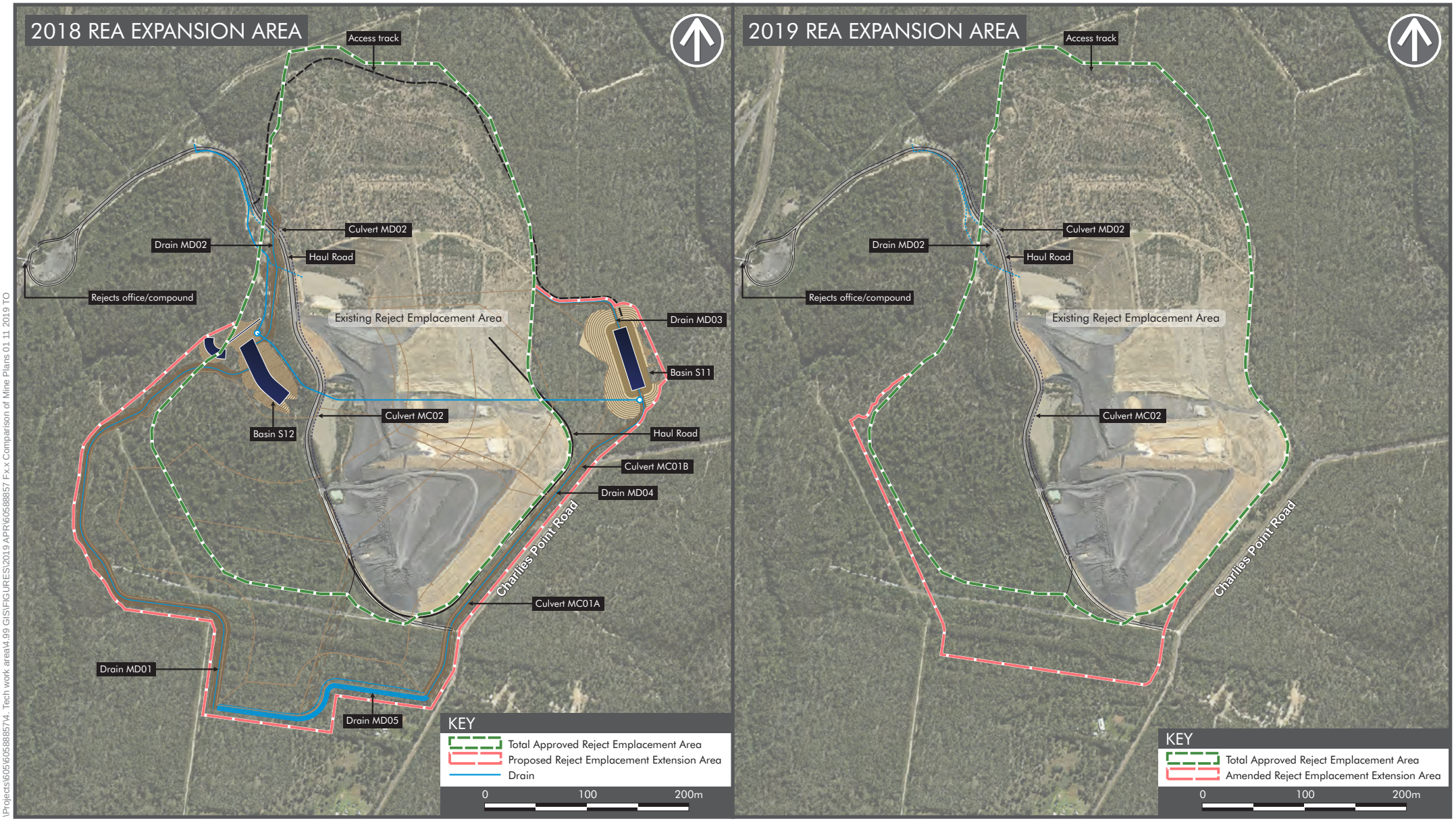
COMPARISON OF EIS MINE PLAN (2018) AND AMENDED PROJECT MINE PLAN (2019)

Tahmoor South Project
Project Amendment Report

FIGURE 2.1



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COMPARISON OF REA EXPANSION AREA (2018) AND AMENDED REA EXPANSION AREA (2019)

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Project Amendment Report

FIGURE 2.2

2.3 REA operations

The NSW Environment Protection Authority (NSW EPA) raised concerns regarding night-time noise impacts on receivers, including sleep disturbance impacts (refer **Section 7.8**). Tahmoor Coal proposes to amend the Project so that the haulage of rejects at the REA would occur during daytime and evening hours (7am to 10pm) only. Rejects would continue to be delivered to the load-out point via conveyor during the night between 10pm and 7am. A front-end loader would then load the stockpile of reject material into a haul truck for transport around the REA. To manage the stockpiled volume, as well as the daytime conveyed volume of rejects, two haul trucks would be required to operate between 7am and 10pm.

2.4 Power Line Easement

Since the exhibition of the EIS, the location and footprint of the power line easement for ventilation shaft site TSC1 has been confirmed (refer **Figure 2-3**) and the construction and operation of the powerline is now included in the project for which approval is sought under Part 4 of the EP&A Act. Additional assessments have been completed for this Project component, in relation to terrestrial ecology, Aboriginal and historic heritage and visual amenity. The results of these assessments are summarised in **Chapter 7.0** and demonstrate that the proposed ancillary infrastructure has been designed to avoid and minimise impacts wherever possible. Mitigation measures as detailed in the relevant assessments for the Project would be implemented to minimise and manage impacts during construction.

2.5 Mine Ventilation

A review of the ventilation strategy for the Project has been undertaken and concluded that the Project would require continued use of the existing upcast shaft (T2). Importantly, the operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South. The continued use of T2 as part of the Amended Project has been considered as part of an updated air quality assessment, which is discussed in **Section 7.9**).



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F2.3 Confirmed Powerline Easement for TSC1 07 11 2019 TO

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CONFIRMED POWERLINE EASEMENT FOR TSC1

Tahmoor South Project
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FIGURE 2.3

3.0 Amended Project Description

This chapter provides a detailed description of the Project, as amended by the changes outlined in **Chapter 2.0**.

3.1 Overview

Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine, extending underground operations and associated infrastructure south, within the Bargo area. The Amended Project seeks to extend the life of underground mining at Tahmoor Mine for an additional 13 years until approximately 2035. Mining has been undertaken at Tahmoor since it first commenced in 1979.

The Amended Project would use longwall mining to extract coal from the Bulli seam within the bounds of Consolidated Coal Lease 716 (CCL 716) and Consolidated Coal Lease 747 (CCL747). Coal extraction of up to four (4) million tonnes of ROM coal per annum is proposed as part of the Project; with extraction of up to 43Mt of ROM coal over the life of the project. The Project would consist of approximately:

- 30Mt coking coal product;
- 2Mt thermal coal product; and
- 11.6Mt rejects.

These approximate market mix volumes include moisture and are therefore an estimate only. Once the coal has been extracted and brought to the surface, it would be processed at Tahmoor Mine's existing coal handling and preparation plant (CHPP) and coal clearance facilities. It would then be transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla and, from time to time, to Newcastle for Australian and international markets. Up to 0.2 Mt per annum of either coal product or reject material is proposed to be transported to customers via road.

The components of the Amended Project are shown on **Figure 3-1** to **Figure 3-9**, and in summary comprise:

- Longwall mining south of the existing Tahmoor Mine using the existing surface infrastructure at the Tahmoor Mine surface facilities area (refer to **Section 3.2.1**);
- Mine development including underground redevelopment, ventilation shaft construction, pre-gas drainage and service connection (refer to **Section 3.2.2**);
- Upgrades to the existing surface facilities area including:
  - Upgrades to the CHPP;
  - Extension of the existing REA;
  - Upgrades to surface water management;
  - Additions to the existing bathhouses and associated access ways; and
  - Upgrades to onsite and offsite service infrastructure, including electrical supply (refer to **Section 3.3**);
- Rail transport of product coal to Port Kembla and from time to time, Newcastle;
- Up to 0.2 Mt per annum of either product coal or reject material is proposed to be transported to customers via road;
- Mine closure and rehabilitation (refer to **Section 3.4**); and
- Environmental management (refer **Section 3.7**).

Each of the individual components of the Amended Project, along with an overview of the proposed environmental management measures, is described in further detail in **Sections 3.2** to **3.7**.

3.2 Underground Mining Operations

3.2.1 Mining Area

Coal from the Bulli Seam would be mined within CCL 747 and CCL 716 as part of the Project. The mining lease areas for the Amended Project have been operationally divided up into different mining domains based on geological complexity and mining potential. The Project comprises mining in the Central Domain only. Further discussion on the other domains and alternatives considered is provided in Chapter 5 of the EIS.

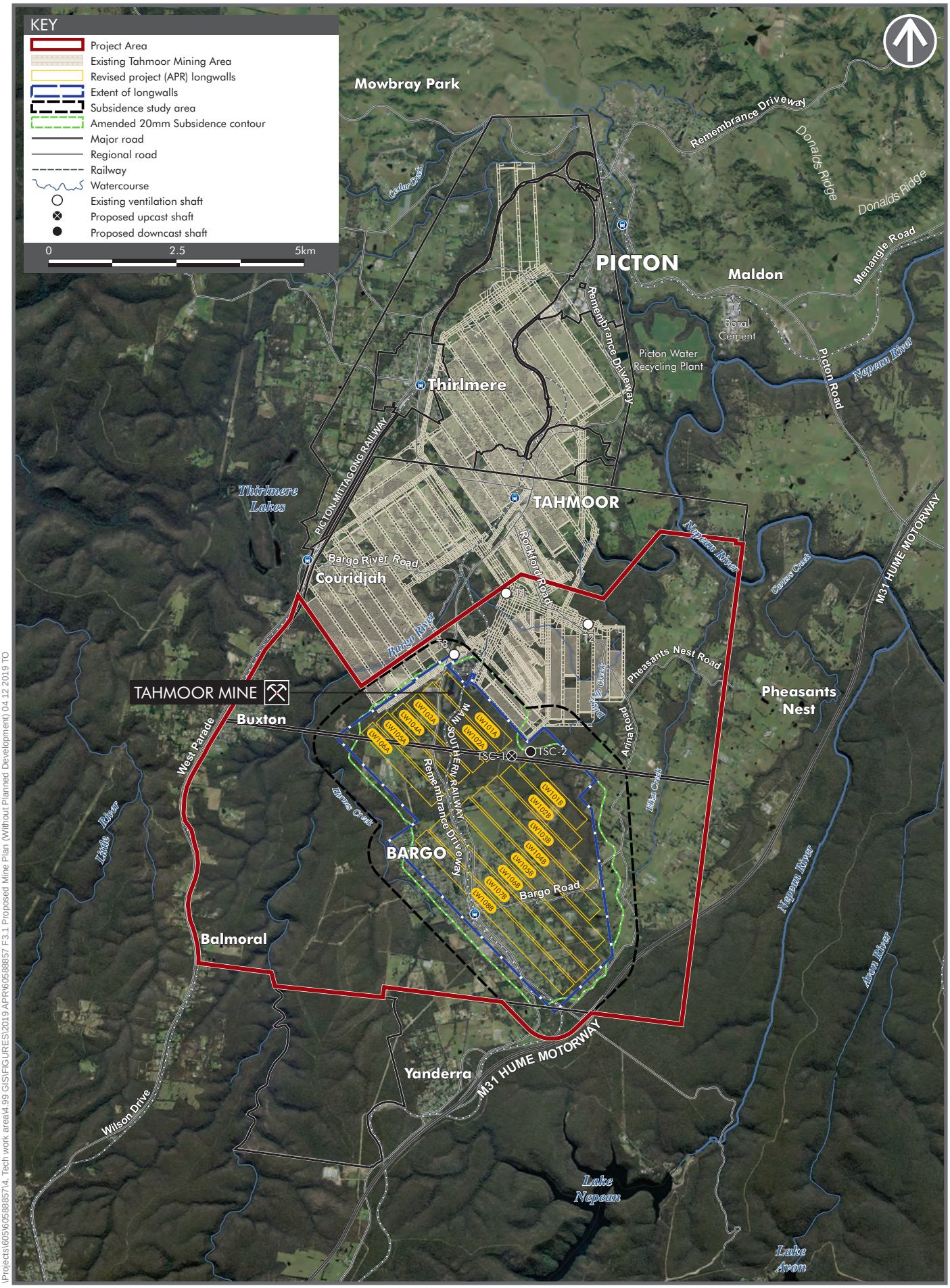
The Amended Project seeks to undertake longwall mining of the Bulli seam within the Central Domain, at a depth of between approximately 365 m and 410 m below ground level. The Central Domain is bounded by known geological fault zones.

The indicative longwall panel layout is shown on **Figure 3-1**. Longwalls in the Central Domain would be orientated in a south-east/north-west direction and would be located within the Bargo area.

The extent of longwalls shown on **Figure 3-1** defines the maximum extent of the footprint of the proposed longwall mining and consists of both first (roadways) and secondary (longwall) workings. The revised impact assessment provided in this Project Amendment Report focuses on changes to impact compared to that predicted in the EIS. As per the EIS, the revised subsidence assessment focuses on the predicted Subsidence Study Area (SSA) and assumes that longwall mining only occurs within the extent of longwalls, except for main development roadways (first workings).

The amended extent of longwalls provides for some flexibility for changes to mining development work and longwall layout during detailed design, subject to geological conditions. As detailed in the EIS, it is proposed that minor changes to the layout would be approved under the Extraction Plan (EP) approval process. The final detailed design of the longwall layouts would be subject to review and approval in consultation with the relevant authorities and to the satisfaction of the Secretary of the DPIE. Mining operations, which are proposed to be undertaken within the amended extent of longwalls include first workings; comprising main headings, gate roads and cut throughs, as well as the development of the longwall panels (secondary workings).

As part of this Project Amendment Report, subsidence predictions have been undertaken for surface infrastructure (e.g. residential, commercial and business structures, public infrastructure and public amenities, utility services such as water and gas mains, and other associated infrastructure) as part of a revised Subsidence Assessment (**Section 7.1**). These predictions and potential impacts would be captured within an EP prior to longwall mining for the Amended Project commencing.



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AMENDED MINE PLAN AND VENTILATION SHAFTS

Tahmoor South Project
Project Amendment Report

Note: The 'extent of longwalls' boundary encompasses the proposed extent of underground workings, being the proposed longwall panels and mains headings (first workings).

FIGURE 3.1

3.2.2 Mine Development

To enable the continuation of mining to occur sequentially with the current mining operations in Tahmoor North, which are scheduled for completion during 2022, development works in anticipation of mining in the Tahmoor South project area commenced in the Tahmoor North mine area in 2019 under existing development consents. These pre-development activities include:

- Recovery of existing underground development roadways;
- Redevelopment of the underground pit bottom;
- Pre-gas drainage;
- Longwall development including establishment of gate roads;
- Installation of electrical, water and gas management networks; and
- The purchase and installation of equipment.

The Amended Project would provide additional employment opportunities, with the requirement for additional people estimated to be between 50 and 175 at various points in time. Additional site infrastructure, including additional onsite amenities and car parks would be required to accommodate the increased workforce during the transition period from mining operations at Tahmoor North and the Amended Project's development works.

3.2.3 Mine Ventilation

The Amended Project would require the use of the existing T2 upcast ventilation shaft. Two additional ventilation shafts would also be required to provide a reliable and adequate supply of ventilation air to support personnel in the mine during operation, being:

- TSC1: an upcast ventilation shaft that would be located on Tahmoor Coal's Charlies Point Road property; and
- TSC2: a downcast ventilation shaft that would be located on Crown Land adjacent to Tahmoor Coal's Charlies Point Road property.

The locations of the ventilation shafts are shown on **Figure 3-2**. Additionally, the power connection easement for ventilation shaft site TSC1 has been determined and is also shown on **Figure 3-2.**

The existing upcast shaft (T2) will use one fan when operating once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

The construction of the ventilation shafts would require a disturbance footprint of approximately 6 ha at TSC1 and 4 ha at TSC2. Access to TSC1 and TSC2 would be from the existing road network.

A conceptual construction and operational layout for each of the two proposed ventilation shafts is shown in **Figure 3-3** and **Figure 3-4**. Construction would involve the following:

- Construction of internal roads to allow access for construction and operational maintenance vehicles.
- Establishment of the construction site to allow enough space for stockpiling of ventilation shaft liners for TSC1 and TSC2, temporary spoil emplacement, water management, storage and safe movement on-site during construction activities. Establishment of each ventilation shaft site would involve:
    - Installation of environmental controls such as silt fences, fencing and a lockable gate, as well as display of appropriate signage relating to restricted entry;
    - Clearing of vegetation and stripping of topsoil. Topsoil would be temporarily stockpiled for use in rehabilitation post construction;

- Excavation and construction of a temporary hardstand area for operation of drilling equipment. The hardstand footprint would be determined by the size and number of liner pieces to be manufactured and excavated to a depth of approximately 0.2 m. The temporary hardstand areas would include:
    - Road base surrounding the site compound area and drill rig slab for site facilities;
    - Laydown areas and a levelled hardstand area for storage of the ventilation shaft liners;
    - A stable access way between the liner storage area and the ventilation shaft to facilitate transport of the cured liner segments on purpose-built trailers; and
    - A concrete pad approximately 20m by 15m is to be constructed around the top of the ventilation shaft as a foundation for the drill rig and to provide a clean work area.

- Connection of 66 kV electrical power along the easement and via tee-off from the 66kV overhead power lines into the TSC1 site on new power poles and establishment of electrical substation at ventilation shaft site TSC1;
- Sinking of the ventilation shaft using blind boring methods (or similar method), and lining of the ventilation shafts using a composite concrete and steel liner (or similar method);
- Construction and installation of ventilation fans. The upcast shaft site fans would also incorporate a fan outlet stack, approximately 20 m high, to control odour discharge from the mine; and
- Construction, installation and commissioning of the ventilation shafts and fans would occur 24 hours a day 7 days a week.

The ventilation shaft construction sites would incorporate water treatment controls, with water extracted from the ventilation shafts being treated and discharged via a licensed discharge point. Following the construction phase, the footprint of the operational area of each ventilation shaft would be reduced to approximately 4.5 ha for TSC1 and 0.8 ha for TSC2, plus provision for an access road. The area immediately surrounding the ventilation shafts would be rehabilitated following the construction phase. The ventilation shafts and fans would operate for the life of the proposed development.

At the TSC1 ventilation shaft site, additional surface to seam boreholes would be constructed to provide power, communications, diesel fuel, gas drainage and water to the mine and service shafts constructed for ballast and concrete delivery into the mine. A service building housing an office and amenities would also be constructed together with a services compound for stockpiled ballast. A 30,000-litre self-bunded diesel fuel tank would also be located at the TSC1 ventilation shaft site to provide a fuel supply to underground equipment.

3.2.4 Gas Drainage Operations

No changes are proposed to gas drainage operations as described in the EIS.

Coal mines need to control underground gas concentration levels to below safe limits so that employees can work in a safe environment and mining operations can be undertaken as efficiently as possible.

The coal seams within the Southern Coalfield are generally known to be ‘gassy’, with CH_4 and CO_2 released from the goaf during mining. Gas in the underground workings would be managed by a series of gas drainage operations including:

- Pre gas drainage, whereby gas would be extracted from the coal seam prior to longwall mining;
- Post gas drainage, whereby gas would be extracted from the goaf; and
- Gas extraction via the mine ventilation system, which would occur throughout mining.

Gas management would continue to use the existing infrastructure, including the Tahmoor Mine Gas Plant, Gas Plant Vent and Flare Plant, as well as the WCMG Power Plant. Some components of the existing gas management infrastructure may need to be upgraded throughout the life of the Project to increase the capacity of the systems, such as the installation of the additional vacuum pumps at the Gas Plant when required.

Pre-Gas Drainage

The purpose of pre gas drainage is to reduce gas volumes in the coal seams prior to mining, with the Bulli, Wongawilli and Balgownie seams targeted for pre gas drainage at Tahmoor Mine. Pre gas drainage of the gas levels in the seams is required to facilitate the timely commencement and progression of mining as well as to reduce the demands on the mine ventilation system for the purpose of gas dilution during operations.

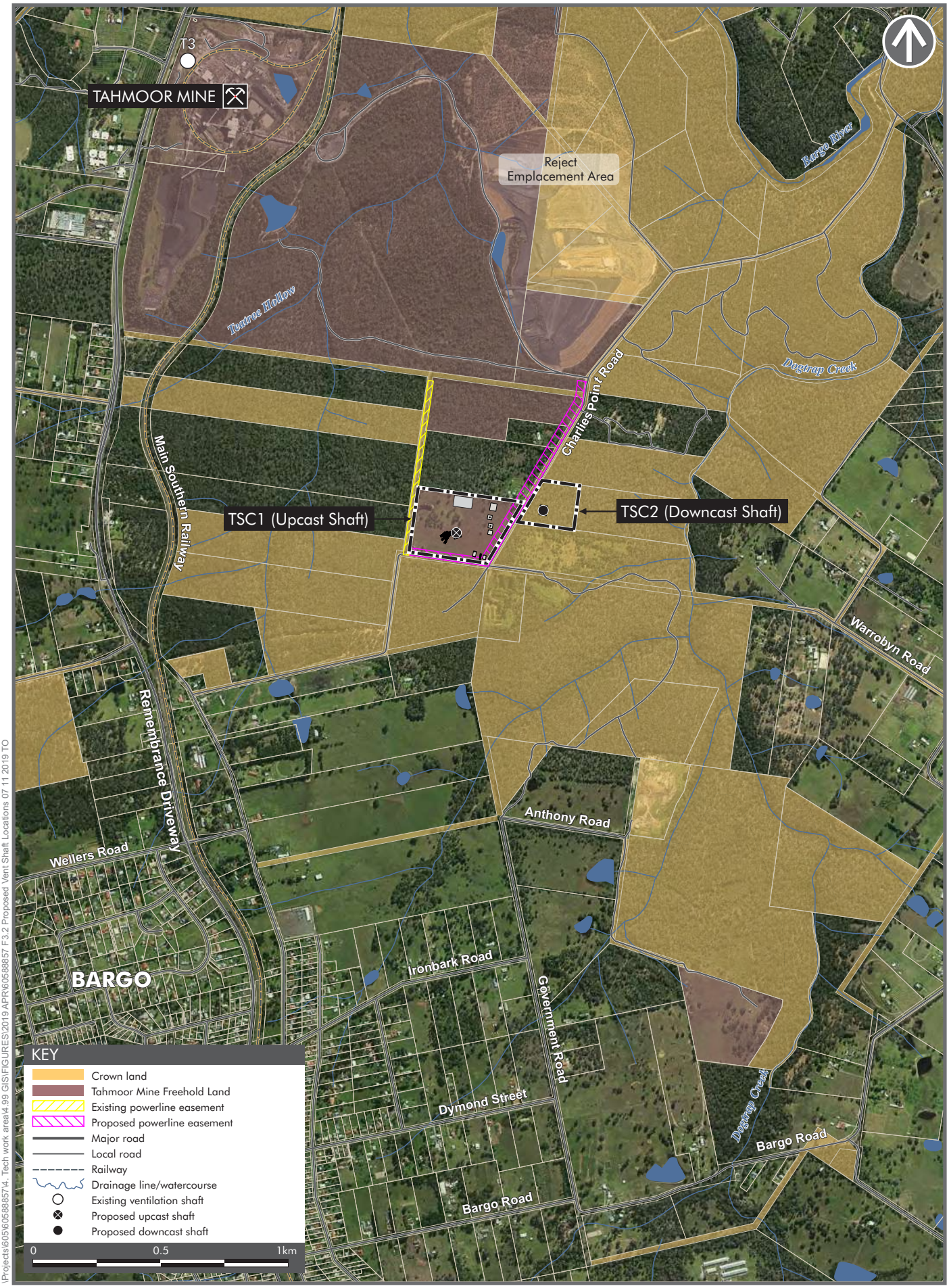
Pre gas drainage activities are mainly undertaken underground, via drilling and drainage from the roadways developed for longwall panels. Underground pre gas drainage works at Tahmoor Mine would drain gas following development of the mine roadways and prior to longwall development. Gas would be drawn from the coal seam by vacuum and piped to the Gas Plant at the surface facilities area via the underground pipe network. Underground gas drainage of the coal seam would continue ahead of longwall development for the life of mining.

Post Gas Drainage

Post gas drainage would be required as strata relaxation caused by the retreating longwall face would liberate volumes of gas into the mine workings from the underlying Wongawilli seam and from overlying strata, released due to fracturing of the goaf. To capture this gas during the proposed development, cross-measure boreholes are proposed to be drilled from the mine workings into the Wongawilli seam. These boreholes would be designed to collect the gas at its source or to intercept gas before it migrates into the mine workings. At the conclusion of mining from each panel, the panel would be sealed, and gas drawn from the sealed areas as part of the post gas drainage operations. The gas collected from the in-seam and cross-measure boreholes would be drawn by vacuum via the underground pipe network to the Gas Plant located at the surface facilities area.

Gas in Ventilation

The ventilation system would deliver fresh air into the mine from the existing and proposed downcast ventilation shafts and would extract stale air from the mine via the existing and proposed upcast ventilation shafts (refer to **Section 3.2.3**). Similar to the existing operations, the ventilation system would carry the remaining diluted gases out of the mine via the upcast mine ventilation shafts (refer to **Section 3.2.3**).



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888574 F3.2 Proposed Vent Shaft Locations 07 11 2019 TO

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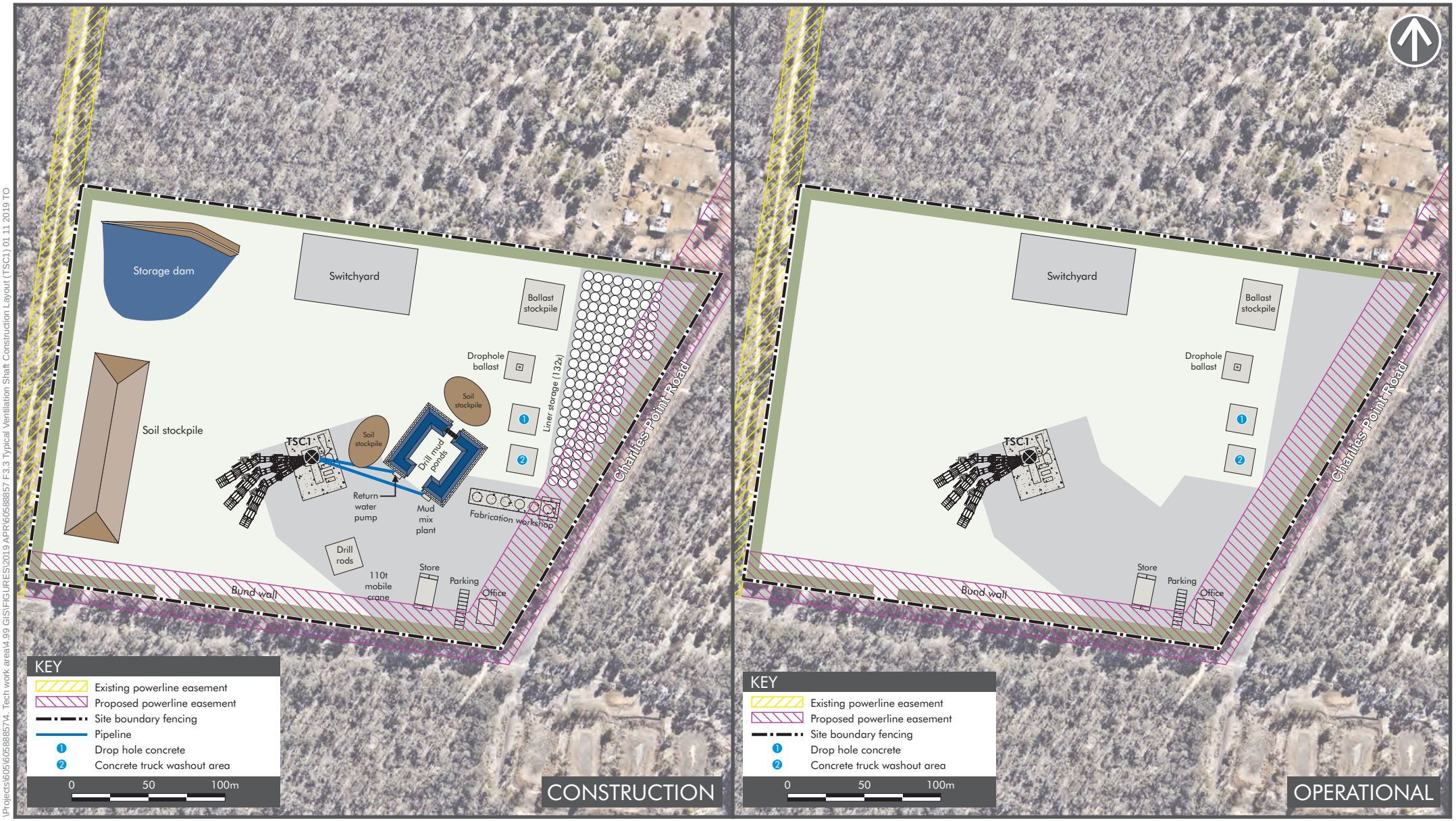
PROPOSED VENTILATION SHAFT LOCATIONS

Tahmoor South Project
Project Amendment Report

FIGURE 3.2



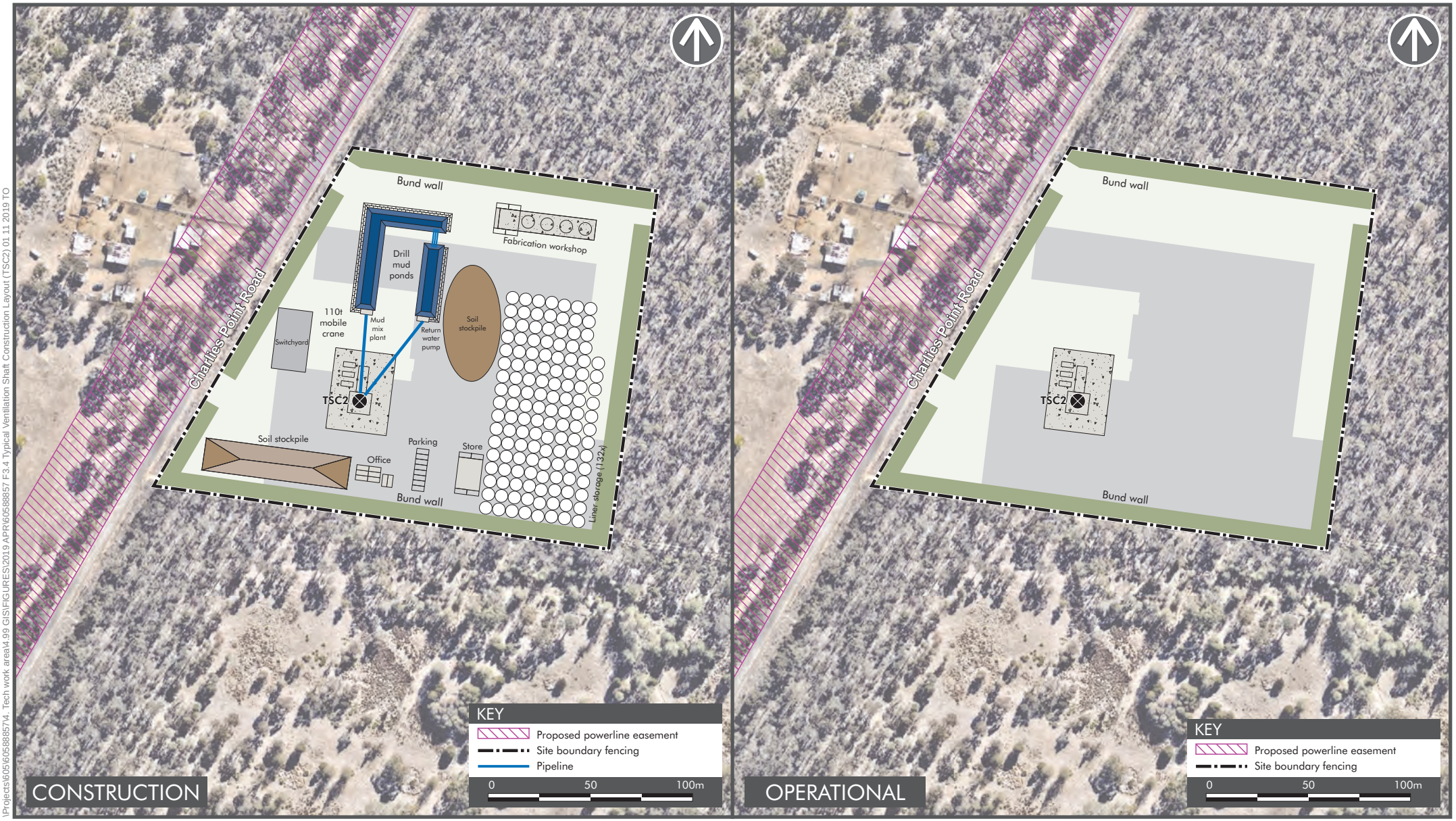
\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.3 Typical Ventilation Shaft Construction Layout (TSC1) 01 11 2019 TO

SIMEC

CONCEPTUAL VENTILATION SHAFT LAYOUT (TSC1)

Tahmoor South Project
Project Amendment Report

FIGURE 3.3



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.4 Typical Ventilation Shaft Construction Layout (TSC2) 01 11 2019 TO

SIMEC

CONCEPTUAL VENTILATION SHAFT LAYOUT (TSC2)

Tahmoor South Project
Project Amendment Report

FIGURE 3.4

3.2.5 Mining Method and Equipment

Underground mining would be undertaken via the main roadway and longwall development using continuous miners. Longwall development refers to the mining of a series of roadways (gate roads) and cut-throughs, to form pillars of coal that would support the overlying strata during the extraction of coal. Longwalls would be up to approximately 285m wide with a height of up to 2.6m, which is similar to the longwall panels extracted in Tahmoor North. The gate roads would be approximately 5.2 m wide and have a height of up to 2.7 m. **Figure 3-5** provides a schematic illustration of the relationship between the longwalls and gate roads.

Coal would be cut from the coal face by the longwall shearer, loaded onto the armoured face conveyor and transported to the surface facilities area via a series of underground conveyors. The longwall would retreat as coal is mined and the overlying rock strata would collapse into the void left by the coal extraction, forming the goaf.

Tahmoor Coal would continue to review and investigate improved or alternate mining methods and technology throughout the life of the Amended Project. Improved methods would be utilised where available and found to be commercially viable to allow for the efficient and economically viable extraction of the coal resource. Tahmoor Coal would ensure that the resulting environmental and social impacts of improved or alternate methods are consistent with those predicted in this Project Amendment Report.

3.2.6 Mine Access

The Amended Project would use the existing infrastructure at Tahmoor Mine for employee and material access to the mine. Access to the Central Domain would be via the existing Tahmoor Mine surface facilities area, the existing drift, and a travel lift for people and materials installed within the T3 downcast shaft. The T3 vertical travel lift has a capacity for 70 persons and approximately 12 tonnes of materials.

3.2.7 Coal Production and Transport

Product coal would continue to be transported from Tahmoor Mine to Port Kembla, via the existing mine rail load out, rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway. Transport of product coal by rail from the Amended Project to Newcastle (Port Waratah) could also occur from time to time, if required.

Tahmoor Mine currently has four allocated train paths per day from ARTC for the rail network between the Tahmoor Mine and Port Kembla. This current allocation is equivalent to the transport of approximately 4.6 Mt of product coal per annum and is sufficient for the life of the Project (which is expected to generate up to 4 Mt of ROM coal per annum). The rail transport study undertaken for the EIS indicated that the existing rail capacity would be sufficient for the proposed transport of product coal to Port Kembla. The estimated maximum coal production would be reduced under the Amended Project (compared to that assessed in the EIS), and as such no increase in rail capacity between Tahmoor Mine and Port Kembla would be required. Existing rail infrastructure and the number of allowable daily train movements would remain unchanged (refer to Section 11.14.4 of the EIS for further details).

The Amended Project would also transport and receive the following by road transport:

- Product coal to domestic end users where rail transport is unavailable;
- Imported coal to blend with Tahmoor Coal for special blends to meet specific customer requirements; and
- Reject material to potential domestic users where rail transport is unavailable and a market opportunity for beneficial use of rejects exists or is being investigated.

Transport of product coal rejects from the Tahmoor Mine and importation of coal would be restricted to a maximum of 0.2 Mt per annum and a maximum of 3,000 tonnes per day. Road transport would be generally on a campaign basis and during these transport campaign periods generate a maximum of eight truck movements per hour during the period between 6 am to 7 pm. This remains consistent with the EIS.

3.2.8 Mine Dewatering

To maintain a safe and efficient underground mine environment, water entering the underground workings needs to be managed. Mine water is proposed to be collected in underground sumps and pumped from the mine to the existing water management system at the Surface Facilities Area for treatment. Treated mine water would be either reused underground for non-potable uses or discharged at the surface via the existing LDP1 to Tea Tree Hollow.

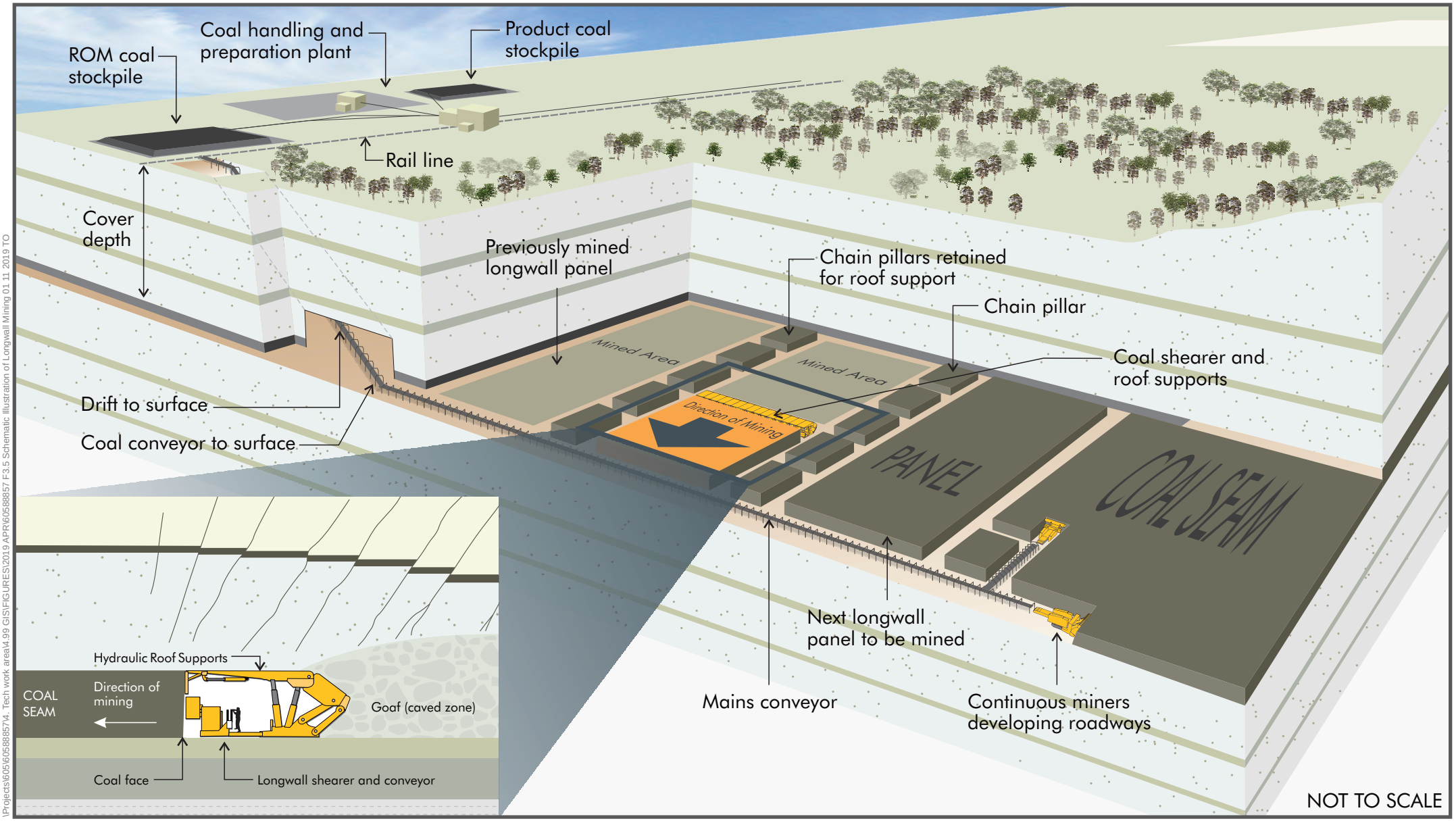
The inflow rates are predicted to increase over the first half of the operational life at Tahmoor South from about 2 ML/day to an average of 4.7 ML/d for the proposed life of Tahmoor South. The model used for impact assessment of the Project predicts that peak rates will be in the order of 7.5-8 ML/d in 2028-29 and 2032-33, noting that these rates are quoted as ML/d but averaged over model stress periods which are typically 6 months to a year. Higher inflows may occur over shorter periods. Empirically, these inflows are higher than expected, given that the historical inflows are 3-5 ML/d and the proposed longwall geometry is similar to that in recent Tahmoor North longwalls.

A revised Surface Water Impact Assessment undertaken for the Amended Project (**Appendix D**) indicates that simulated releases of treated water to Tea Tree Hollow via LDP1 over the life of the Amended Project all complied with the current Environment Protection Licence (EPL) daily volumetric limits. If discharge volumes were to increase beyond this estimate, an application would be made to vary the EPL.

3.2.9 Underground Water Storage

The underground water storage proposal has been modified such that mine dewatering from Tahmoor South will be transferred directly to the proposed Tahmoor North underground storage, rather than from dam M3. As such, potential impacts to groundwater quality are unlikely.

Water storage has been assessed in the Water Management System and Site Water Balance (HEC, 2020b) and recommendations made for increasing the capacity of the upgraded Wastewater Treatment Plant (WWTP) in the future if required.



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.5 Schematic illustration of Longwall Mining 01 11 2019 TO

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SCHEMATIC ILLUSTRATION OF LONGWALL MINING

Tahmoor South Project
Project Amendment Report

FIGURE 3.5

3.3 Surface Facilities Area

The existing surface facilities and infrastructure at the Tahmoor Mine surface facilities area, operating within surface CCL 716 and Mining Lease 1642 (ML1642), would be utilised for the Amended Project.

Upgrades to some aspects of the surface facilities area would be required and are associated with the increase in annual coal production for the Amended Project. Upgrades to existing surface infrastructure would be undertaken within the footprint of the existing Tahmoor Mine surface lease (Mining Lease 1642) and additional surface lease areas required for the Amended Project.

3.3.1 Coal Handling and Preparation Plant

The existing CHPP would be utilised for the Amended Project. The existing CHPP would be modified for the purposes of noise mitigation in line with the recommendations of the Noise and Vibration Impact Assessment for the Amended Project (**Appendix I**) (refer **Figure 3-6**).

The existing ROM stockpile area would continue to be used for the Project. During peak production ROM coal may be transported by truck from the ROM stockpile to the coal product stockpiles and transported back to the ROM stockpile when required. Reject material generated from the coal washing process at the CHPP would be transported to the REA via the existing reject conveyor to the reject bin for disposal. It would then be transported by haul truck to the REA (refer to **Section 3.3.2**).

3.3.2 Rejects Management

The existing approved REA has an area of approximately 87.4 ha and an approved capacity of about 13 Mt, of which about 4 Mt of capacity remains, which is expected to be used for the completion of the Tahmoor North operations. The existing REA would be extended by 11.06 ha using adjacent areas to accommodate the reject material associated with the proposed development (**Figure 3-7**).

A Rejects Disposal Options Study (SKM, 2014) was included as part of the EIS which evaluated available options and identified extension of the REA as the preferred option for rejects disposal for the Amended Project. The rejects disposal method was selected based on a review of a range of disposal options taking into consideration several project objectives including:

- Provide a safe solution, causing no hazards to mine operations and with low impact on mine stability;
- Minimise the impact on the environment where possible, including dust emissions, visual impact, groundwater and sub-surface contamination, use of foreign reagents;
- Provide an economic solution, with minimal capital and operating cost, returning a positive benefit to cost ratio, providing employment for the local community and minimising the impact on mine production;
- Adopt a sound technical solution, utilising proven technology with high availability and reliability, versatility and flexibility; and
- Provide a solution that would enable the disposal of the total volume of rejects forecast for the Tahmoor South project.

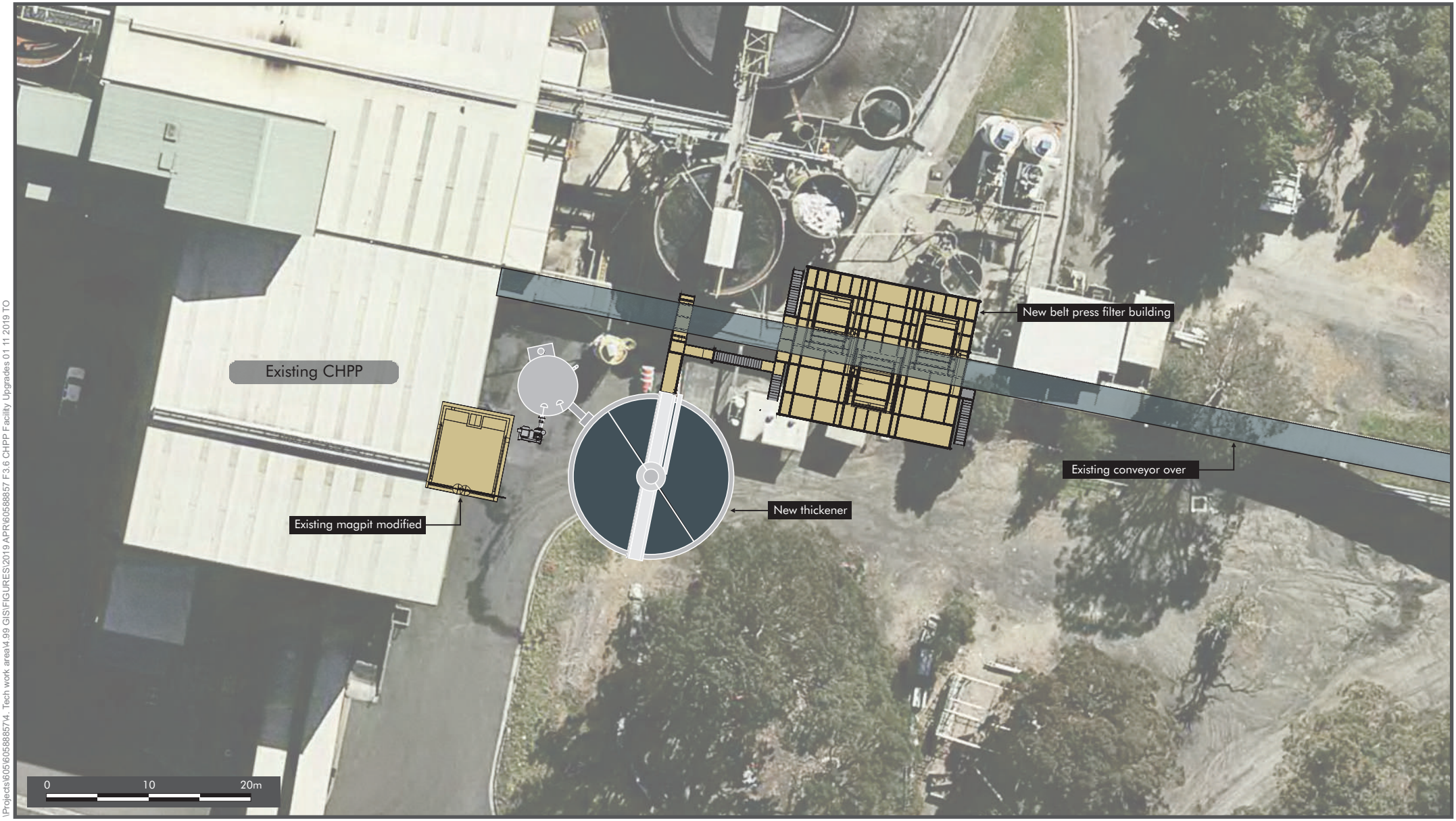
Following the EIS exhibition, a Rejects Management Options Gap assessment was undertaken by Palaris in July 2019, which reviewed the previous SKM options assessment and issues raised in the agency submissions. The Gap Analysis confirmed that an extension of the REA comprises the best option for the Amended Project. Further details of the REA Gap Analysis are provided in **Section 2.2**.

The revised REA footprint provides a balance between amenity impacts to surrounding properties and the reduction of impacts to local biodiversity. The REA is proposed to be increased in height from RL 305 m stated in the EIS to RL 310 m.

The amended REA strategy consists of utilising a staged fill plan approach (refer **Figure 3-8**). The REA would be progressively rehabilitated over the life of the mine.

Construction and maintenance of new internal haul roads around and within the REA would be required to cater for the REA extension. The existing stormwater infrastructure would be upgraded to include bunding, additional surface water drainage controls and sedimentation basins for the additional areas. These water management controls would be installed at the base of the REA, inside the proposed footprint.

Alternative uses for rejects would be investigated during the life of the Amended Project and to facilitate beneficial uses of reject material (where these become feasible).



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.6 CHPP Facility Upgrades 01 11 2019 TO

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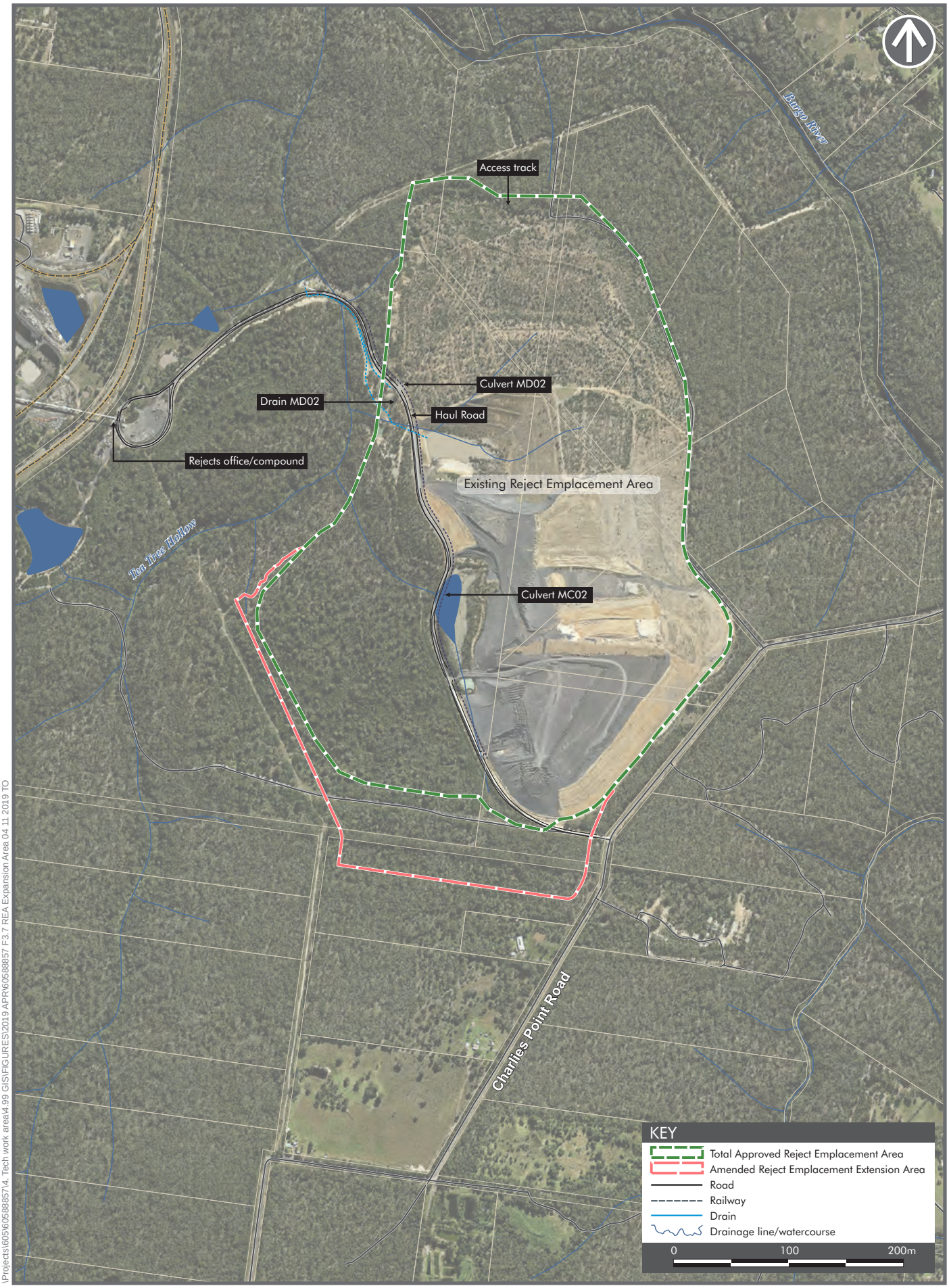
CHPP FACILITY UPGRADES

Tahmoor South Project
Project Amendment Report

FIGURE 3.6



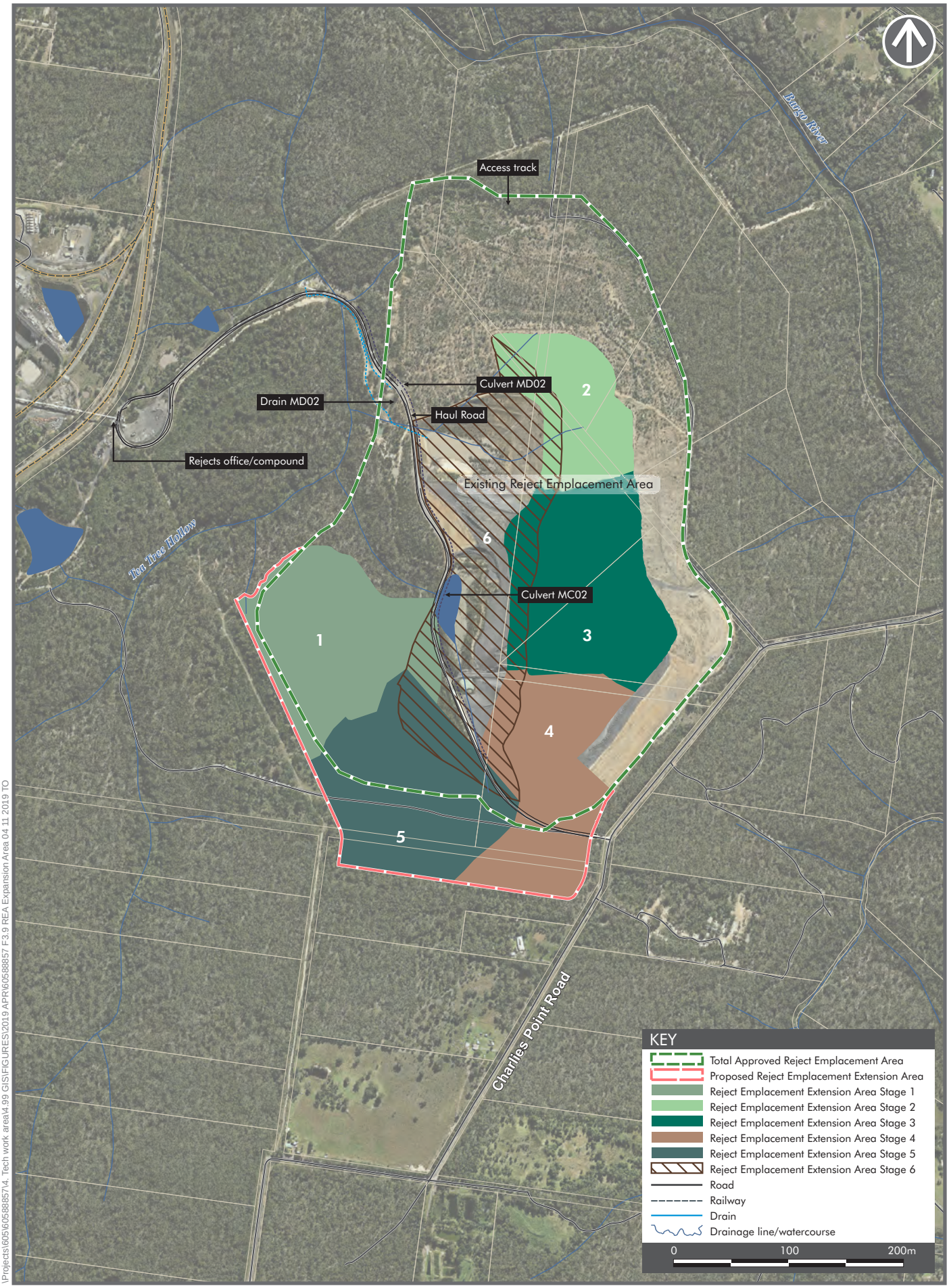
\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.7 REA Expansion Area 04 11 2019 TO

SIMEC

REJECT EMPLACEMENT EXTENSION AREAS

Tahmoor South Project
Project Amendment Report

FIGURE 3.7



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.9 REA Expansion Area 04 11 2019 TO

SIMEC

STAGING PLAN FOR THE REA

Tahmoor South Project
Project Amendment Report

FIGURE 3.8

3.3.3 Plant and Equipment

The Amended Project would use existing plant and equipment located at the Tahmoor Mine facilities area. It would also require:

- Additional mobile plant for coal material handling at the surface facilities area; and
- Ancillary equipment such as trucks, cranes and forklifts for use around the surface facilities area to manage product and equipment stores.

Tahmoor Coal would continue to investigate and utilise improved or alternate coal handling and preparation methods and technology throughout the life of the Amended Project to allow for the efficient processing of coal and reject. Tahmoor Coal would ensure that environmental and social impacts resulting from the use of alternate methods are consistent with those predicted in this EIS.

3.3.4 Site Amenities and Layout

While the existing site amenities at the Tahmoor Mine surface facilities area would be used for the Project, additional facilities would be required to accommodate the increased workforce (discussed in **Section 3.6.1**).

These would be constructed adjacent to the existing amenities and would consist of pre-fabricated modular buildings (**Figure 3-9**). The existing sewage treatment plant would be upgraded to accommodate the additional employees.

The Amended Project would also require minor upgrades of the existing services such as onsite firefighting, water reticulation and power supply systems.

3.3.5 Infrastructure Services Upgrades

A range of infrastructure services including existing offsite electrical, telecommunications and water reticulation infrastructure currently servicing the Tahmoor Mine would continue to be used with some upgrades. In addition, the construction and commissioning of an extension to the existing 66kV overhead power line from the REA along Charlies Point Road to the proposed ventilation shaft sites would be required.

3.3.6 Site Access and Improvements

The existing vehicular access arrangements to Tahmoor Mine's surface facilities area via Remembrance Driveway, approximately three kilometres south of Tahmoor and five kilometres north of Bargo would continue to provide access for employees, contractors and materials.

There is currently a passing lane northbound and a deceleration turning lane southbound on Remembrance Driveway at the turnoff to Tahmoor Mine. These lanes allow vehicles entering Tahmoor Mine from the south to turn into the Mine without impeding other traffic on Remembrance Driveway.

The existing intersection at the entry to Tahmoor Mine from Remembrance Driveway would be upgraded as part of the Amended Project. The upgrade would provide a dedicated right-hand turning bay for vehicles entering the surface facilities area from the south; and extended acceleration and deceleration lanes for vehicles entering and exiting from the north and south.

The intersection upgrade would accommodate additional traffic movements during the concurrent undertaking of pre-mining activities for the Amended Project and the finalisation of longwall mining in Tahmoor North. The traffic impacts of the intersection upgrade are assessed in Section 11.13 of the EIS prepared for the Project. The upgraded intersection would provide a Level of Service (LoS) of A/B (refer Appendix P of EIS), which is appropriate for the projected traffic along Remembrance Drive for the life of the Amended Project.

3.4 Rehabilitation and Mine Closure

A Mine Closure Plan has been developed for the Project and was included in Appendix V of the EIS. An amended Mine Closure Plan has been prepared for the Amended Project and is shown in **Appendix Q**. Rehabilitation of the Amended Project would be undertaken using a staged approach comprising:

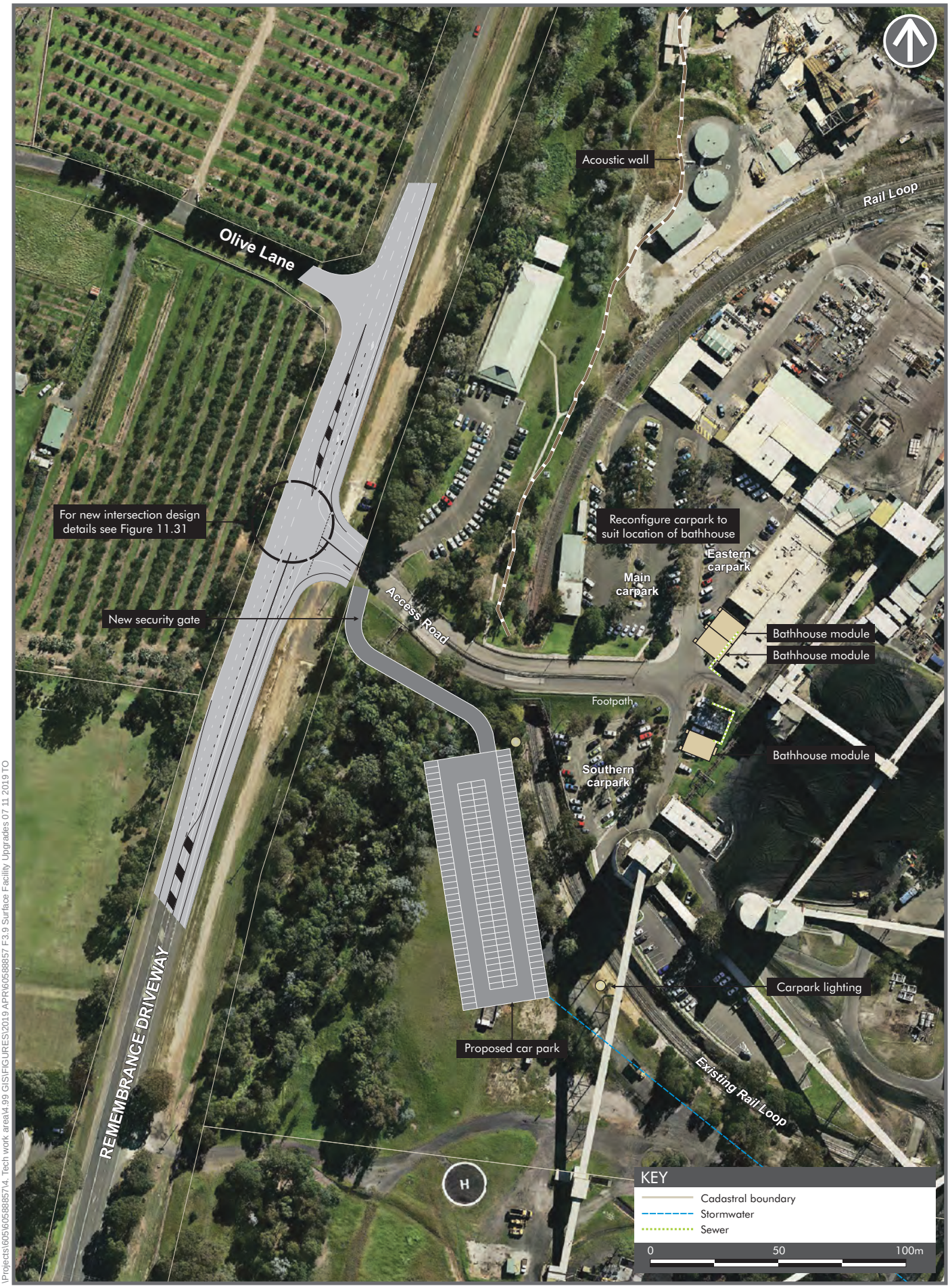
- Progressive rehabilitation of the REA; and
- Mine closure and rehabilitation of the surface facilities area and ventilation shafts.

In the EIS, the REA was proposed to be progressed in 15-stages throughout the life of the mine. Based on the amendments to the Project, the REA is now proposed to be progressed in six stages. Where practicable, each stage of the REA will be progressively rehabilitated. This process would involve capping the reject material with topsoil and establishing vegetation. Annual monitoring would be undertaken to determine the success of revegetation and to inform ongoing management of the rehabilitated areas.

There are several post mining land use options that may apply to the Project including passive recreation, native bushland conservation or employment lands such as light industrial uses. It is considered that the likely final land use option for most of the surface areas would be native bushland. However, final land use options would be confirmed in a detailed closure planning process, which involves undertaking a final land use analysis and consultation with relevant stakeholders. A detailed Mine Closure Plan would be developed within five years of mine closure. In broad terms, rehabilitation of the surface facilities area and ventilation shafts would involve:

- Removal of infrastructure and services;
- Levelling, re-contouring and grading to achieve safely battered slopes and surfaces;
- Applying topsoil for rehabilitation where required;
- Establishing native bushland vegetation which would require minimal ongoing care and maintenance; and
- Monitoring of rehabilitated areas to assess the success and inform the management of areas of re-established vegetation.

Infrastructure and facilities may be retained where compatible with the end land uses which would be identified in the detailed mine closure.



\Projects\605\605888574. Tech work area\4.99 GIS\FIGURES\2019 APR\605888857 F3.9 Surface Facility Upgrades 07 11 2019 TO

SIMEC

Source: Arkhill Engineers (11/06/2013)

SURFACE FACILITY UPGRADES
Tahmoor South Project
Project Amendment Report

FIGURE 3.9

3.5 Project Timeframes

3.5.1 Indicative Mining Schedule

The Amended Project seeks to extend the life of underground mining at Tahmoor Mine beyond the predicted completion of mining at Tahmoor North in 2022, with this timing depending upon geological, mining and economic conditions.

Several pre-mining activities are required to be completed prior to commencement of longwall mining for the Tahmoor South Project. These pre-mining activities include:

- Gas drainage;
- Redevelopment of the pit bottom;
- Longwall development including establishment of gate roads;
- Installation of electrical, water and gas management networks; and
- The purchase and installation of equipment.

The Amended Project's pre-mining activities are anticipated to take approximately three to four years to complete before longwall mining can commence in the Central Domain. Longwall mining is proposed to commence in the Central Domain once mining is completed at Tahmoor North mine, which is anticipated to be completed by 2022.

Mining for the Amended Project would be complete by approximately 2035, with surface works, rehabilitation and mine closure occurring after the completion of mining activities. **Table 3-1** provides an outline of the indicative schedule for mining.

Table 3-1 Indicative mining schedule (dependent on geological, mining and economic conditions)

Activity	Year
Pre mining activities, which are approved activities under the existing Tahmoor North lease, consents and approvals.	Commenced in 2019
Central Domain development, some of which would be approved activities under the existing Tahmoor North lease and approvals.	Approximately 2020
Mining of Tahmoor North complete	Approximately 2022
Central Domain longwall mining	Approximately 2022 – 2035

3.6 Workforce and Hours of Operation

3.6.1 Workforce

The Amended Project would involve the ongoing employment of approximately 400 people in ongoing permanent and contract roles. In addition, there would be a period of concurrent operation up to four years, involving pre-mining activities for the proposed development and longwall mining in Tahmoor North, during which time approximately 50 to 175 additional people would be required to augment the current workforce requirements.

3.6.2 Hours of Operation

The Amended Project, including construction activities, would operate 24-hours a day, seven days per week, consistent with the working hours of the current operations at the Tahmoor Mine.

Construction of the ventilation shafts, upgrades and augmentation of the existing infrastructure, services and amenities at the surface facilities area, and upgrades to the intersection at the entrance to the surface facilities area would be generally undertaken between the hours of 7 am and 6 pm, seven days a week. During ventilation shaft construction (including the ventilation shaft drilling rig and ventilation shaft lining), fan construction and commissioning would operate continuously 24 hours a day, seven days a week.

3.7 Environmental Management

Environmental management at Tahmoor Mine is currently governed by the *Environmental Management System Strategy and Framework.* The Amended Project would be managed within this Framework and in line with existing procedures. Where required, the existing procedures and management plans would be updated to reflect the specific details of the Amended Project.

In addition, a Mining Operations Plan (MOP) or Rehabilitation Management Plan (RMP) would be prepared to meet the requirements of the Mining Act and *Mining Regulation 2016*. The NSW Division of Resources and Geoscience (DRG) would be consulted to ensure that the MOP or RMP is prepared in accordance with the current guidelines at the time.

3.7.1 Subsidence Monitoring and Management

Tahmoor Coal currently manages and monitors subsidence as part of the existing operations at Tahmoor North mine. The systems and programs currently in place to monitor and manage subsidence would continue during the Amended Project and would be augmented to monitor the effects of mining within the Central Domain.

Specifically, subsidence would be managed through implementation of an EP in consultation with stakeholders. This plan would describe measures to be undertaken to monitor surface subsidence and physical changes that are predicted to occur during mining. Measures detailed in the management plans would include:

- The requirements for inspection regimes for natural and built surface features;
- The layout of monitoring points and parameters to be measured;
- Monitoring methods and accuracy;
- The timing and frequency of surveys and inspections; and
- Processes for recording and reporting of monitoring results.

The management and monitoring plans would be prepared and lodged with the DRG prior to the commencement of mining.

3.7.2 Water Management

Surface water runoff from operational areas and stockpiles would continue to be captured by the existing stormwater treatment dams at the surface facilities area. Following treatment, the water would continue to be discharged to Tea Tree Hollow at LDP1.

Potable water supply for use at the surface facilities area and underground would be drawn from the town water main, and non-potable supply sourced from the recycled water treatment plant at the Surface Facilities Area. Mine water would be treated and recycled for non-potable underground use or pass through the stormwater treatment dams and be discharged via the licensed discharge point (LDP) and licensed wet weather licensed overflow points (LOPs). Surface water management including catchment drains to convey water to sediment basin S12 would be installed at the base of REA inside the Amended Project footprint.

Licensed Discharge Point

The proposed development would collect water underground in sumps and pump this water via underground pipes to the surface. Similar to the existing operations at Tahmoor mine, the Amended Project would continue to discharge a portion of the stormwater and treated mine water via licensed discharge point LDP1 under EPL 1389.

Site Water Balance

The major components of the mine water balance for the Amended Project would be:

- Inflows from surface runoff, direct rainfall onto dam surfaces, potable water draw and groundwater inflows to the underground operations; and
- Outflows including discharges to the Bargo River catchment via the LDP1 and LOPs to Tea Tree Hollow; evaporation from dam surfaces; and water loss to product coal and coarse rejects.

The amendments to site water balance is discussed in detail in **Appendix D** of this report.

Site Water Management Plan

Water management during operation of the Amended Project would be governed by the water management plan currently in place at Tahmoor Mine. The Water Management Plan would be updated to encompass the operations associated with the Amended Project and would be implemented in line with the following objectives:

- Utilise available surface water runoff for use as process water;
- Minimise instances of licensed discharge;
- Minimise the magnitude of licensed discharge; and
- The quality and quantity of water discharged to be in accordance with relevant water quality criteria.

4.0 Strategic Context

Tahmoor Mine would function as a key supplier of coking coal that is an important resource to the state. The value in the continuation of the Project is highlighted through the importance in producing coking coal for steel production, the premium quality of the coking coal and the continuation of an established mine site.

Production of coking coal

Coking coal is used to create coke, which is one of the key inputs for the primary production of steel. Global steel production is dependent on coal, with approximately 70% of steel produced using coking coal. This steel is used to deliver products that are needed in society including healthcare, telecommunications, transport and agricultural equipment.

Coking coal is of high economic importance compared to thermal coal due to its use in the steel sector and few options for substitution available. Apart from the electric arc furnace method which relies solely on scrap steel there are currently no alternatives to the use of metallurgical coal for the production of iron and steel. The carbon in metallurgical coal is a key element in the process of extracting iron from iron ore. Despite the global increase in demand for steel and hence coking coal there is a limited global market for scrap steel and there is a corresponding limit to the use of EAF for steel making. As a result, there is still a growing global demand for coking coal, particularly the high-quality coking coal from Tahmoor Mine. Coking coal will continue to be the principal component of steel making worldwide in the foreseeable future.

Premium quality coking coal

Tahmoor Mine is recognised in the steel production industry as one of the existing mines in Australia that produce high fluidity (maximum of approximately 1000 dial divisions per minute (DDPM)) coking coal. Since mining first commenced in 1979 coal produced at Tahmoor mine has been used for steel production at Port Kembla, Whyalla and overseas. The Amended Project would allow for the continued supply of this valuable product to existing domestic and international markets.

Globally, Australia is the second largest coking coal supplier. The production of coking coal is dependent of specific environments factors including a higher carbon energy content and lower ash and moisture. These are environmental influences have been identified from Australian exported coal that are of high-quality blended mix, ensuring an optimum level of performance of the blast furnace and associated steel production.

Continuation of an established mine site

The continuation of mining into the Tahmoor South area would facilitate the supply of premium grade coal through utilising existing facilities rather than to establish a separate, new mine to access this resource. The use of a currently operating mine is considered preferable to construction of a new mine from an environmental, economic and social perspective to maximise production and supply product coal into established export markets.

The Amended Project seeks to continue the life of underground mining at the Tahmoor Mine until approximately 2035. Without approval, completion of mining in the Tahmoor North mining area would result in closure of Tahmoor Mine by approximately 2022 effectively ceasing the extraction of a coking coal resource via existing infrastructure. The Amended Project would enable mining to be undertaken within the southern portion of Tahmoor Coal's (and its wholly owned subsidiary Bargo Collieries Pty Ltd) existing mining lease areas, and operations and employment to continue for approximately a further 13 years.

5.0 Statutory Context

The exhibited EIS addressed the potential impacts of the Project against a range of matters relevant to the development. Upon review of the Amended Project, the summary of the statutory context provided in Chapter 8.0 of the EIS remains unchanged. Refer to Section 8.0 of the EIS.

In terms of assessment policy and the statutory requirements for assessment, the NSW EPA has updated the policy used to guide the assessment of noise impacts. The updated policy is the *Noise Policy for Industry* (NPfI). In its submission on the EIS, the NSW EPA directed Tahmoor Coal to provide a revised assessment of noise impacts for the Project, in line with the NPfI. This assessment has been completed and is provided in **Appendix I** and summarised in **Section 7.8**. This assessment supersedes the Noise and Vibration Assessment provided as part of the EIS.

6.0 Stakeholder Engagement

Stakeholder engagement has been undertaken throughout the project planning and environmental impact assessment process, including consultation with local and State Governments, industry regulators, near neighbours (specifically including owners along Charlies Point Road with regards to property acquisition agreements), the local Aboriginal community and the wider local community. This Chapter of the Project Amendment Report provides an overview of the engagement process applied, its objectives, a description of the various engagement phases and the engagement activities undertaken.

The EIS for the Tahmoor South Project was placed on public exhibition from the 23 January 2019 until 5 March 2019 for a total of 42 days. The NSW Department of Planning, Industry and Environment invited the community to comment on the EIS for the Tahmoor South Coal Project from 23 January 2019 via a media release on the same date:

Tahmoor Coal has consulted with stakeholders about the Project via:

- Newsletters via letterbox drop and placement in local shopping centre;
- Tahmoor Coal Community Consultative Committee (TCCCC);
- Tahmoor Coal's website which includes the EIS and project updates;
- Community information days held on 4 September, 30 October 2018 and 19 February 2019 at the Bargo Community Centre;
- Community stands at Tahmoor Town Centre, Bargo IGA, Community Pantry speaking to over 100 people
- Tahmoor Coal/ SIMEC Complaints and Enquiries line and email
  - (02) 46 400 100;
  - 1800 154 415 (24-hour contact number); and
  - Tahmoorenquiries@simecgfg.com.
- Media statements and newspapers including:
  - Sydney Morning Herald;
  - Daily Telegraph;
  - The Australian;
  - Southern Highland News;
  - Macarthur Chronicle; and
  - Wollondilly Advertiser.

Stakeholder engagement activities during the exhibition period included meetings and presentations with the following groups:

- Elected State and federal representatives;
- Wollondilly Shire Council and Wingecarribee Shire Council;
- Government agencies including Department of Planning, Industry and Environment (DPIE), Environmental Protection Agency (EPA), Office of Environment and Heritage and Department of Industry (Water);
- Bargo Progress Association, Picton Chamber of Commerce;
- TCCCC; and
- The wider community including local schools, property developers and residents.

7.0 Assessment of impacts

This Chapter presents an assessment of the environmental, economic and social impacts associated with the Amended Project, (detailed in **Chapter 3.0**) where a change in impact from the assessment presented in the EIS is anticipated.

7.1 Subsidence

A revised Subsidence Assessment has been prepared for the Amended Project (refer **Appendix B**), which serves as an update to the Subsidence Prediction and Assessment Report submitted with the EIS (Appendix F to the EIS) (EIS Subsidence Assessment).

7.1.1 Revised Assessment

The methodology used to predict subsidence movements for the Amended Project is unchanged from that presented in the EIS Subsidence Assessment. Several Government agencies commented on the methodology and assessment of subsidence movements, in particular the incremental profile method. These comments are noted and responded to with clarifications in the Response to Submissions Report for the Project.

The Project amendments relevant to the revised Subsidence Assessment are the changes to the mine plan, namely:

- The removal of LW109;
- An amended longwall layout comprising two series of shorter longwall panels, rather than long continuous panels as proposed in the EIS;
- Reduction in the height of extraction within longwall panels from up to 2.85 metres to up to 2.6 metres; and
- Reduction in the proposed longwall width, from up to 305 metres to approximately 285 metres.

The height of extraction and longwall width proposed for the Amended Project is now consistent with the current operations at Tahmoor North.

Longwall geometry under the Amended Project mine plan is summarised in **Table 7-1**. Subsidence impacts predicted by the amended assessment are summarised in **Section 7.1.2**.

Table 7-1 Comparison of Longwall Geometry: EIS vs amended mine plan

Longwalls		Longwall Widths (m)	Depths of Cover (m)	Width-to-Depth Ratios	Extraction Heights (m)
EIS mine plan	LW 101 to LW 108	285 & 305	370 ~ 415 (390 average)	0.70 ~ 0.82 (0.78 average)	2.05 ~ 2.85 (2.6 average)
Amended mine plan	LW 101A to LW 106A	Up to 285	370 ~ 415 (390 average)	0.68 ~ 0.76 (0.73 average)	2.1 ~ 2.2 (2.1 average)
	LW 101B to LW 108B	Up to 285	370 ~ 410 (390 average)	0.69 ~ 0.76 (0.73 average)	2.1 ~ 2.6 (2.5 average)

7.1.2 Revised Impacts

7.1.2.1 Summary of Changes in Impacts

A key finding of the revised assessment is that the reduction in panel width and extraction height and change in layout has resulted in an overall reduction in the maximum predicted subsidence, tilt and curvature to the levels presented in the EIS by approximately 15%. Consistent with the EIS Subsidence Assessment, the revised Subsidence Assessment finds the levels of impact and damage to all identified natural features and built infrastructure will be manageable through the preparation and implementation of Extraction Plans for each longwall panel, and through the implementation of procedures gained over many years of experience in managing subsidence in Tahmoor North.

7.1.2.2 Subsidence Measurements

The revised Subsidence Assessment of the amended longwall mine plan predicts lower maximum subsidence levels than those associated with the EIS mine plan. The reasons are due to both the proposed reduction in panel width and proposed reduction in extraction heights. Maximum subsidence predictions comparing the EIS and amended mine plan are summarised in **Table 7-2** below. The predicted impacts of the Amended Project would be managed as outlined in **Section 7.1.3**.

Table 7-2 Comparison of Maximum Subsidence Predictions: EIS vs amended mine plan

Longwalls		Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm/m)	Maximum predicted total conventional hogging curvature (km^{-1})	Maximum predicted total conventional sagging curvature (km^{-1})
EIS Mine plan	LW 101 to LW 108	1,900	12.0	0.19	0.33
Amended mine plan	LW 101A to LW 106A	1,350	8.7	0.16	0.23
	LW 101B to LW 108B	1,650	10.5	0.18	0.28
EIS Mine plan	LW 109	1,000	8.0	0.09	0.24
Amended mine plan	LW 109	No longer proposed			

7.1.2.3 Watercourses

The location of watercourses in the subsidence study area (SSA) and in relation to the revised longwall layout is summarised in **Table 7-3**.

Table 7-3 Location of Watercourses: EIS vs amended mine plan

Watercourse	Strahler Stream Order	Location under EIS mine plan	Location under amended mine plan
Nepean River	7th order	River is not located within the SSA.	River is not located within the SSA.
Bargo River	5th order	River would not be directly mined beneath and is located 975m from the nearest longwall (LW102). Only a 165 m long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the SSA. This length of the river that is within the SSA is a 4th order perennial stream.	River would not be directly mined beneath and is located 690m from the nearest longwall (LW102A). Only a 165 m long length of the Bargo River that is immediately upstream from the Picton Weir is located inside the SSA. This length of the river that is within the SSA is a 4th order perennial stream.
Hornes Creek	4th Order	Not directly mined beneath and located 360 m south-west of proposed LW108.	Not directly mined beneath, located 540 m south-west of amended LW108B
Carters Creek	3rd order	Creek is not located within the SSA.	Creek is not located within the SSA.
Cow Creek	3rd order	Creek is not located within the SSA.	Creek is not located within the SSA.
Dry Creek	3rd order	Creek is not located within the SSA.	Creek is not located within the SSA.

Watercourse	Strahler Stream Order	Location under EIS mine plan	Location under amended mine plan
Dog Trap Creek	3rd Order	Located directly above proposed LW101 to LW109, with a total length of 3.1 km directly mined beneath.	Located directly above longwalls LW101B and 103B to LW108B, with a total length of 2.8 km directly mined beneath.
Tea Tree Hollow	3rd order	Located directly above proposed LW101 to LW105, with a total length of 1.9 km directly mined beneath.	Located directly above longwalls LW101A to LW106A, with a total length of 2.1 km directly mined beneath.
Tributary to Tea Tree Hollow	3rd Order	Located directly above the proposed LW101 to LW106, with a total length of 2.4 km directly mined beneath.	Located directly above longwalls LW101A to LW103A, and LW105B to LW106B, with a total length of 1.2 km directly mined beneath.
Eliza Creek	2nd order	Creek is not located within the SSA.	Creek is not located within the SSA.
Sugarloaf Gully	2nd order	Creek is not located within the SSA.	Creek is not located within the SSA.
Tributary 1 to Dog Trap Creek	2nd order	Located directly above the proposed LW101 to LW107, with a total length of 2.6 km directly mined beneath.	Located directly above the proposed LW101B to LW108B, with a total length of 2.6 km directly mined beneath.
Tributary 2 to Dog Trap Creek	2nd order	Located directly above the proposed LW101 to LW107, with a total length of 2.4 km directly mined beneath.	Located directly above the proposed LW101B to LW107B, with a total length of 2.4 km directly mined beneath.

A summary of the comparison between maximum predicted subsidence, upsidence and closure along the streams between the EIS mine plan and amended mine plan is shown in **Table 7-4**.

Table 7-4 Predicted Total Subsidence, Upsidence and Closure along Streams resulting from the extraction of the EIS mine plan and amended mine plan

Mine plan	Location	Maximum predicted total subsidence (mm)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
Amended mine plan (MSEC1060) Revised Subsidence Assessment for Longwall 101A to 108B (see **Appendix B**)	Dog Trap Creek	1,550	575	425
	Hornes Creek	20	20	20
	Tea Tree Hollow	1,350	375	250
	Tributary 1 to Dog Trap Creek	1,600	750	750
	Tributary 2 to Dog Trap Creek	1,575	525	450
	Tributary 3 to Dog Trap Creek	1,250	400	350
EIS mine plan (MSEC997) EIS Subsidence Assessment for Longwalls 101 to	Dog Trap Creek	1,850	550	425
	Hornes Creek	50	30	50
	Tea Tree Hollow	1,400	400	275
	Tributary 1 to Dog Trap Creek	1,850	750	725

Mine plan	Location	Maximum predicted total subsidence (mm)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
109 (refer Appendix F of EIS)	Tributary 2 to Dog Trap Creek	1,800	525	450
	Tributary 3 to Dog Trap Creek	1,700	475	400

The predicted maximum total conventional subsidence, upsidence and closure movements due to the extraction of the amended mine plan are less than the predicted maxima from the EIS mine plan. The reasons are due to a combination of the amended mine plan and the proposed reduction in panel width and extraction height. This is expected to reduce the overall frequency and severity of impacts.

7.1.2.4 Houses

A summary comparison between maximum predicted conventional subsidence, tilt and curvature at houses between the EIS mine plan and amended mine plan is shown in **Table 7-5**.

Table 7-5 Maximum Predicted Total Conventional Subsidence, Tilt and Curvature at Hoses resulting from the extraction of the EIS mine plan and amended mine plan

Mine plan	Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm/m)	Maximum predicted total conventional hogging curvature (km-1)	Maximum predicted total conventional sagging curvature (km-1)
Amended mine plan (MSEC1060)	1,650	10	0.13	0.28
EIS mine plan (MSEC997)	1,900	13	0.17	0.33

The amended mine plan will result in lower predicted total subsidence, tilt and curvature at points on the surface directly above the longwalls; when compared to original mine plan contained in the EIS. As mentioned above, the predicted maximum total conventional subsidence, tilt and curvatures due to the extraction of the amended mine plan are less than the predicted maxima from the EIS mine plan by approximately 15%. This reduction is due to both the proposed reduction in panel width and proposed reduction in extraction heights.

It should be noted that whilst the overall predicted total subsidence, tilt and curvatures have been reduced, predictions at points on the surface directly above the longwalls may differ (increase or decrease) from the predictions previously provided for the original mine plan, for the following reasons:

- There are some houses located where the longwall footprint has been extended, mainly around the north-western ends of LWs 101A to 106A. As a result of the amended footprint these houses are now directly above the longwalls and may potentially have increased or decreased curvature or tilt from subsidence movements;
- There are some houses, mainly above the main gate (western) side of previously proposed LW 108, and areas that lie in between the proposed split A and B series panels where the longwall footprint has been reduced. As a result of the amended position, some houses are no longer directly above these longwall panels. It is expected that these houses would be subject to decreased subsidence predictions, and/or would be at a reduced risk of subsidence impacts due to depth amendments; and

- As the panel widths have been reduced but pillar widths have remained unchanged, the longwalls in the amended mine plan are staggered in their positions relative to the EIS mine plan. It follows, therefore, that the positions of each house on the surface relative to the proposed longwalls has changed. For example, houses on the surface above the centrelines of longwalls in the amended mine plan may have been previously located directly above a chain pillar, and vice versa. Depending on the new location of the longwalls relative to housing, subsidence impacts have predominately decreased in tilt and curvature with minimal increased tilt and curvature increases predicted. Subsidence predictions have been updated in Table D.03 of **Appendix B**.

A summary comparison between the overall distribution of the assessed impacts at houses between the EIS mine plan and amended mine plan is shown in **Table 7-6**.

It can be seen from **Table 7-6** that the overall distribution of impacts under the amended mine plan has reduced compared to the assessments previously provided for the EIS mine plan. The longwall reduction is the result of the amended mining footprint; with 180 fewer houses now directly impacted. Most of these houses are located above previously proposed LWs 107 and 108 within the urban areas of Bargo township.

As the houses are generally predicted to experience less subsidence, tilt and curvature due to the amended mine plan compared to the EIS mine plan, it is expected that the overall frequency and severity of impacts would reduce. Whilst the predicted subsidence movements and assessed distribution of impacts are reduced for the amended mine plan, the recommendations for managing potential impacts to residential structures are unchanged from the EIS and impacts would be managed via an Extraction Plan process.

Table 7-6 Assessed impacts for houses resulting from the extraction of the EIS mine plan and amended mine plan

Mine plan	Group	Repair Category			
		No claim or R0	R1 or R2	R3 or R4	R5
Amended mine plan (MSEC1060)	All houses (total of 1,458)	1,118 (77 %)	234 (16 %)	86 (6 %)	20 (1 %)
	Directly above proposed longwalls (total of 571)	308 (54 %)	172 (30 %)	73 (13 %)	18 (3 %)
	Directly above solid coal (total of 887)	810 (91 %)	62 (7 %)	13 (1 %)	2 (< 0.5 %)
EIS mine plan (MSEC997)	All houses (total of 1,458)	1,019 (70 %)	296 (20 %)	115 (8 %)	28 (2%)
	Directly above proposed longwalls (total of 751)	391 (52 %)	234 (31 %)	100 (13 %)	26 (3%)
	Directly above solid coal (total of 707)	628 (89 %)	62 (9 %)	15 (2 %)	2 (<0.5%)

7.1.2.5 Bargo Waste Management Centre (BWMC)

The BWMC is on Anthony Road, Bargo, and is located directly above the proposed Longwall 102B, as shown in Drawing No. MSEC1060-20 in the revised Subsidence Assessment (**Appendix B**). The BWMC is operated by Wollondilly Council and accepts waste that is free of food and putrescible material.

In response to a request from Wollondilly Shire Council in their submission on the Project, Tahmoor Coal commissioned geotechnical engineering consultant Douglas Partners to conduct a visual inspection of the site in October 2019, which was then used to inform the subsidence assessment with respect to the landfill (see Section 9.3 of the revised Subsidence Assessment, **Appendix B**).

The BWMC is expected to experience subsidence movements as a result of the Amended Project. Mining directly beneath the BWMC may potentially result in impacts on:

- The slopes of the landfill;
- The surface water treatment. Although, the likelihood of impacts is considered low based on experience of mining beneath farm dams and other wastewater treatment ponds during the mining of Longwalls 22 to 31 at Tahmoor Mine; and
- A new weighbridge which is currently being designed by Council. Although, the likelihood of impacts is considered low based due to the small footprint of the weighbridge.

Whilst the likelihood of slope instability, damage to the pond and damage to the proposed weighbridge due to mining-induced subsidence is considered to be low, potential impacts can be controlled by selecting and implementing a range of feasible measures in consultation with Wollondilly Shire Council. These measures are provided in **Section 7.1.3**.

While there may be potential impacts, appropriate management measures would be put in place in consultation with Wollondilly Shire Council to ensure that the BWMC would remain safe and serviceable during mining for any orientation, extension or shortening of longwalls within the Extent of Longwalls boundary, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

7.1.3 Revised Management and Mitigation Measures

As noted previously, the revised subsidence assessment generally predicts less subsidence at houses under the amended mine plan compared to the EIS mine plan. Whilst the predicted subsidence movements and assessed distribution of impacts are reduced for the amended mine plan, the recommendations for managing potential impacts to residential structures are unchanged from the EIS and impacts would be managed via an Extraction Plan process. The measures outlined in Section 11.1.7 and Appendix F of the EIS prepared for the Project remain applicable to the Amended Project.

In addition, Tahmoor Coal will, in consultation with Wollondilly Shire Council, study the potential for impacts to the BWMC and develop management measures to ensure that the BWMC remains safe and serviceable, as well as ensure that impacts on the BWMC do not result in environmental consequences on the adjacent Dog Trap Creek catchment. The management measures may include a combination of:

- Mitigation or strengthening measures prior to mining, particularly to the landfill slopes and surface water treatment ponds;
- Installation of a monitoring systems, which includes, among other things, the monitoring of ground movements, and condition of the landfill slopes, leachate collection system, the storage ponds, storage containers and the weighbridge;
- Conduct regular visual inspections of the BWMC; and
- Implement planned response if triggered by monitoring and inspections.

7.1.4 Conclusion

The revised Subsidence Assessment concluded that the levels of impact and damage to all identified natural features and built infrastructure will be manageable, as was the conclusion of the Subsidence Assessment in the EIS and can be controlled by the preparation and implementation of Extraction Plans and associated sub-plans. It is noted that the predicted maximum total conventional subsidence, tilt and curvatures due to the extraction of the Amended Layout are less than the predicted maxima from the EIS Layout by approximately 15%, due to both the proposed reduction in panel width and proposed reduction in extraction heights.

Tahmoor Mine has a long history of successfully implementing Extraction Plans to safely mine beneath natural features and infrastructure. Over the past thirteen years, Tahmoor Mine has mined under approximately 1,890 houses above Tahmoor Longwalls 22 to 29, the majority of which experienced little if any damage from mine subsidence impacts. This has involved proven processes from 15 years of successful interactions with relevant stakeholders, identification of impacts, risk assessment and controls and implementation of management measures including mitigation and preventative works, monitoring plans, Trigger Action Response Plans (TARPs) and communications plans.

7.2 Groundwater

An updated Groundwater Assessment has been prepared for the Amended Project and is presented in **Appendix C**. The assessment considers the differences in impacts compared to the original Project as presented in the EIS.

7.2.1 Revised Assessment

The Groundwater Assessment has been updated as follows:

- The numerical model was revised to incorporate comments raised by Government agencies and DPIE's Independent Peer Reviewer; and
- The relevant Project amendments were incorporated into the revised numerical model.

7.2.1.1 Revised Numerical Model

DPIE's peer reviewer confirmed that the numerical groundwater model, as presented in the EIS, was fit for purpose and that the overall methodology (allowing for refinements) is consistent with best practice and suitable for dewatering impact assessment, management plans and licensing decision making.

Government agencies, including the DPIE, the DoI Water, the Natural Resources Access Regulator, and the DPIE's Independent Reviewer raised several items relating to the numerical model used to assess the impacts of the Project on groundwater resources. Following receipt of Government agency submissions, a meeting was held in April 2019 between Tahmoor Coal, DPIE, DoI Water, Natural Resources Access Regulator, and the DPE's Independent Peer Reviewer.

Several changes were made to the numerical model to address the comments made by Government agencies via submissions, at the April 2019 meeting, and in DPIE's Independent Peer Reviewer report. The key changes are presented in **Table 7-7**.

Table 7-7 Key changes to the numerical modelling for the Amended Project

Key Change	Comment
Incorporate a representation of surface cracking in the numerical modelling, relying on literature and recent investigation at Redbank Creek, and incorporating this effect in estimated surface water losses.	This has been incorporated in the model, based on literature and local monitoring data.
Account for transient river stages and river leakage in estimated surface water losses.	This has been incorporated in the model, based on available monitoring data.
Revise the representation of lake bed and stage elevations at Thirlmere Lakes. Improve calibration to groundwater levels in Thirlmere Lakes bores.	This has been revised based on data from Hydro Engineering Consulting (HEC) (see **Appendix C**). In the EIS groundwater assessment (Appendix I of the EIS) lake stages were set at a constant stage height. In order to better capture variation of lake levels, the MODFLOW River package was updated to include transient stages for the five freshwater lakes (refer Section 4.4.5 of the revised Groundwater Assessment in **Appendix C**).

Key Change	Comment
Improve the overall model performance in matching historical groundwater levels and mine inflows at Tahmoor;	The history match to groundwater inflow is good, and overall calibration performance to groundwater levels has improved
Include groundwater pumping from private bores in the modelling.	Recent entitlement data has been obtained from WaterNSW, however estimates of actual groundwater pumping data are limited. As a result, a single predictive scenario incorporating an estimate of groundwater use at local bores has been run for assessment of key impacts.

7.2.1.2 Relevant Project Amendments

The Project amendments relevant to the revised Groundwater Assessment are the changes to the mine plan, namely:

- An amended longwall panel layout and the removal of LW109;
- A reduction in the height of extraction within the longwall panels from up to 2.85 m to up to 2.6 m; and
- A reduction in the proposed longwall width, from up to 305 m to approximately 285 m.

These changes affect the height of the connected fracture zone and have a slight change on depth to which surface cracking is inferred to extend down from ground surface. The change to the footprint of longwall panels means that there is a change to areas in which surface cracking would occur (i.e. it will not occur with the same intensity above the new central mains than it would directly above panels).

7.2.2 Revised Impacts

Impacts of longwall mining on the groundwater regime arise from changes in bulk rock mass permeability caused by the fracturing associated with longwall subsidence, and the pumping out of groundwater that enters the mine as a consequence. The caving of the overburden and the subsequent extraction of groundwater impacts the hydrogeological system during and after mining operations. The Groundwater Assessments prepared for both the Project as presented in the EIS and the Amended Project assessed the following impacts:

- **Aquifer Interference** - inflow of water to the underground mine and the management of that mine water;
- **Baseflow** - impacts of baseflow capture on surface waterways during and after mining;
- **Drawdown** - impacts on groundwater levels during and after mining; and
- **Groundwater quality** - impacts on groundwater quality via mining-induced mixing of groundwater from different strata.

Impacts on groundwater were also assessed against the criteria for minimal impact considerations specified by the *NSW Aquifer Interference Policy* (NSW Office of Water, 2012) (AIP) which relates to:

- **Aquifer Interference** - licensable takes of water (and their partitioning);
- **Drawdown** - water table and pressure head drawdown; and
- **Groundwater quality**.

The updated assessment for the Amended Project has re-assessed the impacts listed above and considers the differences compared to the original project as presented in the EIS.

An overview of the revised Groundwater Assessment (**Appendix C**) is provided in **Section 7.2.2.1** to **Section 7.2.3**and includes a summary of changes in impacts of the Amended Project compared to the EIS Project

7.2.2.1 Summary of Changes in Impacts

Table 7-8 presents a summary of the differences between the key impacts of the EIS project and the Amended Project on groundwater resources.

Table 7-8 Summary of differences

Original EIS	Amended Project	Comment
Aquifer interference		
Mine inflow (average): 4.7 ML/d Mine Inflow (peak): 7.5-8 ML/d (2029-30 and 2032)	Mine inflow (average): 4.7 ML/d Mine Inflow (peak): 7.5-8 ML/d (2028-29 and 2032-3)	Mine inflow would be similar to that presented in the EIS. Refer **Section 7.2.2.2**. Groundwater licensing requirements are similar to the EIS, including the very low likelihood of 'take' from Groundwater Sources other than the Nepean Sandstone Groundwater Source.
Baseflow		
Peak take (ML/d): Pheasants Nest MZ: 0.04. Stonequarry MZ: 0.06. Maldon Weir MZ: 0.6.	Peak take (ML/d): Pheasants Nest MZ: 0.014. Stonequarry MZ: 0.01. Maldon Weir MZ: 0.2.	Similar in overall magnitude to the EIS, but now considered to be more reliable as a result of revised modelling in line with submissions. The revised assessment also includes assessment of take from more Water Sources or zones than provided for in the EIS. Refer **Section 7.2.2.3**.
Drawdown at High Priority GDE's		
Thirlmere Lakes alluvium - Incremental: 0.03 m Thirlmere Lakes alluvium - Cumulative: 0.02 to 0.05 m	Thirlmere Lakes alluvium - Incremental: 0.02 m Thirlmere Lakes alluvium - Cumulative: 0.08 to 0.48 m	Similar magnitude of incremental drawdown at Thirlmere Lakes due to Tahmoor South. Refer to **Section 7.2.2.4** Higher groundwater drawdown at Thirlmere Lakes: • Cumulative impact in EIS: 0.05 m • Cumulative impact for Amended Project: 0.13 to 0.48 m (note this drawdown does not translate to a predicted change in lake water levels, as explained in **Section 7.2.2.4**) The higher groundwater drawdown for the cumulative scenario is associated with the inclusion of surface cracking in the numerical model associated with the Tahmoor North area, rather than changes to the Tahmoor South mine plan as presented in this Project Amendment Report. Refer to **Section 7.2.2.4**.
Drawdown at neighbouring bores by greater than 2m		
31 registered bores	46 registered bores	Greater number of registered bores are predicted to be affected under the Amended Project. This is associated with a revised method of assessment, rather than changes to the mine plan in the Project Amendment Report. Refer to **Section 7.2.2.5**.
Effect on groundwater quality		
No specific metrics.	No specific metrics.	Impacts to groundwater quality remain consistent with the assessment presented in the EIS prepared for the Project. The Amended Project remains within the Level 2 Minimal Impact Considerations of the AIP for the 'Highly Productive' Groundwater source comprising the *Permo-Triassic* porous rock aquifer. The requirement for a Groundwater Management Plan (GWMP) remains consistent. Refer to **Section 7.2.2.6**.

7.2.2.2 Revised Impacts – Aquifer Interference

Sensitivity testing of the numerical model suggests that mine inflows could be higher than predicted by the 'base case' model. That is, average inflows of 3.5 to 5.1 ML/d (1,600 to 1,900 ML/a) and peak inflows during year 7 and year 11 of the Amended Project of up to 2,800 ML/a, possibly up to 3,200 ML/a in a 12-month period for the proposed development.

The peak groundwater inflow to the Amended Project would likely be 2,300-2,900 ML/a. The base case model predicts 2,850 ML/a, equivalent to a peak annual inflow of 8 ML/d. Empirically, these inflows are higher than expected, given that the historical inflows are 3-5 ML/d and the proposed longwall geometry is similar to that in recent Tahmoor North longwalls. These peak inflows are expected to occur during the extraction of Longwalls 104B-105B and 107B-108B (anticipated to be in the period 2028-29 and 2032-3033 respectively). The groundwater entitlement volume currently held by Tahmoor Coal is 1,642 ML/a. The Amended Project would utilise the existing groundwater extraction and discharge licences.

The groundwater assessment for the Amended Project (**Appendix C**) confirms that there remains a good match between the 'base case' model and the variance given in the sensitivity modelling. The high inflows from the sensitivity run are considered overly conservative for licensing annual rates of groundwater extraction however are presented for completeness. The conclusions remain consistent with the assessment prepared for the EIS with a high degree of correlation demonstrated between the modelled inflows for the calibrated historical model, and the observed inflows.

In order to calculate groundwater 'take' from the relevant Groundwater Sources, water balances were re-assessed. These included groundwater flow to/from other defined zones in the area, which comprised:

- Nepean MZ2 (the zone in which the Project lies);
- Nepean MZ1;
- Sydney Central; and
- Sydney South.

The average change in flux between Nepean MZ2 and neighbouring zones was calculated. The findings remain unchanged from the estimates reported in the EIS prepared for the Project. It is therefore considered that the predicted influxes continue to not represent a significant component of these groundwater resources.

The take from the other zones are in the range 0-1 ML/a. In practical terms these do not appear significant enough to license as the total licence allocation recommended for the mine from the Nepean GMA MZ2 is sufficient to cover the total take. groundwater licensing requirements therefore remain unchanged from the EIS.

7.2.2.3 Revised Impacts – Baseflow

Waterways

Updated baseflow impacts predicted as a result of the Amended Project and the cumulative case (Tahmoor North and other Southern Coalfields mines) are summarised in **Table 7-9**.

Table 7-9 Predicted baseflow reductions to watercourses

Watercourses	Proposed Development (Estimated max ML/d)	Cumulative Case (Estimated max ML/d)
Eliza Creek	0.001	0.005
Carters Creek	0.002	0.002
Blue Gum Creek	0.015	0.140
Dog Trap Creek	0.101	0.133
Tea Tree Hollow	0.027	0.088
Cow Creek	0.018	0.019

Watercourses	Proposed Development (Estimated max ML/d)	Cumulative Case (Estimated max ML/d)
Stonequarry Ck	0.013	0.077
Bargo River (SW-1)	0.002	0.002
Bargo River (SW-13)	0.051	0.175
Bargo River (SW-14)	0.083	0.303
Hornes Ck	0.001	0.001
Nepean River	0.340	1.181
Matthews Creek	0.001	0.020
Cedar Creek	0.005	0.056
Redbank Creek	0.002	0.030
Avon River	0.018	0.228
Cordeaux River	0.028	0.422
Rumker Gully	0.000	0.000
Newlands Gully	0.000	0.000
Myrtle Creek	0.001	0.020
Dry Creek	0.001	0.002

Based on simulated baseflow capture the sub-catchments most affected by the Project would be Dog Trap Creek, Bargo River between SW-1 and SW-13 and Nepean River SW-21.

The modelling indicates that peak baseflow effects from Tahmoor South would occur at different times for different watercourses. For example: at Dog Trap Creek, the modelling indicates an early peak in 2023-24 and a slight recovery for a period before a new and more persistent effect peaking in 2040-50. Peak affects are predicted for Bargo River SW13 in 2033 and Cow Creek in 2070 (after the completion of mining at Tahmoor South).

With respect to cumulative impacts, it is noted that predicted impacts at Stonequarry Creek and Blue Gum Creek (watercourses located closer to the approved Tahmoor/Tahmoor North longwalls) reflect the greater influence of historic mining in these areas compared to the effects of Tahmoor South. With respect to Blue Gum Creek it is noted that the revised groundwater assessment predicts slightly higher maximum baseflow depletion impacts due to Tahmoor South compared to the EIS (0.015 ML/d verses 0.011 ML/d in the EIS), however the mean impacts (0.005 ML/d) remains consistent with that predicted in the EIS.

At Cow Creek (within the Metropolitan Special Area) a maximum baseflow reduction rate of 0.018 ML/day and a long-term baseflow reduction rate of 0.014 ML/day is predicted due to the Amended Project. A maximum baseflow reduction rate of 0.019 ML/day and a long-term baseflow reduction rate of 0.015 ML/day have been predicted based on cumulative impacts. The revised Surface Water Impact assessment (**Appendix C**) assessed the impacts of baseflow losses on creek flowrates and identified that the estimated level of change to streamflow in Cow Creek, as a result of the predicted baseflow reduction, may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions. However, the assessment indicated that the minor baseflow changes at Cow Creek would have no discernible impact on Sydney water supply sources.

At the Wirrimbirra Sanctuary, located halfway along Tea Tree Hollow and one of its main tributaries, loss of baseflow due to Tahmoor South is predicted to peak at 0.016 ML/d. The cumulative mining effect is predicted to be 0.021 ML/d. These losses are calculated as the upstream losses in the catchment of Tea Tree Hollow and the tributary to the northern (downstream) boundary of the Wirrimbirra Sanctuary property. Peak losses within this sub-catchment are predicted to occur from about year 4 of the Project (as the site is mined under), and persist into the future, due to combined drawdown and surface cracking effects.

Surface Water Sharing Plans

The Amended Project remains to be subject to the following (surface) water sharing plan: *Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water Sources 2011*. Within the WSP, the proposed development is located within the Upper Nepean River source. The Amended Project (including other mining as part of the cumulative impact assessment) would result in a reduction in baseflow in six management zones (MZs) in the Nepean River Water source:

- Maldon Weir MZ: maximum baseflow depletion is predicted to be approx. 0.19 ML/d (Tahmoor South), 0.49 (Tahmoor total) and 0.5 ML/d (cumulative mining effect).
- Upper Nepean Tributaries Headwaters MZ: 0.049 ML/d (Tahmoor South), 0.052 (Tahmoor total) and 0.5 ML/d (cumulative mining effect);
- Maguires Crossing MZ: 0.028 ML/d (Tahmoor South), 0.029 (Tahmoor total) and 0.032 ML/d (cumulative mining effect);
- Pheasants Nest Weir to Nepean Dam MZ: 0.014 ML/d (Tahmoor South), 0.015 (Tahmoor total) and 0.016 ML/d (cumulative mining);
- Little River MZ: 0.01 ML/d (Tahmoor South), 0.15 (Tahmoor total) and 0.15 ML/d (cumulative mining effect); and
- Stonequarry Creek MZ: 0.008 ML/d (Tahmoor South), 0.044 (Tahmoor total) and 0.085 ML/d (cumulative mining effect).

Water Storage Reservoirs

There are five WaterNSW dams partly or wholly within the groundwater model domain. The predicted leakage rates associated with the Project are small. Capture of leakage/baseflow into Lake Nepean, being the closest to Tahmoor South, is predicted to be up to 0.006 ML/d for the project (this is similar to the 0.007 ML/d predicted in EIS prepared for the Project).

The revised surface water impact assessment (**Appendix D**) identifies that in the long term the predicted baseflow losses would result in negligible and indiscernible impacts to mean daily waterflow within these management zones. The revised Surface Water impact assessment identifies that the combined effects of the Tahmoor South Project, consumptive groundwater extraction and the effects of other existing mining projects are predicted to have a negligible impact on Sydney's water supply sources.

Special Areas

WaterNSW manages the Metropolitan Special Area (to the east of Tahmoor Mine) and Warragamba Special Area (to the west). Impacts to the Warragamba Special Area have not changed from the assessment in the EIS prepared for the Project. For the Metropolitan Special Area, the south-eastern ends of the proposed longwall panels have been deliberately planned to be set back from this area. The Amended Project is predicted to result in an average of 0.05 ML/d (18 ML/a) decline in baseflow in the Metropolitan Special Area. This impact is predicted to peak at approximately 0.1 ML/d (36 ML/a) in around 2100 before declining again. In comparison, environmental releases from Avon and Nepean Dams totalled 8,463ML for the 12 months to November 2019 (as noted on the WaterNSW website).

7.2.2.4 Revised Impacts – Drawdown at High Priority Groundwater Dependent Ecosystems

Several high priority Groundwater Dependent Ecosystems (GDEs) are identified in the relevant Water Sharing Plan (Metropolitan Groundwater Sources).

The Aquifer Interference Policy (AIP) specifies that the '*minimal harm criteria*' is "*less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from* … a high priority GDE". With respect to Thirlmere Lakes, which are the closest high priority GDEs to Tahmoor Mine, two monitoring bores provide relevant water level fluctuation information:

- GW075409/01, screened 3-13 m across alluvium and Hawkesbury Sandstone, and adjacent to Lake Couridjah. Water levels in this bore reside below the alluvium and within the weathered rock. This may not be completely relevant to the GDE. Water level fluctuation in this bore is up to 2.3 m; and
- GW075410, screened 2.5-14.5 m in alluvium, and adjacent to Lake Nerrigorogang. Water level fluctuation in this bore is up to 6 m within a year, or up to 10 m over the historical record.

These records are used for subsequent assessments against the AIP. The record from GW075410 is the most representative of groundwater levels within the alluvium, however, both bores have been used to assess the predicted drawdown against the AIP.

Impacts of the Tahmoor South Project

The Thirlmere Lakes are predicted to experience groundwater drawdown of <=0.02 m due to the operation of Tahmoor South Project, which is located 3.5 km or more from the lakes. The revised modelling indicates a reduction in maximum predicted drawdown at Lake Couridjah (0.01 m in the revised assessment compared to 0.03 m in the EIS) and at Lake Barabah (0.01 m in the revised assessment compared to 0.02 m in the EIS).

As per the AIP, this is less than 1% of observed water level fluctuation in the alluvium. The assessment against the AIP criteria as a percentage of water level fluctuation highlights that the Tahmoor South Project would have negligible effect on groundwater levels at the Thirlmere Lakes. This is consistent with the distance between the Amended Project and the lakes, and the position of the historical Tahmoor North longwall areas between the Amended Project and the lakes.

Except for Thirlmere Lakes, the other high priority GDEs are over 20 km away (being O'Hares Creek, Macquarie Rivulet estuary) and therefore lie outside the active domain of the impact assessment model. Due to the distance they are expected to experience no drawdown impact or baseflow depletion as a result of the Amended Project. This conclusion is supported when considering the magnitude of drawdown impacts at Thirlmere Lakes (located <4 km away).

Cumulative Impacts

The revised groundwater modelling assessed predicted cumulative drawdown at the Lakes as a percentage (%) of lake water level fluctuations as per the AIP.

At three of the lakes, the predicted groundwater drawdown was found to be consistently lower than the AIP threshold (Nerrigorang, Werri Berri and Baraba). At Lakes Couridjah and Gandangarra (the two closest to historical longwalls at Tahmoor North), the simulated drawdown was predicted to be greater, at 9 and 12% of the shallow water table fluctuation. This is indicative of a 'Level 2' impact under the AIP, which is consistent with the overall cumulative impact level (Level 2) identified in the EIS.

It is important to note that these cumulative effects are associated with the influence of historic Tahmoor North operations rather than contributions of the Amended Project. As noted above, the influence of the Tahmoor South project itself on the Lakes is less than 1% of observed water level fluctuation in the alluvium under the AIP.

Furthermore, surface water balance modelling of the Lakes undertaken as part of the Surface Water Impact Assessment (**Appendix D**) predicts a negligible increase in groundwater recharge ('leakage') from the Lakes as a result of the Project, and a negligible decrease in outflows to Blue Gum Creek. The changes are predicted be unmeasurable or imperceptible in the field and approaching the limits of accuracy of the model. As a result, average modelled Lake water levels are predicted to decrease by very small amounts which would be imperceptible and very small compared to natural variability.

Culturally Significant Sites

No 'high priority' culturally significant sites are identified in the relevant Water Sharing Plan (Metropolitan Groundwater Sources). As a result, the proposal is not considered a risk to such sites.

The Wirrimbirra Sanctuary is located along the middle of Tea Tree Hollow and above the proposed 'A' block of longwalls and was identified in the submission received by the Heritage Council. Notably the revised subsidence assessment (**Appendix B**) predicts overall maximum subsidence across the Sanctuary property to be less than the predicted levels associated with the EIS mine plan, with the exception of a minor increase to subsidence predictions at a shed within the property (from a range of 850-1150 mm to 900-1300 mm). Notwithstanding, the position of Tea Tree Hollow above longwalls means that it will be subject to drawdown via depressurisation and also surface cracking effects (refer to the revised Subsidence Assessment in **Appendix B** and discussed in **Section 7.1**). As such this property is predicted to experience approx. 5-10 m of water table drawdown and a reduction in surface water flow within the Tea Tree Hollow sub-catchment by approximately 0.016-0.02 ML/d.

The surface water, terrestrial ecology and historic heritage impacts to Wirrimbirra Sanctuary are further discussed in **Appendices D, E and H**, respectively. The assessments indicate that impacts predicted at the Sanctuary overall remain consistent with that predicted in the EIS.

7.2.2.5 Revised Impacts – Drawdown at Neighbouring Bores

The revised Groundwater Assessment predicts that a total of 46 registered bores and four unregistered bores are expected to experience drawdown of greater than 2 m as a result of the Amended Project. The number of bores impacted beyond 2 m rises to a possible 73 registered bores and 8 unregistered bores, respectively if the results of all deterministic scenarios are considered. A summary of the number of registered bores impacted by the Amended Project and the degree of impact is presented in **Table 7-10**).

Table 7-10 Number of registered bores with predicted impacts above threshold

Degree of Impact	No. of Registered Bores Exceeding Threshold			
	Calibrated 'Base Case' Model		Sensitivity Runs (Max Drawdown)	
[m]	Tahmoor South Impact	Cumulative Mining Impact	Additional Bores: Tahmoor South	Additional Bores: Cumulative Mining
>2 m	46 bores (plus, a further six already predicted to be affected by Tahmoor North) = 52	228	21	36
Total bores in model area	791			

Of the 46 bores predicted to be affected beyond 2 m due to the Amended Project, eight are predicted to experience 5-10 m maximum drawdown and 16 to experience greater than 10 m, meaning that 22, or 50%, are predicted to experience 2-5 m drawdown. As noted in **Table 7-10**, a further six are predicted to be already affected beyond 2 m by Tahmoor North.

Accounting for cumulative impacts of mining at Tahmoor and the other mines within the groundwater model the number of impacted bores increases to 228 registered bores potentially affected and 12 sites from the project bore census. The deterministic scenarios indicate an even more conservative assessment of the number of bores that could be affected beyond the 2 m threshold by mining, with up to 264 registered bores and 12 census bores (the same as the base case) potentially affected.

7.2.2.6 Revised Impacts – Groundwater Quality

Mining-induced changes to the hydraulic properties and depressurisation of the strata in the Tahmoor South Project area will result in mixing of potentially chemically different groundwater between overlying and underlying units. However, it is considered unlikely that this will result in changes to the beneficial uses of groundwater in the Permo-Triassic rock units. The risk of such impacts decreases with distance from the mine footprint.

The Amended Project would result in a Level 1 minimal impact consideration classification.

7.2.3 Revised Management and Mitigation Measures

The mitigation measures outlined in Section 11.3.5 and Appendix I of the EIS prepared for the Project remain applicable to the Amended Project. Although, the revised Groundwater Assessment provides further detail regarding monitoring of groundwater during operation of the project, such that monitoring would include:

- A condition assessment of bores and monitoring equipment (VWPs) of new bores around Tahmoor South, with a specific update of the GWMP;
- Re-install at least one bore in the footprint of a Tahmoor North longwall (e.g. at TNC029) to monitor post-mining groundwater level and groundwater quality; and
- Monitoring in longwall centre-lines of pre- and post-mining conditions Tahmoor South. This is would be undertaken for the longwall (LW101A), and then every two or three after that. Packer testing would also be undertaken, followed by installing VMPs at four elevations in the Hawkesbury Sandstone and then two in the Bulgo Sandstone to assist in defining a profile of fracturing and depressurisation above longwalls.

In addition to these measures, since exhibition of the EIS, Tahmoor Coal has installed a number of piezometers in and around Longwalls 31-32 and the Western Domain longwalls (in Tahmoor North) at the northern edge of the mine. These have already, and will in future, provide useful information for conceptualisation and model calibration/ verification.

7.2.4 Conclusion

The groundwater assessment carried out for the EIS was overall found to be fit for purpose by the DPIE independent reviewer, who found the assessment to be based on “conservative assumptions” with “sound calibration performance to multiple criteria.” The groundwater assessment for the Amended Project was revised based on extensive discussions with agencies including the Peer Reviewer as further detailed in the Response to Submissions Report. The groundwater modelling provided in the EIS and revised assessment (**Appendix C**) is therefore considered to be robust and conservative for the purposes of impact prediction.

Based on the findings of the revised groundwater assessment, the Amended Project falls within the Level 2 Minimal Impact Considerations of the AIP for the ‘Highly Productive’ Groundwater source comprising the Permo-Triassic porous rock aquifer. The modelling predicts drawdown beyond 2 m at up to 46 registered and four unregistered bores. Hence, the existing Groundwater Management Plan (GWMP) at the mine would be updated to incorporate Tahmoor South. Tahmoor Coal has extensive experience managing subsidence and groundwater impacts from over 30 years of longwall mining in the area. This includes make-good measures for any bores identified to be affected by the mine. It is noted that to-date Tahmoor Coal has only been called upon to provide ‘make-good’ provisions at two groundwater bores, despite over 70 being predicted to be affected by the operation of Tahmoor North. This further demonstrates the highly conservative nature of the groundwater modelling applied to the proposed development.

The updated GWMP for Tahmoor South would define groundwater level triggers, and a TARP, with management responses including investigation, mitigation and make-good measures. The existing groundwater monitoring bores/piezometers network would also be updated as necessary to incorporate Tahmoor South.

Thirlmere Lakes is a High Priority Groundwater Dependent Ecosystem listed in the relevant Water Sharing Plan. Despite there being some limited groundwater drawdown predicted in this area, the predicted changes in groundwater-surface water interaction and consequent reduction in surface water level due to the Amended Project are considered negligible. Cumulative effects of mining activities, including historical operations at Tahmoor Mine, have been modelled and quantified and assessed as being minor.

7.3 Surface Water

Tahmoor Coal submitted a Surface Water Assessment in support of the EIS prepared for the Project. An updated assessment has been prepared for the Amended Project and is presented in **Appendix D**. The amended Surface Water Assessment comprises four components:

- A Baseline Assessment report, which documents the available baseline and background information and analysis of the climate, hydrology and water quality characteristics of local and regional water resources of relevance to the Amended Project;
- A Flood Study comprising an assessment of the effects of the Amended Project with regard to flooding by overlying watercourses and their floodplains;
- A Water Management System and Site Water Balance Report (WMS & SWB), which describes the existing water management system, the proposed amendments to site water management and the results of a water balance model simulation of the proposed water management system over the Amended Project life. This includes water supply reliability, the adequacy of the current discharge licence to Tea Tree Hollow to manage disposal of water during periods/circumstances of predicted excesses and the risk of overflows under a wide range of climatic conditions which could occur during the life of the Amended Project; and
- A Surface Water Impact Assessment report (SWIA), which contains a detailed qualitative and quantitative assessment of the potential impacts which are either predicted to occur or could occur from the Amended Project. This includes the effect of predicted subsidence on natural stream features, potential effects to catchment yield, flow diversion and stream water quality.

The assessment considers the differences in surface water impacts compared to the original project as presented in the EIS.

7.3.1 Revised Assessment

The Surface Water Assessment reports have been updated in response to Government agency and community submissions, and to incorporate the Project amendments outlined in **Chapter 2.0**.

The reports were updated as follows

- Baseline Assessment: has been updated since submission of the EIS to:
  - Incorporate additional streamflow and surface water quality monitoring
  - Use the additional streamflow monitoring data in the re-calibration of the catchment models (AWBM) for Dog Trap Creek Downstream, Eliza Creek and Bargo River Upstream. Statistical metrics for the re-calibrated models are provided in Table 14 of the revised Surface Water Baseline Study.
  - Prepare improved estimations of the baseflow indices and baseflow recession rates for each catchment. The baseflow index and baseflow recession rates have reduced for Dog Trap Creek and increased for Eliza Creek and Bargo River Upstream from the previous model calibrations. As such, the recalibrated models provide for increased confidence in the simulated streamflow for each catchment, specifically in the simulation of low flows and baseflow recession.
- Flood Study: the approach for the flood study remains consistent with that presented in the EIS and has been updated to incorporate the revised subsidence predictions for the Amended Project;
- WMS & SWB: the approach for the flood study remains consistent with that presented in the EIS, and has been updated to incorporate the Project amendments; and
- SWIA: the approach for the SWIA remains consistent with that presented in the EIS, although an assessment of Cow Creek, Eliza Creek and Carters Creek has been included.

The project amendments relevant to the surface water assessments are:

- The amended mine plan which would alter:
  - The extent of subsidence movements, influencing flood impacts and impacts to creeks (both flow and water quality);
  - The level of groundwater drawdown, which in turn impacts the extent of impacts on baseflow in waterways;
  - The volume of mine water take, which impacts the required capacity of the mine water management system;
- The amended REA extension, which would alter the management of surface water runoff at the REA.

These Project amendments have been assessed in each of the surface water reports.

7.3.2 Revised Baseline Assessment

The Baseline Assessment has been revised to incorporate additional baseline data assessed for the Amended Project following submission of the EIS. The report has also been revised to address key issues raised in the EIS submissions pertaining to the baseline hydrology and water quality characteristics of the proposed Amended Project area. The key changes relate predominately to the collation and analysis of additional streamflow monitoring and water quality monitoring data for the Amended Project area and surrounding region that has led to improvements to streamflow.

7.3.2.1 Catchment Modelling and Streamflow Analysis

The catchment models for Dog Trap Creek, Eliza Creek and Bargo River Upstream were recalibrated with additional streamflow data monitored between 2015 and 2019. **Table 7-11** presents a comparison of the statistical metrics for the previous calibration and the revised calibration incorporating additional streamflow monitoring data.

Table 7-11 AWMB statistical metrics

Stream/Gauging Station	Ratio of Model to Recorded Streamflow		Coefficient of Determination on Monthly Flows (r^2)		Nash Sutcliffe Coefficient of Efficiency on Monthly Flows	
	Amended	EIS	Amended	EIS	Amended	EIS
Dog Trap Creek (GS 300063)	97.3%	143%	0.77	0.86*	0.77	0.69*
Eliza Creek (GS 300073)	97.2%	86.5%	0.76	0.91**	0.76	0.78**
Bargo River Upstream (GS 300010a)	105%	91.4%	0.72	0.66	0.62	0.51

* Based on only 6 months with complete data

** Based on only 7 months with complete data

The results in **Table 7-11** illustrate improvements to the model calibration due to incorporation of the additional streamflow monitoring data. The ratio of model to recorded streamflow has vastly improved and is now less than 5% difference as recommended by Vaze et al. (2011). Although the coefficient of determination on monthly flows was higher for the previous Dog Trap Creek and Eliza Creek models, the analysis was based on a dataset with only six months of complete data. Consequently, the dataset was likely to be inadequate with regard to capturing seasonal variation.

The recalibrated models have enabled improved estimations of the baseflow indices and baseflow recession rates for each catchment. The baseflow index and baseflow recession rates have reduced for Dog Trap Creek and increased for Eliza Creek and Bargo River upstream from the previous model calibrations. As such, the recalibrated models provide increased confidence in the simulated streamflow for each catchment; specifically, in the simulation of low flows and baseflow recession.

7.3.2.2 Water Quality Monitoring

The following summarises the comparative findings of the water quality data presented in the Baseline Assessment (BA) and the updated data presented in the revised BA (**Appendix D**):

- The water quality summary for Bargo River (SW-1), Hornes Creek (SW-9) and Bargo River at Upstream Bargo (SW-13) were generally consistent for the previous BA and the revised BA;
- The median concentrations of aluminium, arsenic, selenium and zinc have reduced from the previous BA, with the reduction in arsenic concentration indicative of improvements to the water quality released at LDP1;
- The water quality summary for Dog Trap Creek Downstream (SW-15) and Dog Trap Creek Upstream (SW-16) were generally consistent for the previous BA and the revised BA;
- The water quality summary for Eliza Creek (SW-18), Dry Creek (SW-20A) and Nepean River at Maldon Weir (SW-21) were generally consistent for the previous BA and the revised BA;
- The median concentrations of aluminium, arsenic, selenium and zinc recorded at Tea Tree Hollow (SW-22) have reduced from the previous BA, with the reduction in arsenic concentration indicative of improvements to the water quality released at LDP1;
- The median concentrations of aluminium and zinc recorded at Carters Creek (SW-23) have reduced from the previous BA; and
- The median concentration of iron recorded at all sites except Bargo River (SW-1) and Eliza Creek (SW-18) have increased from the previous BA.

7.3.3 Revised Flood Study

Results of modelling indicate that predicted subsidence would result in some localised minor changes to flooding in creeks in the Project Area for events up to the 1% AEP level. These simulated changes include both increases and decreases in the inundation area. The largest increases in flood inundation were predicted using the hydraulic model to occur in mostly undeveloped, open areas in the upper reaches of Dog Trap Creek.

The predicted subsidence associated with the Amended Project is expected to have less impact on flow depth within overland flow paths than predicted for the original assessment.

7.3.4 Revised Water Management System and Site Water Balance Assessment

This section summarises the proposed changes to site water management as a result of the Amended Project and presents the results from the water balance model simulation of the proposed water management system over the Amended Project life. The assessment considers and outlines the differences in impacts compared to the original project as presented in the EIS prepared for the Project (see **Appendix D**).

The following summarises the key changes to the assessment outcomes for the Amended Project as compared to the assessment undertaken for the EIS:

- Groundwater inflow to the underground mine is predicted to average 1,916 ML/annum based on the Amended Project in comparison with an estimated 1,693 ML predicted for the EIS (see **Table 7-12**);
- Discharge via LDP1 is predicted to average 2,114 ML/annum based on the Amended Project in comparison with an estimated 2,135 ML predicted for the EIS (see **Table 7-12**);
- Discharge via the LOPs to Tea Tree Hollow is predicted to average 112 ML/annum based on the Amended Project in comparison with an estimated 58 ML/annum predicted for the EIS;
- The simulated annual release to Bargo River from dam S11 is predicted to peak at 25 ML/annum based on the 95th percentile results for the Amended Project as opposed to a predicted 116 ML/annum presented in the EIS;

- The simulated annual release to Tea Tree Hollow from dam S12 is predicted to peak at 50 ML/annum based on the 95th percentile results for the Amended Project (release from dam S12 was reported in the EIS as a component of the total estimate of discharge via the LOPs);
- The underground water storage is predicted to increase from 2025 and is likely to near the storage capacity by 2032 based on the median model results for the Amended Project. The 95th percentile results indicate that the stored water volume may reach the storage capacity by the end of 2031 for the Amended Project. The EIS predictions identified that the underground water storage was likely to near the storage capacity by 2034 based on the median model results and by the end of 2033 based on the 95th percentile results; and
- As per the EIS predictions, a WWTP capacity upgrade of between 1.5 to 3 ML/day is likely to be required prior by 2031 for the Amended Project, dependent on actual groundwater inflow and climatic conditions experienced at the mine.

Table 7-12 Simulated average water balance results

Description	Volume (ML/annum)		% of Total Inflows or Outflows	
Inflows	**Amended**	**EIS**	**Amended**	**EIS**
Rainfall Runoff	366	373	13%	14%
Sydney Water Supply	480	485	17%	18%
Groundwater Inflow to Underground Mine	1,916	1,693	66%	63%
Ventilation Moisture (In)	136	136	5%	5%
Total Inflows	**2,897**	**2,687**		
Outflows	**Amended**	**EIS**	**Amended**	**EIS**
Evaporation	63	56	2%	2%
Discharge via LDP1	2,115	2,135	78%	82%
Other Discharge*	117	58	4%	2%
CHPP Make-Up Water Supply	81	76	3%	3%
Haul Road Dust Suppression	11	11	<1%	<1%
Stockpile Sprays (Dust Suppression)	73	26	1%	1%
Pit Top Washdown Water	14	14	3%	1%
Ventilation Moisture (Out)	233	224	9%	9%
Total Outflows	**2,707**	**2,600**		

7.3.4.1 Underground Water Storage

The current WWTP capacity of 6 ML/day is to be retained for the proposed upgraded WWTP. Forecast groundwater modelling for the Project (HydroSimulations, 2019) has indicated that Project underground inflows may at times exceed 6 ML/day. In addition to underground dewatering, water recovered from the pit top area and REA which is pumped to mine water dam M3 (i.e. rainfall runoff from these areas) will also report to the upgraded WWTP. Therefore, there may be times when the capacity of the upgraded WWTP is exceeded.

As part of the Amended Project, it is proposed to develop an underground storage within goafed areas of the Tahmoor North underground into which mine dewatering from Tahmoor South underground would be pumped. At times of lower inflow, water could be recovered from the underground storage, treated within the upgraded WWTP and released via LDP1. The underground storage would be formed within the void space of the mined longwall panels up to and including LW30. A storage capacity of 4,752 ML has been estimated within this area. Water would be pumped into and out of the storage via the existing drift and no new surface infrastructure is envisaged outside the pit top area.

7.3.5 Revised Surface Water Impact Assessment (SWIA)

The SWIA has been revised to assess the potential impacts of the Amended Project on local and regional surface water regimes and surface water quality. In addition, the SWIA has been revised to address key issues raised in the submissions pertaining to the surface water impact for the Project. The key changes to the assessment outcomes for the Amended Project as compared to the assessment undertaken for the EIS includes:

- Potential Impacts to the Hydrology of Thirlmere Lakes;
- Loss of flow to subsidence induced fracturing;
- Loss of surface flows to groundwater;
- Changes in flow velocity and bed shear stress due to subsidence;
- Risks and consequences of water releases from pit top area; and
- Cumulative impacts.

Each key change to the assessment outcomes is discussed in further detail below.

7.3.5.1 Potential Impacts to the Hydrology of Thirlmere Lakes

The Thirlmere Lakes are a series of five interconnected Lakes (in order from most upstream to downstream): Gandangarra, Werri Berri, Couridjah, Baraba and Nerrigorang. A water balance model of the Thirlmere Lakes has been used to assess the likely impacts of the Project on the hydrology of the lakes. The model simulates surface water processes as well as groundwater flux informed by separate groundwater modelling. Modelled total inflows and outflows for the two simulated cases are summarised in **Table 7-13**.

Table 7-13 Modelled Total (129 Year) Lake Water Balance

Inflow Component	Existing (ML)	With Project (ML)
Direct Rainfall	22,161 (35%)	21,856 (35%)
Catchment Runoff	40,436 (65%)	40,457 (65%)
Total	62,597	62,313
Outflow Component	**Existing (ML)**	**With Project (ML)**
Evaporation & Evapotranspiration	41,675 (65.9%)	41,190 (65.5%)
Groundwater Recharge	14,989 (23.7%)	15,319 (24.3%)
Overflow and Seepage to Blue Gum Creek	5,085 (8.0%)	4,978 (7.9%)
Pumped Extraction	1,446 (2.3%)	1,433 (2.3%)
Total	63,195	62,921

The water balance model was used to assess changes that could occur due to the increase in groundwater recharge that is predicted as a result of the Amended Project. It was determined that the most significant outflow component from the Lakes is to evaporation/evapotranspiration, comprising approximately two-thirds of outflows. Groundwater recharge by contrast comprises approximately a quarter of outflows. Therefore, based on the modelling the Amended Project should only affect the groundwater recharge component.

7.3.5.2 Loss of Flow to Subsidence Induced Fracturing

For the EIS, two pools in Tea Tree Hollow were located in an area of moderate risk of impact to flow holding capacity. The baseflow reduction predictions for local and regional streams and subsequent estimated loss of surface flow, presented in the EIS as compared with that assessed for the Amended Project, are summarised as follows:

- The percentage reduction in mean daily flow for Bargo River has reduced from 0.4% to 0.17% due to the Amended Project. For Tea Tree Hollow, the percentage reduction in mean daily flow has reduced from 1.7% to 0.4% while for Dog Trap Creek the percentage reduction in mean daily flow has reduced from 1.7% to 0.4% due to the Amended Project.
- Bargo River Upstream: the level of potential streamflow change would be imperceptible and very small compared to natural variability in catchment conditions and is therefore considered to be negligible (no change between EIS and Amended Project).
- Tea Tree Hollow: due to the persistent releases from LDP1, the effects of predicted baseflow reduction on Tea Tree Hollow at the gauging station (GS 300056) would be negligible (no change between EIS and Amended Project).
- Dog Trap Creek Downstream: the level of potential streamflow change would be detectable during normal periods of low flow. This level of change would likely be distinguishable from natural variability in catchment conditions (no change between EIS and Amended Project).
- Carters Creek: the level of change would be small compared to natural variability in catchment conditions (Carters Creek was not presented in the EIS).
- Eliza Creek: the level of potential streamflow change would be imperceptible and very small compared to natural variability in catchment conditions and is therefore considered to be negligible (Eliza Creek was not presented in the EIS).
- Cow Creek: the level of potential streamflow change may be detectable during normal periods of low flow and distinguishable from natural variability in catchment conditions (Cow Creek was not presented in the EIS).

7.3.5.3 Changes in Flow Velocity and Bed Shear Stress due to Subsidence

The changes in flow velocity and bed shear stress due to subsidence, presented in the EIS as compared with that assessed for the Amended Project, are summarised as follows:

- Dog Trap Creek:
  - Significant increases in velocity based on subsidence predictions (i.e. between 0.8 and 0.9 m/s) were predicted in isolated sections overlying LW 104B and LW106B. The same magnitude of increase in velocity was predicted for the EIS in isolated sections overlying LW 103 to 106.
  - The changes in bed shear stress due to subsidence predictions were generally small with increases overlying the south-western (upstream) side of longwall panels (where longitudinal bed steepening would occur) of up to generally 30-50 Pa. Small isolated increases of more than 50 Pa were predicted. These increases were consistent with those estimated for the EIS.
- Tea Tree Hollow
  - The most significant increases in velocity based on subsidence predictions (i.e. between 0.7 and 1 m/s) are predicted in isolated reaches overlying LW103A and LW105A for the Project. The most significant increases in velocity (i.e. between 0.4 and 0.6 m/s) were predicted in isolated sections overlying LW 104 and LW105 for the EIS.
  - The most notable changes in bed shear stress based on subsidence predictions for the Project were simulated on the south-western sides of LW 102A (30-140 pa) and LW103A (30-70 Pa). The most notable changes estimated for the EIS were simulated on the south-western sides of LW 102 (30-50 pa) and LW101 (10-30 Pa).

7.3.5.4 Risks and Consequences of Water Releases from Pit Top area

The results of predicted water balance modelling relating to water releases from the pit top water management system for the Amended Project and associated downstream impacts are summarised as follows:

- The results of predictive modelling (HEC, 2019) of the water management system over the remaining mine life indicate that release to LDP1 is unlikely to increase above the EPL 1389 volume limits. On this basis, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system.
- Discharge via the LOPs and the proposed dam S12 to Tea Tree Hollow is predicted to be less than the maximum discharge via the LOPs to Tea Tree Hollow recorded in 2016. As such, it is expected that the Amended Project would not result in adverse water quality impacts due to releases and overflows from the site water management system to Tea Tree Hollow.
- Overflow to Bargo River from dam S11 is estimated to result in a very slight increase in the concentration of sodium and total dissolved solids at Bargo River Downstream. The estimated concentration of sodium and total dissolved solids would remain below the ANZECC (2000) default guideline default trigger values for protection of aquatic ecosystems and recreational use.

7.3.5.5 Cumulative Impacts

The baseflow reduction predictions for local and regional streams as a result of cumulative impacts and subsequent estimated loss of surface flow, presented in the EIS as compared with that assessed for the Amended Project, are summarised as follows:

- The percentage reduction in mean daily flow for Bargo River has reduced from 1.3% to 0.6% due to the Amended Project for cumulative impacts. For Tea Tree Hollow, the percentage reduction in mean daily flow has reduced from 2.1% to 1.3% while for Dog Trap Creek the percentage reduction in mean daily flow has reduced from 5.7% to 1.7% due to the Amended Project.
- A maximum reduction in mean daily flow at Pheasants Nest Weir of 0.01% (due to the Amended Project) to 0.012% (cumulative effect) is predicted based on the revised assessment. For the EIS, a maximum reduction in mean daily flow at Pheasants Nest Weir of 0.03% (due to the Amended Project) to 0.36% (cumulative effect) was predicted. The predicted maximum reduction in mean daily flow represents an immeasurably small and likely indiscernible impact to flows at Pheasants Nest Weir. In the long-term, the reduction in baseflow, either due to Amended Project or the cumulative effect, is estimated to have negligible observable impact on the mean daily flow at Pheasants Nest Weir.
- For Stonequarry Creek at Picton, a maximum reduction in mean daily flow of 0.56% is predicted due to cumulative effects, reducing to 0.45% in the long-term (based on the Amended Project). For the EIS, a maximum reduction in mean daily flow of 1.86% was predicted due to cumulative effects, reducing to 0.10% in the long-term. The predicted maximum reduction in mean daily flow represents an immeasurably small and likely indiscernible impact to flows at Stonequarry Creek.
- At Maldon Weir, a maximum reduction in mean daily flow of 0.27% is predicted due to cumulative effects, reducing to 0.23% in the long-term (based on the Amended Project). For the EIS, a maximum reduction in mean daily flow of 0.69% is predicted due to cumulative effects, reducing to 0.16% in the long-term. The predicted maximum reduction in mean daily flow represents an immeasurably small and likely indiscernible impact to flows at Maldon Weir.

7.3.6 Revised Management and Mitigation Measures

Management and mitigation measures will be dependent on appropriate monitoring. The following monitoring recommendations are made in relation to assessing the performance of the water management system as it relates to surface water:

- As stated in the Surface Water Baseline Study (HEC, 2019a), streamflow monitoring has recommenced on Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data (up to the period of mining within these catchments) and assess impacts to flows post mining.

- Additional water level monitoring sites have also been implemented, or are proposed to be implemented, on Hornes Creek (four additional sites), Dog Trap Creek (four additional sites), Tea Tree Hollow (four additional sites) and Eliza Creek (one additional site). These monitoring sites will provide baseline water level data necessary to enable the assessment of potential impacts to pool water levels as a result of the Amended Project.
- Streamflow gauging activities should be continued to support the development and maintenance of viable gauging station ratings and the generation of reliable continuous flow data at all stations. The gauging stations on Dog Trap Creek downstream and the recommended new gauging station on Tea Tree Hollow would be established with enhanced low flow control weirs in order to reliably record low flows.
- Prior to the commencement of Project longwall mining, an adaptive monitoring and TARP would be developed. The following surface water elements would be incorporated into the plan:
    - TARPs for water quality exceedances which incorporate both baseline and control monitoring data. Site specific trigger values have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Project – refer HEC (2019).
    - TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis.
    - TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions.
- The pit top water management system performance would be assessed annually against its predicted performance range. This would entail monitoring the climatic conditions on site, the main water transfers, including off site discharges and changes in stored water volumes.
- The water balance model of the Thirlmere Lakes would be updated following completion of the OEH Research Program and be used to update the predictions.
- Monitoring of streamflow, pool water levels and water quality would continue for two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation.

7.3.7 Conclusion

The SWIA has been revised to address key issues raised in submissions relating to the EIS. The report summarises the results of an assessment of the potential impacts of the Amended Project on local and regional surface water regimes and surface water quality. Results from the assessment have been used to determine mitigation measures to reduce the effects of subsidence on the flow, water quality and stability of overlying watercourses. Commitments have also been made for ongoing monitoring.

7.4 Terrestrial Ecology

Tahmoor Coal submitted a Biodiversity Assessment Report (BAR) in support of the EIS prepared for the Project. An updated assessment has been prepared for the Amended Project and is presented in **Appendix E**. The assessment considers the differences in impacts compared to the original Project as presented in the EIS.

7.4.1 Revised Assessment

The assessment of terrestrial ecology impacts has been updated in response to Government agency and community submissions and to incorporate the Project amendments outlined in **Chapter 2.0**.

7.4.2 Revised Methodology

The methodology for the amended Biodiversity Assessment Report is consistent with the assessment in Section 11.6.2 and Appendix K of the EIS, and in line with the *Framework for Biodiversity*

Assessment - NSW Biodiversity Offsets Policy for Major Projects (FBA) (OEH 2014), in accordance with the transitional arrangements provided under the NSW *Biodiversity Conservation Act 2016* (BC Act). The revised Biodiversity Assessment Report for the Amended Project included additional assessments in response to requests raised by NSW Office of Environment & Heritage, Wingecarribee Shire Council, Wollondilly Shire Council and the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining (IESC).

The revised assessment includes:

- Further discussion on how the 'avoid' principle of biodiversity assessment policy guidelines were met in regard to minimising the footprint of the Amended Project;
- An assessment of hollow-bearing trees and hollow-bearing tree dependent species;
- Further consideration of *Persoonia bargonesis* in accordance with the FBA; and
- Further development of the Biodiversity Offset Strategy for the Project, to demonstrate the offsets required, after all avoidance measures have been applied.

The Study Area for the revised Biodiversity assessment comprised approximately 2,156 hectares (ha) consisting of:

- The extent of the proposed surface infrastructure including two ventilation shaft sites, powerline and REA; and
- The area within the predicted 20mm subsidence contour.

7.4.2.1 Relevant Project Amendments

The Project amendments relevant to the revised Biodiversity Assessment Report are:

- Reduction in the REA extension footprint from 43 ha to 11.06 ha (a reduction in area of 74%), resulting in a significant reduction in required vegetation clearing and associated terrestrial ecology impacts (including required biodiversity offsets). The reduction in footprint has been achieved through the increase in height of the REA as well as changes to the longwall mine plan which has reduced the overall estimated volume of rejects to be generated (Refer **Sections 2.1** and **2.2**). The redesign of the REA extension was specifically carried out to avoid and minimise biodiversity and threatened species impacts as far as possible, resulting in the following benefits:
  - The overall amount of Shale Sandstone Transition Forest (endangered ecological community) to be cleared has been reduced by 43.4 hectares to 23.57 hectares (approximate 46% reduction);
  - Reducing the removal of 96 individuals of a known population *Persoonia bargoensis* to 8 individuals, and
  - Largely avoiding a core population *of Grevillea parviflora* subsp. *parviflora* and *Pomaderris brunnea*.
- Inclusion of the power line easement for ventilation shaft site TSC1; and
- The changes to the mine plan, which have reduced the extent and magnitude of the predicted subsidence movements and groundwater impacts.

7.4.2.2 Additional Fieldwork

Additional fieldwork was undertaken to assess:

- Impacts to hollow-bearing trees; and
- Impacts associated with the proposed power line easement for ventilation shaft site TSC1.

7.4.3 Revised Impacts

Summary of Changes in Impacts

Table 7-14 provides a summary of the differences between the direct impacts of the original project as presented in the EIS, and the Amended Project.

Table 7-14 Summary of differences between direct impacts of the Original Project and Amended Project

Aspect	Original Project	Amended Project	Notes
Expanded REA footprint	43ha	11.06ha	74% reduction. Increase in height of existing and proposed REA to reduce footprint. Clearance of mine rehabilitation will be required to increase the height of the existing REA.
Disturbance of native vegetation	49.2ha	23.57ha (plus 14.2ha of mine rehabilitation). Total of 37.77 ha, including rehabilitated areas to be cleared.	52% reduction in the area of previously undisturbed vegetation to be cleared. 23% reduction in total vegetation to be cleared for the project.
Shale Sandstone Transition Forest (EEC)	43.5 ha	23.57 ha	46% reduction
Persoonia bargoensis	96	8	REA extension re-designed to avoid majority of the population, avoiding a 'significant impact' for this species
Grevillea parviflora subsp. *Parviflora* (individuals)	2,324	491	Most of the core population is now avoided, and the Amended Project remains unlikely to result in a 'significant impact' for this species.
Pomaderris brunnea (individuals)	40	1	Remains unlikely to result in a 'significant impact' for this species.

7.4.3.1 Vegetation

The Amended Project would result in the clearing of native vegetation and removal of habitat to allow for extension of the REA, installation of a new power line easement and construction of two new ventilation shafts for the Project.

A total of 37.77 ha of native vegetation would be removed as a result of the Amended Project, comprising of:

- 14.2 ha of rehabilitated land; and
- 23.57 ha of the TEC Shale Sandstone Transition Forest (PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)) including 17.26 ha in good condition, and 6.31 ha in derived native grassland condition.

The Project amendments, including a reduction in the proposed REA extension footprint, have reduced the predicted impacts on Shale Sandstone Transition Forest from 43.4 ha of clearing to 23.57 ha of clearing, a reduction of around 46%.

In addition to the clearing of vegetation, subsidence also has the potential to impact on biodiversity including resultant gas emissions along watercourses, and changes to hydrology, which could result in localised temporary dieback of native vegetation. Importantly however, based on subsidence predictions presented in the revised Subsidence Assessment for the Amended Project (see **Appendix B**) and supported by observations of previous events in the Southern Coalfield, the likelihood for such an event to occur and result in detrimental change to native vegetation is highly unlikely. For the most part, the native vegetation in the amended Study Area consists of open woodland and forest habitat types that are unlikely to be impacted by subsidence. Furthermore, no Coastal Upland Swamps or GDE were recorded within the Study Area.

An Assessment of Significance under the EPBC Act has also been completed in relation to the impact on the Commonwealth listed Shale Sandstone Transition Forest. This assessment concluded the Amended Project is likely to significantly impact the Threatened Ecological Community (TEC). As such, an offset for Shale Sandstone Transition Forest is proposed as part of the Amended Project (refer to **Section 7.4.4.4**).

7.4.3.2 Threatened flora

Forty-seven threatened flora species have been recorded or have potential habitat within 10 km of the Study Area. Seven threatened flora were recorded in the Study Area and immediate surrounds. These were: *Acacia bynoeana* (recorded outside of Study Area), *Epacris purpurascens var. purpurascens*, *Grevillea parviflora subsp*. p*arviflora*, *Persoonia hirsuta*, *Persoonia glaucescens var*. *glaucescens*, *Persoonia bargoensis*, and *Pomaderris brunnea*. Three species (*Grevillea parviflora subsp*. *parviflora, Persoonia bargoensis* and *Pomaderris brunnea*) were recorded in the area proposed for ancillary surface infrastructure.

The clearing of native vegetation for the surface infrastructure would result in an impact to threatened flora as shown in **Table 7-15**.

Table 7-15 Impacts to Threatened Flora from Amended Project

Threatened Species	Impact Avoided (compared to EIS)	Residual Impact from Amended Project
Persoonia bargoensis	avoided removal of 96 individuals	eight individuals
Grevillea parviflora subsp. *Parviflora*	avoided removal of 2,324 individuals	491 individuals
Pomaderris brunnea	avoided removal of 40 individuals	One individual

Assessments of Significance under the EPBC Act concluded that the Amended Project is unlikely to result in a significant impact to *Persoonia bargoensis*, *Grevillea parviflora subsp*. *Parviflora,* and *Pomaderris brunnea* due to the relatively large size of the known populations within the locality. Notably, due to the reduction in the REA extension area, the Amended Project avoids the significant impact to *Persoonia bargoensis* reported in the Biodiversity Assessment Report prepared for the EIS.

An additional three species (*Acacia bynoeana*, *Persoonia glaucescens* and *Persoonia hirsute*) listed under the EPBC Act have been previously recorded in the amended Study Area, due to inclusion of the powerline easement in the Amended Project. An Assessment of Significance concluded that impacts to these species were unlikely, as they were considered unlikely to be present in the areas proposed to be cleared for the Project, and unlikely to be impacted by subsidence.

7.4.3.3 Threatened fauna

Seventy-four threatened fauna species have been previously recorded or are predicted to occur within 10 km of the amended Study Area. Of those listed under the *Biodiversity Conservation Act 2016* (BC Act), 18 are regarded as 'species credit species' (noting 12 are 'dual credit' species), which unlike 'ecosystem credit species' cannot be predicted by habitat surrogates.

During site surveys between 2013 and 2019, twelve threatened fauna species listed on the BC Act were recorded within the amended Study Area or immediately adjacent. These included: Glossy Black Cockatoo, Little Eagle, Powerful Owl, Scarlet Robin, Sooty Owl, Varied Sittella, Eastern Bentwing Bat, Eastern Free-tail Bat, Large-footed Myotis, Eastern Cave Bat, Eastern False Pipistrelle and Red-crowned Toadlet. None of the threatened fauna recorded during the field survey are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Based on threatened species records and species identified during site surveys thirty-four threatened and migratory fauna have been attributed a moderate or higher likelihood of occurrence within the amended Study Area. The majority of these species are highly mobile species (such as threatened birds and microbats) that are likely to use the amended Study Area on an intermittent basis and would not be solely dependent upon the habitat features within the area to be disturbed by the surface infrastructure works. The Red-crowned Toadlet was recorded outside of the Study Area along Hornes Creek. The species was attributed a low-moderate likelihood of occurrence within the Study Area based on potential habitat.

Of the above, five 'species credit species' were recorded or identified with the potential to occur in the amended Study Area:

- Eastern Cave Bat;
- Large-footed Myotis;
- Large-eared Pied Bat;
- Koala and; and
- Eastern Pygmy-possum.

The Eastern Cave Bat was recorded within the surface area footprint during surveys (a single anabat recording on one night) and vegetation is considered potential foraging habitat. The Large-footed Myotis was also recorded within the surface area footprint of the REA.

The Large-eared Pied Bat, Koala, and Eastern Pygmy-possum were not recorded in the amended Study Area but have been assumed present based on the presence of suitable habitat and records within the locality. Given the only confirmed records of the Red-crowned Toadlet occur outside the predicted subsidence impact area, and the habitat within the Study Area is degraded by surrounding land uses, the species is considered unlikely to be impacted.

The Amended Project is considered likely to impact on known foraging habitat for the Large-footed Myotis and potential habitat for the Eastern Cave Bat, Large-eared Pied Bat, Koala, and Eastern Pygmy-possum and appropriate offsets have been calculated. A summary of impacts to potential threatened fauna habitat from vegetation clearing due to the Amended Project compared to the EIS are shown in **Table 7-16**.

In relation to EPBC Act listed threatened fauna, the Amended Project may potentially impact habitat associated with the following species: Fork-tailed Swift, Great Egret, Cattle Egret and Rainbow Bee-eater, Satin Flycatcher, Swift Parrot, Large-eared Pied Bat, Grey-headed Flying Fox, Koala, and Greater Glider. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that there is unlikely to be a significant impact to any EPBC Act listed threatened fauna.

Table 7-16 Impacts to threatened fauna habitat

Threatened Fauna	Species habitat impacts in original EIS	Species habitat impacts for the Amended Project	Notes
Red-crowned Toadlet	0	0	Habitat not in Study Area
Large-footed Myotis	7.4 ha	17.26 ha	Hollow-bearing trees within 200 metres of a riparian zone are areas of habitat for the Large-footed Myotis. Portions of the proposed surface infrastructure for the REA contain hollow-bearing trees within 200 metres of Tea Tree Hollow. In the EIS only areas within 200m of Tea Tree Hollow (7.4 ha) were calculated as impacted habitat for this species. For the revised assessment, as a conservative measure the entire 17.26 ha of impacted area has been considered habitat for the purposes of offsets.
Eastern Cave Bat	0	17.26	The species was recorded within the surface infrastructure area (one anabat recording on one night to the east of the REA). Should a breeding colony be present in the vicinity, more activity would be expected. Based on this, the EIS considered that the vegetation to be cleared for the surface works was unlikely to contain important foraging or breeding habitat for the species. Whilst this conclusion remains unchanged, the revised assessment has taken the conservative approach of assuming the entire 17.26 ha of impacted area to be potential foraging habitat.
Large-eared Pied Bat	0	17.26	Cliff lines are identified as important roosting habitat for this species. The EIS considered that impacts to cliff habitat was unlikely based on subsidence predictions and the small length of cliff lines within the subsidence study area. Notwithstanding given previous recordings of this species within the Study Area and surrounds, the revised assessment has conservatively assumed the entire 17.26 ha of impacted area to be potential foraging habitat.
Koala	43.5 ha	17.26 ha	Reduction in impact of 25.90 ha
Eastern Pygmy-possum	0	17.26 ha	The EIS assessed this species as having a low likelihood of occurring within the surface infrastructure areas based on there being no previous records or known populations in the Study Area and no recordings during survey. However, based on EES advice during the EIS exhibition, the revised assessment has conservatively assumed the presence of this species based on the presence of suitable potential foraging habitat (eucalypt forest) and shelter/nesting resources (14 hollow-bearing trees) for the species within the Study Area.

7.4.4 Revised Management and Mitigation Measures

7.4.4.1 Avoidance and minimisation

Most of the key avoidance measures presented in the EIS for the project remain applicable. Additional avoidance measures proposed for the Amended Project include:

- The REA was redesigned to minimise the potential impacts on Shale Sandstone Transition Forest TEC from 43.4 hectares to 23.57 hectares (approximate 46% reduction);
- The redesign of the REA has avoided a significant impact under the EPBC Act for *Persoonia bargoensis*, by reducing impacts from approximately 96 to eight individuals of a known population; and
- Reducing impacts to *Grevillea parviflora* subsp. *Parviflora* from 2,324 to 491 individuals;
- Reducing impacts to *Pomaderris brunnea* from approximately 40 individuals to one.

7.4.4.2 Mitigation and management

Management measures for the Amended Project remain consistent with those listed in the EIS, apart from offset credit calculations which have been updated.

7.4.4.3 Credit calculations

Credits required to offset threatened flora and fauna impacts for the Amended Project have been calculated using the BioBanking Credit Calculator and are included in **Table 7-17**.

Table 7-17 Species credits required for the Amended Project

Threatened species (Flora)	Area/ No. impacted	Credits required
Shale Sandstone Transition Forest /PCT1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556)	23.57ha	1,084
Mine rehabilitation (best fit PCT)/PCT1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin (HN564).	14.20ha	398
Persoonia bargoensis	8 individuals	616
Grevillea parviflora subsp. *parviflora*	491 individuals	6,874
Pomaderris brunnea	1 individual	15
Large-footed Myotis	17.26 ha	380
Koala	17.26 ha	449
Large-eared Pied Bat	17.26 ha	224
Eastern Cave Bat	17.26 ha	224
Eastern Pygmy Possum	17.26 ha	345

7.4.4.4 Offset Strategy

1. The revised Offset Strategy for the Amended Project consists of a three-stage offset approach spanning over a 4-year period, as not all the surface infrastructure would be cleared in the first year. Stage One of the offset strategy will appropriately mitigate the impacts as a result of proposed ventilation shaft TSC 1; Stage Two would mitigate for ventilation shaft TSC 2, the power line and part of the REA; while, Stage Three will offset the remainder of the REA. Tahmoor Coal proposes to undertake a combination of the following offset mechanisms to offset the Project: Establishment of biodiversity stewardship sites within Tahmoor Coal landholdings, located at:
    - Bargo Colliery land;
    - 185 Charlies Point Road;
    - 220 Charlies Point Road;
    - Pit Top; and
    - Rockford Road.
2. Purchase of the required credits available on the public register;
3. Payment into the NSW Biodiversity Offsets Fund (noting that this is not available for the Commonwealth Shale Sandstone Transition Forest TEC); and
4. Establishment of stewardship sites on additional landholdings (purchase or agree with landholders).

Biodiversity stewardship sites within the above landholdings have been updated for the Amended Project as the areas were deemed too small according to indicative ecosystem.

7.4.5 Conclusion

The Biodiversity Assessment prepared for the Amended Project concludes that the Amended Project would result in the disturbance of 37.77 ha of native vegetation, with the potential for subsidence related impacts. Indirect impacts may include dust, noise, erosion and sedimentation.

The Amended Project will result in disturbance to approximately 23.57 ha of the TEC listed under the BC Act and EPBC Act. This TEC would be offset according to the requirements of the FBA.

The Project would result in the following impacts to threatened flora as a result of vegetation clearance in the surface infrastructure area:

- Removal of eight individuals of *Persoonia bargoensis*;
- Removal of an estimated 491 individuals of *Grevillea parviflora* subsp. *parviflora*; and
- Removal of one individual *Pomaderris brunnea*.

In terms of species credit fauna, this assessment has identified impacts to the following:

- Removal of 17.26 ha of known habitat for the Large-footed Myotis; and
- Removal of 17.26 ha of potential habitat for the Koala, Large-eared Pied Bat Eastern Cave Bat and Eastern Pygmy-possum.

This assessment concludes that native vegetation, threatened flora or species credit fauna are unlikely to be impacted by subsidence associated with the Project. Impacts to threatened species within the study area will be mitigated and managed through the implementation of a Biodiversity Management Plan and an on-going monitoring program.

7.5 Aquatic Ecology

An Aquatic Ecology Impact Assessment Report, prepared by Niche Environment and Heritage, was submitted in support of the EIS prepared for the Project. An updated assessment has been prepared for the Amended Project and is presented in **Appendix F**. The assessment considers the differences in impacts compared to the original Project as presented in the EIS.

7.5.1 Revised Assessment

The methodology for the revised assessment is consistent with the assessment in Section 11.7.2 and Appendix K of the EIS prepared for the Project, which contains detailed descriptions and clarifications on the assessment guidelines and methodologies that were used.

Government agency submissions raised concerns relating to the discharge of mine water to Tea Tree Hollow via LDP1 and the current performance of the existing Waste Water Treatment Plant under PRP 22. A new management strategy has been proposed for mine water management; that is Stage 3-PRP 22 to address water quality.

Other issues raised related to the adequacy/ age of the aquatic monitoring data. While it is acknowledged that the data was collected five years ago, the data collected is considered appropriate for impact assessment for the following reasons:

- The sites selected were representative of the system that had available aquatic habitat in the areas potentially impacted by longwall mining or mine water discharge;
- Monitoring was conducted in multiple seasons (autumn and spring) over two years;
- Monitoring used a variety of techniques, notably AUSRIVAS and quantitative sampling;
- Monitoring was undertaken during wet and dry periods, which is a controlling factor in aquatic communities in intermittent streams;
- AUSRIVAS sampling was undertaken twice in each season in each year;
- The process affecting aquatic flora and fauna has remained unchanged over the five years; and
- The predicted type of impact to invertebrate communities is unchanged despite any temporal variation in community composition.

However, it is recognised that more recent data will be required prior to longwall mining for ongoing monitoring. Further monitoring will be conducted in spring 2019 (complete) and autumn 2020 to update the baseline data for future monitoring purposes. This will involve sampling of potential impact sites and non-impacted/control locations at sites that are representative of the system present in the study area and will include additional sites in Tea Tree Hollow and Dog Trap Creek tributaries.

The adequacy of Sydney Hawk Dragon Fly (SHD) surveys was raised as a concern in IESC's submission on the proposal. A detailed response is provided to this issue in the Response to Submissions Report. In summary, the survey for SHD was considered adequate considering its low likelihood of occurrence in the study area. The Aquatic Ecology impact assessment undertaken for the EIS (Appendix K of the EIS) considered most of the habitat in the project area to be marginal for this species. Notwithstanding, the areas were subject to survey as *Austodorulia refracta* (a similar species) has been detected in Eliza Creek and it is known that the two species can coexist in similar habitat (DPI, 2016). However, the Aquatic Ecology assessment noted that *A. refracta* can occur in smaller systems, intermittent streams and shallow pools, whereas *A. leonardi* are found in deep riverine pools which are only present in some sections of Bargo River downstream.

While it is unlikely that the SHD occurs in the study area and is not considered to be directly or indirectly impacted, as a conservative measure, Tahmoor Coal will resurvey for adult and larval dragonflies in summer (2019/2020) in the Bargo River.

In response to concerns raised in community submissions, the revised assessment includes commentary related to the predicted effects of climate change on aquatic ecology. Tahmoor Coal would mitigate these potential impacts through its mitigation of greenhouse gas impacts as described in **Section 7.10**.

7.5.2 Revised Impacts

7.5.2.1 Subsidence

Subsidence related impacts based on mine subsidence predictions presented in the revised Subsidence Assessment for the Amended Project (**Appendix B**), it is anticipated that there will be negligible impact on aquatic habitat and biota in the Nepean and Bargo Rivers.

Streams within the Amended Project area that occur directly over the proposed longwalls would experience fracturing, resulting in surface water flow diversion and potential changes in water chemistry. In times of heavy rainfall, most of the runoff would flow over the beds of the streams and would not be diverted into the dilated strata below the stream beds. In times of low flow however, some or all the surface flow could be diverted into the strata below the stream beds. Where loose materials occur in the substrate upstream of fracturing, it is possible that fracturing in the bedrock would not be seen at the surface as the fractures may be filled with soil during subsequent flow events (MSEC 2019). Strata cracking may also cause a degradation of water quality, typically a lower pH, elevated electricity conductivity (EC), increase in dissolved metals and precipitation of iron flocculants.

Fracturing and the partial or total loss of water could result in loss of aquatic habitat in sections of Dog Trap Creek and Tea Tree Hollow, and subsequently loss of aquatic biota inhabiting pools. Native fish recorded in these waterways may be subject to desiccation and a range of macroinvertebrates will also suffer mortalities in areas where pools are drained. Hardier species such as freshwater yabbies (*Cherax destructor*) and freshwater crayfish (*Euastacus spinifer*) may be able to relocate to other areas of aquatic habitat or retreat into their burrows.

Dog Trap Creek and Tea Tree Hollow have substrate consisting of sand, mud and cobbles upstream of the areas of impact. As such, there may be some natural infilling during subsequent flow events that will return some aquatic habitat over time. Considering the ability of aquatic fauna to recolonise intermittent waterways, there is expected to be some recovery of stream fauna once pool holding capacity and habitat is re-established.

Additional assessment of Cow Creek was undertaken as part of the revised Aquatic Ecology assessment (**Appendix F**) to determine the impacts of the amended mine plan (and associated subsidence, groundwater and surface water changes) on the aquatic ecology of the creek. The revised subsidence assessment (**Appendix B**) identified that the nearest Amended Project longwall would be located approximately 1 km from Cow Creek and at this distance, the maximum predicted subsidence, upsidence and valley closure would be less than 20 mm. Accordingly, the potential for localised impacts on Cow Creek such as fracturing, surface water flow diversion and associated water quality changes are considered to be extremely low.

The revised Groundwater assessment (**Appendix C**) estimated a maximum baseflow reduction rate of 0.018 ML/day at Cow Creek due to the Amended Project and a cumulative maximum baseflow reduction rate of 0.019 ML/day. The revised Surface Water assessment (**Appendix D**) undertook additional modelling in relation to baseflow impacts to pools within Cow Creek, considering three pools (small, medium and large) and using existing catchment runoff and baseflow, and predicted baseflow reductions. The modelling indicated that the estimated reduction in water level would likely be imperceptible in the pools in Cow Creek, and very small compared to natural variability in catchment conditions and therefore negligible. Based on this, the revised aquatic assessment (refer Sections 6.5.3 and 6.7.6 of **Appendix F**) determined that baseflow changes would result in negligible effect on aquatic ecology at Cow Creek.

7.5.2.2 Mine Water Discharge

Mine water contains elevated concentrations of dissolved salts (EC) and heavy metals and can pose environmental risks to aquatic biota. Barium precipitate from mine water discharge has been observed in Tea Tree Hollow, which is thought to be impacting benthic macroinvertebrates by smothering the substrate. Whilst the precipitate is inert, the lack of interstitial spaces and covering of organic matter are thought to be limiting macroinvertebrate habitat and food supply.

Tahmoor Coal is licensed to release treated water from its water management system in accordance with Environmental Protection Licence (EPL) release limits. A waste water treatment plant (WWTP) was constructed at Tahmoor Mine in June 2015 to reduce the concentrations of heavy metals (Arsenic, Nickel and Zinc) in mine water prior to discharge from LDP1, with the treatment objectives set by a Pollution Reduction Program (PRP 22) under the EPL. During commissioning of the WWTP, it was found that the complex water chemistry of the underground mine waters was buffering chemical reactions in the treatment processes preventing the effective removal of metals.

Whilst a range of upgrades to the WWTP have been implemented (PRP 22– Stage 2), the water quality objectives for Nickel and Zinc have not been achieved (although met for Arsenic). Tahmoor Coal are currently progressing PRP 22– Stage 3 involving further enhancements to the WWTP with alternate technology solutions to achieve the required water quality criterion.

Increases in heavy metals in mine water discharge are not predicted from the Tahmoor South Project and it is expected that the re-commissioning of the WWTP as part of PRP 22-Stage 3 will reduce the presence of heavy metals at Tea Tree Hollow and downstream. Therefore, future impacts from the development to aquatic ecology from heavy metals (including precipitate) are unlikely. Studies of salinity from mine water discharge in the Southern Coalfield have not shown a direct link between salinity and effects on macroinvertebrates. Salinity levels were investigated under PRP23 and reported in Cardno 2016, which recommended no change to EC discharge limits for LDP1 currently listed in the EPL. The revised Surface Water impact assessment (Appendix D) simulated the water quality of mine discharge water from Tahmoor South and found a very slight increase in the concentration of sodium and electrical conductivity at Bargo River downstream. However, the levels are predicted to remain below the ANZECC (2000) and Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) (2018) default guideline trigger values for protection of aquatic ecosystems and recreational use (Appendix D). The WWTP upgrade under PRP 22 – Stage 3 is expected result in treated water at 500 µS/cm (a reduction in EC). As such, it is expected that that reductions in salinity concentrations will improve aquatic ecology downstream of the mine water discharge.

Results of predictive modelling of the water management system over the remaining mine life indicate that total discharge and spill from the pit top of the combined existing Tahmoor North operation and the Amended Project are unlikely to increase from current levels. Therefore, it is not expected that the Amended Project would result in additional adverse water quality impacts due to releases and spills from the site water management system (HEC, 2019). Completion of the PRP 22- Stage 3 would see enhanced water quality through reduced heavy metals, EC and barium precipitate in Tea Tree Hollow and downstream Bargo River.

An aquatic ecology monitoring program aimed at identifying any future changes in aquatic health due to improvements in the discharge quality from LDP1 would be established as identified in the EIS.

7.5.3 Revised Management and Mitigation Measures

The mitigation measures outlined in Section 11.7.5 and Appendix K of the EIS remain applicable to the Amended Project. In addition, the following measures would be adopted:

- Monitoring in spring 2019 (complete) and autumn 2020 of potential impact sites and non-impacted/control locations at sites that are representative of the system present in the study area and will include additional sites in Tea Tree Hollow and Dog Trap Creek tributaries;
- Monitoring for adult and larval dragonflies in summer (2019/2020) in the Bargo River; and
- Upgrade of the WWTP ahead of Tahmoor South commencement as part of PRP 22- Stage 3.

With respect to creek remediation, it is noted that Tahmoor Coal has developed a Corrective Management Action Plan for the remediation of creeks previously mined beneath in the Tahmoor North mining area (Redbank Creek and Myrtle Creek), in consultation with regulatory agencies and approved by DPIE. The Corrective Management Action Plan details remediation measures include the trial grouting of pool 23 with the objective of restoring pool holding capacity as well as aquatic ecology in Myrtle Creek to determine the response of stream health to remediation measures. The Corrective Management Action Plan developed for Redbank and Myrtle Creeks, as well as ongoing improvements , will be used to develop a Creek Remediation Action Plan for the streams potentially affected by subsidence by the Tahmoor South Project, in consultation with regulatory agencies.

7.5.4 Conclusion

The revised Aquatic Ecology Assessment for the Amended Project confirmed that aquatic habitats of streams within the SSA may be impacted by subsidence related impacts to surface water in Tea Tree Hollow, Dog Trap Creek and downstream watercourses, such as changes to stream beds, altering surface water flows and ponding, and changes to water quality.

The revised Aquatic Ecology Assessment determined:

- Significant subsidence movements are not predicted at the Nepean and Bargo Rivers and these rivers would not be mine beneath, indicating that the quality and quantity of available aquatic habitat is unlikely to be impacted;
- One listed threatened aquatic species is considered to have potential habitat within the Project Area (Sydney Hawk dragonfly). It was determined that the Amended Project is unlikely to have a significant impact on this species;
- There would be moderate to low impacts to stygofauna and hyporheic sites as a result of the Amended Project; and
- Completion of WWTP upgrades as part of PRP 22- Stage 3 would see enhanced water quality through reduced heavy metals, EC and barium precipitate in Tea Tree Hollow and downstream Bargo River. PRP 22 - Stage 3 would be completed in time for the operation of Tahmoor South.

Rehabilitation of subsidence impacts to land, including rehabilitation of surface cracking impacts to watercourses and drainage lines, would be undertaken as described in Section 11.1.7 of the EIS prepared for the Project. Specific impacts to areas of Key Fish Habitat would be mitigated by the measures outlined in Section 11.7.5 of the EIS and residual impacts would be offset in negotiation with DoI – Fisheries (as required).

7.6 Aboriginal Cultural Heritage

Tahmoor Coal submitted an Aboriginal Cultural Heritage Assessment (ACHA) Report in support of the EIS (Appendix L to the EIS). The ACHA has been revised to assess the impacts of the Amended Project (refer **Appendix G**). The assessment considers the differences in impacts compared to the original Project as presented in the EIS.

7.6.1 Revised Assessment

The Project amendments relevant to the revised Aboriginal cultural assessment are the changes to the mine plan, namely amendments to the longwall layout and geometry (refer **Chapter 2.0**) which have resulted in amendments to the extent of the 20mm subsidence contour. Amendments to surface infrastructure including identification of the proposed power line easement have not resulted in additional impacts to Aboriginal heritage sites. Changes to Aboriginal heritage impacts from the Amended Project relate only to the amended extent of the 20mm subsidence contour.

The methodology for the revised ACHA is consistent with the assessment in Section 11.8 and Appendix L of the EIS, which contained a detailed assessment against the guidelines and methodologies. The revised ACHA is in **Appendix G**.

A revised search of the Aboriginal Heritage Information Management System (AHIMS) has been completed for the Amended Project. An additional seven (7) Aboriginal cultural Heritage sites have been identified as a result of this revised search. These sites would not be impacted by the Amended Project.

In addition, an addendum to the revised ACHA has been prepared (**Appendix G**) to:

- Address additional archaeological test excavation and assessment commitments as specified in Section 15 of the EIS ACHA (Appendix L of the EIS);
- Respond to a submission from the DPIE - Biodiversity and Conservation Division (BCD; former Office of Environment and Heritage) in relation to the EIS ACHA, requesting that the recommended test excavation program at the proposed site of a new ventilation shaft (TSC 2) be undertaken prior to development consent being granted; and
- Assess the proposed powerline easement, now included as part of the Amended Project.

The following additional survey was undertaken to complete the addendum:

- Archaeological test excavation – test excavation at TSC 2 ventilation shaft site location as recommended by the EIS ACHA (Appendix L of the EIS); and

- Additional archaeological survey to consider impacts associated with the proposed powerline easement.

7.6.2 Revised Impacts

7.6.2.1 Subsidence Impacts

As outlined above, the adoption of a revised mine plan for the project, comprising an amended longwall layout, has resulted in a reduction in the extent of the 20 mm subsidence contour predicted for the project. There are 30 sites identified within the 20mm subsidence contour, as follows:

- 24 sites of low significance;
- 2 sites of moderate significance; and
- 4 sites of high significance

There are three fewer Aboriginal cultural heritage sites identified within the 20 mm subsidence contour associated with the amended mine plan when compared to the 20 mm subsidence contour presented in the EIS, and therefore would not be impacted by the Amended Project. The three Aboriginal cultural heritage sites (comprising of stone artefacts) are:

- SW Corner Bargo Sports Ground (52-2-4034);
- Dog Trap Creek (52-2-1532); and
- Bargo Isolated Find 1 (52-2-3976).

The dreamtime story identified in the EIS would also be located outside of the 20 mm subsidence contour for the Amended Project.

Due to the amendments made to the mine plan there has been a minor change to the predicted subsidence for affected Aboriginal Heritage sites. In terms of impacts of subsidence on Aboriginal heritage:

- Artefact scatters and isolated finds – Impacts remain consistent with those assessed in the EIS;
- Axe grinding grooves – Impacts remain consistent with that assessed in the EIS;
- Scarred tree – Impacts remain consistent with that assessed in the EIS; and
- Sandstone shelters – Subsidence impacts to four rock shelter sites that have been given a high significance rating (in comparison to three in the EIS) and are predicted to experience between 90 mm and 150 mm of vertical subsidence due to the extraction of the proposed longwalls. Impacts remain consistent to that assessed in the EIS with likelihood of impacts considered to be low.

7.6.2.2 Surface Infrastructure

Of the 30 Aboriginal cultural heritage sites within the 20mm subsidence corridor, one Aboriginal cultural heritage site is also located within the footprint of one of the proposed ventilation shaft sites (TSC 2). This site, Charlies Point Road OCS-1 (52-2-4487), is an Open Camp Site. A test excavation was completed in 2019 to further determine the subsurface nature of Charlies Point Road OCS-1, in accordance with the recommendations of the ACHA presented in the EIS. The test excavation found no further subsurface deposit associated with the three artefacts eroding out of the access track. The site was determined to be of low scientific significance due to the site comprising three stone artefacts.

There were no Aboriginal cultural heritage sites identified at any of the remaining areas proposed to be disturbed by the Project for the construction of surface infrastructure; the second proposed ventilation shaft site (TSC 2), or the footprint of the proposed extension to the REA. Notwithstanding, detailed avoidance, mitigation and management measures have been developed to reduce potential impacts on Aboriginal heritage.

Addendum to the ACHA

An Addendum to the ACHA has been prepared to address the additional archaeological test excavation and assessment commitments specified in the ACHA prepared for the EIS. An additional assessment in the form of archaeological test excavations and additional surveys were undertaken and are presented in **Appendix G**. The Addendum also provides an updated impact assessment and management measures in response to the Amended Project, specifically the addition of the proposed powerline route to the proposed ventilation shaft site TSC 1.

Archaeological Survey

Assessment of the amended area included additional archaeological surveys spread across the proposed and existing powerline easement conducted on the 3rd of October 2019. The survey was completed by two EMM archaeologist's and two Registered Aboriginal Party (RAP) representatives. During the survey, access was not permitted to Lot 2016 DP751250 and Lot 2231 DP787222. The survey was therefore conducted within the adjacent road corridor and observations of the areas within the lots were made from publicly available areas. Preliminary assessments of the archaeological potential of these areas have been made based on these observations and of the survey results of the surrounding properties, which share the same environmental values (i.e. landform and levels of disturbance).

The survey identified one ironbark tree with scarring. The scarring was assessed to be unlikely of Aboriginal origin.

Test Excavations

An archaeological test excavation was performed within the disturbance footprint of TSC2. This excavation confirmed the presence of 13 open camp sites, including six artefact scatters and seven isolated finds within the area.

The test excavation program was undertaken over three days from 1 October to 3 October 2019 involving four EMM archaeologists and four RAP representatives on each day. The methodology involved the following:

1. Five linear transects were set out across the TSC 2 ventilation shaft location;
2. A total of 38 50 cm x 50 cm test pits were spaced at 20 m intervals along each transect;
3. The first test pit at each site was dug manually with hand tools in 5 cm spits to identify the nature of the soils and to identify if a stratigraphic sequence existed. The remaining pits were dug in 10 cm spits as no stratigraphic sequence was identified;
4. Each pit was excavated until basal clay or impenetrable parent rock (i.e. ironstone and/or shale) was reached. The majority of test pits were excavated to a depth of 20 cm, with a sample of test pits excavated to 30 cm;
5. All excavated soil was sieved on-site using a dry sieving technique. The soil was sieved through 5 mm aperture mesh sieves; and
6. All test pits were backfilled by the excavation team after each pit was recorded.

The archaeological potential for the area was deemed as low to moderate. Based on the predictive model and results outlined in the ACHA, archaeological resources of the area are more likely to be concentrated in closer proximity to a water source (i.e. within 200m) and in association with rock outcrop areas (i.e. shelter sites). The closest water source to the test site is located at Dog Trap Creek 500 m from the excavation area and is situated on a featureless, plain landform within which focal points for past activity cannot be readily defined.

Charlies Point Road OCS-1 (52-2-4487) is an Open Camp Site located within the proposed footprint TCS 2. The test excavation concluded that there was no further subsurface deposit associated with the three artefacts eroding out of the access track. The site was determined to be of low scientific significance due to the site comprising of three stone artefacts. Further management would be undertaken in consultation with a suitably qualified archaeologist and in accordance with an Aboriginal Heritage Management Plan (AHMP).

These minor changes have not altered any of the management and mitigation measures outlined in the ACHA that was Appendix L of the EIS.

7.6.3 Revised Management and Mitigation Measures

The management and mitigation measures outlined in the EIS remain relevant for the Amended Project:

- Avoid surface impacts to axe grinding grooves and sandstone shelter;
- Monitor subsidence at grinding grooves and sandstone shelters;
- Consider engineering solutions to reduce potential subsidence impacts on sites of higher significance;
- Ensure that the Aboriginal community is involved in all aspects of managing Aboriginal heritage throughout the Amended Project life; and
- Develop an AHMP with the Aboriginal community to detail all management requirements and responsibilities.

7.6.4 Conclusion

One Aboriginal cultural heritage site (an open camp site) assessed to be of low significance has the potential to be impacted by surface disturbance works and subsurface works as a result of construction of a proposed new ventilation shaft. Thirty (30) sites have the potential to be impacted by subsidence impacts. Due to the change in the Project layout there has been a minor change to the predicted subsidence within the Project area. This minor change has not altered any of the management and mitigation measures outlined in the ACHA that was included as Appendix L of the EIS. Impacts to Aboriginal cultural heritage would be managed through the implementation of an AHMP, and in consultation with the Aboriginal community.

7.7 Non-Aboriginal Heritage

Tahmoor Coal submitted a Historic Heritage Assessment (HHA) report in support of the EIS (Appendix L of the EIS) for the Project. Impacts to non-Aboriginal heritage have been reviewed against the Amended Project and the findings are presented in **Appendix H**.

The review considered the differences in impacts compared to the Project as presented in the EIS. Table 1 of **Appendix H** is taken from the original assessment and has been revised with the amended MSEC predictions (MSEC 2019, Table D.12 of **Appendix B**).

Overall subsidence predictions associated with the amended mine plan have reduced at all identified heritage sites within the amended subsidence study area, except for Item 10 (Cottage at 91 Hawthorn Road), where a minor increase in subsidence levels is predicted. A small increase in the predicted maximum subsidence is also predicted at a shed located within Wirrimbirra Sanctuary (from a range of 850-1150 mm to 900-1300 mm). Although the predicted maximum tilt, final tilt, total hogging curvature and total sagging curvature within the property are predicted to be less. Notably, overall maximum subsidence across the property is predicted to be less than the predicted levels associated with the EIS mine plan.

All mitigation and management measures as outlined in the original assessment remain the same.

7.8 Noise and Vibration

A Noise and Vibration Assessment (**Appendix I**) has been prepared to assess the noise and vibration impacts of the Amended Project on identified noise-sensitive receptors. The revised assessment was undertaken in accordance with the *Noise Policy for Industry* (NPfI) (EPA, 2017) and supersedes the findings of the EIS Noise and Vibration Impact Assessment (NVIA) (Appendix M of the Tahmoor South EIS).

The following key changes are reflected in the revised assessment:

- Adoption of the NPfI: at the request of the NSW EPA, the assessment of the Amended Project has been undertaken to reflect the contemporary noise policy. The original assessment was conducted in accordance with the *Industrial Noise Policy* (EPA, 2000), which was the relevant policy at the time of preparation of the assessment, as per the SEARs;
- Additional noise monitoring undertaken for the existing operations; and
- Amendments made to the Project, as outlined in **Chapter 2.0** of this Project Amendment Report, to:
  - Reflect the amended REA design;
  - Reduce the impacts of night-time noise from the REA on receivers by restricting haulage of rejects at the REA to daytime and evening hours (7am to 10pm) only; and
  - The existing upcast shaft (T2) will use one fan when operating once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

7.8.1 Revised Assessment

The NPfI provides a methodology for the assessment of noise from existing industrial sites. The process established by the NPfI for existing sites like Tahmoor Mine includes:

1. An initial evaluation, including whether approvals/licences include noise limits and whether they are being met;
2. Establish relevant Project Noise Trigger Levels (PNTLs), in accordance with the NPfI, to establish a benchmark level to assess the need to consider noise mitigation;
3. Measure/predict the noise levels produced by the source in question, having regard to meteorological effects such as wind and temperature inversions;
4. Compare the measured/predicted noise level with the PNTLs;
5. Where the PNTLs are exceeded, assess feasible and reasonable noise mitigation strategies;
6. Develop and refine achievable noise limits that will become goals for the project. This may involve interaction between the regulator and proponent as well as consultation with the community; and
7. Monitor compliance with the agreed noise limits, review and amend the noise performance of the Project area as required.

The revised NVIA also assessed a number of scenarios relating to the progressive development of the REA; whereas the EIS only considered one scenario, being the ‘worst case’. The revised NVIA considered the following stages of the Amended Project:

- Stage 2 (approximately three years from project approval): representative of an acoustically worst-case for residences to the north and some to the east of the REA;
- Stage 4 (approximately six years from project approval): representative of an acoustically worst-case for residences to the south-east of the REA; and
- Stage 5 (approximately nine years from project approval): representative of an acoustically worst-case for residences to the south of the REA.

7.8.1.1 Meteorology

During certain weather conditions, mine noise emissions at the assessment locations may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above the ground that occurs during winds or where air temperature changes with height. A simple yet conservative approach was selected for the consideration of potentially noise-enhancing weather conditions with reference to Fact Sheet D of the NPfI. Noise emissions from Tahmoor Mine have been predicted for both calm and noise-enhancing conditions as provided in **Table 7-18**.

This approach provides a conservative approach since the noise emissions predicted under noise-enhancing conditions are expected to represent the upper range of noise emissions from the mine.

Table 7-18 Modelled meteorological parameters

Assessment condition	Period	Temperature	Wind speed / Direction	Relative humidity	Stability Class
Calm	Day	20°C	n/a	70%	D
	Evening / Night	10°C	n/a	90%	D
Noise-enhancing	Day	20°C	3m/s Source to receiver	70%	D
	Evening / Night	10°C	2m/s Source to receiver	90%	F

7.8.1.2 Assessment locations

The assessment locations from the original NVIA (Appendix M of the EIS, EMM, 2018) have been updated for the purpose of this noise assessment; including consideration of some changes in land ownership. Assessment locations have been categorised in 11-noise catchment areas (NCA) based on similar ambient acoustic environments.

A description of the noise catchment and their locations is described in **Table 7-19**.

Table 7-19 Noise Catchment Area

NCA	Description and relating to Noise Monitoring
1	This is the eastern area of Olive Lane; residences nearest to the Tahmoor Colliery. It is represented by the ambient noise levels recorded at NM1 which was located approximately 100 m from Remembrance Drive.
1a	This is the western area of Olive Lane and captures other residences at a similar distance from the Tahmoor Mine. Tahmoor Mine is the main contributor to ambient noise in this area. Based on the results of operator-attended noise surveys and noise modelling it is known that noise from site reduces by approximately 4 dB in this area compared to the logger location NM1. An adjustment of minus 4 dB has been made to the Rating Background Levels (RBLs) measured at NM1 to determine RBLs representative of this area.
1b	This is the area located west of NCA1a. The same approach as for NCA1a to establishing RBLs has been adopted here; an adjustment of minus 4 dB to the RBLs determined for NCA1a.
2	This area is representative of the nearest residential locations to the north of the mine. It is represented by the ambient noise levels recorded at NM2. Ambient noise levels here are dominated by traffic on Remembrance Drive and Tahmoor Mine.
3	This is the residential area adjacent to Remembrance Drive further north of the site than NCA2. It is represented by the ambient noise levels recorded at L1 and dominated by traffic noise from Remembrance Drive.
4	This is the area north of the REA and is represented by the ambient noise levels recorded at NM3. Ambient noise levels here are dominated by natural sounds and noise from Tahmoor Mine.
4a	This is the area north of NCA4 and south of NCA3. This area is less influenced by noise from the mine than NCA4 and less influenced by road traffic noise than NCA3. A conservative approach has been taken to establishing relevant background noise levels for this area; the minimum NPfI levels have been assumed for day and night and, for evening, a level of 35 dB has been assumed which is 3dB lower than that measured at NCA4 and 2 dB lower than that measured at NCA3.

NCA	Description and relating to Noise Monitoring
5	This is the area south of the REA and is represented by the ambient noise levels recorded at NM4. Noise levels in this area are dominated by natural sounds with some influence from distant traffic.
6	This is the area adjacent to (i.e. within 100 m either side of) Remembrance Drive south of the mine. It is represented by the ambient noise levels recorded at L5 (noting that the noise logger that was located at NM5 failed).
6a	This is the area situated from 100 m to 200 m from Remembrance Drive south of the mine. Representative RBLs for this area have been determined by assuming a reduction to those measured at L5 based on the measurements undertaken at locations L5, AN4 and NM5.
7	This area is representative of all other typically rural locations within the project study area. Ambient noise levels in this area are consistent with the minimum level provided in the NPfI thus providing a conservative, yet realistic, assessment approach

7.8.1.3 Noise and Vibration Criteria

Operational noise targets

Project noise trigger levels (PNTLs) are the lower of the derived intrusiveness and amenity levels.

The intrusiveness trigger levels require that $L_{Aeq,15min}$ noise levels from site during the relevant operational periods (i.e. day, evening and night) do not exceed the relevant RBL by more than 5 dB. It is noted that where the RBL for the evening or night period is higher than day period RBL, the lower RBL for the day period has been adopted as the evening and night period RBLs in accordance with the NPfI.

The project intrusive noise levels determined from the RBLs for the noise catchment areas are presented in **Table 7-20**.

Table 7-20 Intrusive noise levels

NCA (representative logger location)	Measured / expected RBL, dB			Adopted RBL, dB			Project Intrusive noise level, $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	46	46	42	46	46	42	51	51	47
1a	42	42	38	42	42	38	47	47	43
1b	38	38	34	38	38	34	43	43	39
2	46	44	42	46	44	42	51	49	47
3	39	37	30	39	37	30	44	42	35
4	36	38	39	36	36	36	41	41	41
4a	35	35	30	35	35	30	40	40	35
5	34	34	30	35	34	30	40	39	35
6	44	37	30	44	37	30	49	42	35
6a	40	34	30	40	34	30	45	39	35
7	35	30	30	35	30	30	40	35	35

Notes: Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.

Amenity assessment locations within NCA1, NCA1a, NCA1b, NCA2, NCA3, NCA4, NCA4a and NCA6 have been categorised in the suburban amenity category in accordance with the NPfI definition of a suburban receiver type (i.e. an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry). All other assessment locations (NCA5, NCA6a and NCA7) have been categorised in the rural amenity category in accordance with the definition of a rural receiver type, i.e. an area with an acoustical environment that is dominated by natural sounds and generally characterised by low background noise levels.

The corresponding recommended amenity levels for all assessment locations adopted for the Amended Project are given in **Table 7-21**.

Table 7-21 Project amenity noise levels

NCA or Receiver	Indicative area	Project amenity noise level ($L_{Aeq,15min}$) dB		
		Day	Evening	Night
1	Suburban	58	48	43
1a	Suburban	58	48	43
1b	Suburban	58	48	43
2	Suburban	58	48	43
3	Suburban	58	48	43
4	Suburban	58	48	43
4a	Suburban	58	48	43
5	Rural	53	48	43
6	Suburban	58	48	43
6a	Rural	53	48	43
7	Rural	53	48	43
College Administration	Commercial	68	-	-
College sports field	Active Recreation Area	58	-	-
College Classroom[2] (internal)	School (internal)	43 (internal) 53 (external)	-	-
Anglican Church	Place of worship (internal)	43 (internal) 53 (external)	43 (internal) 53 (external)	-

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.

2. The recommended acceptable noise amenity level for an existing school affected by existing industrial noise sources has been established as per note to Table 2.2 of the NPfI. Amenity noise level for the College and Church applies “when in use” – it has been assumed the College operates during the day period only and the Church operates during day and evening only.

The PNTLs are the more stringent of either the project intrusive or amenity noise levels and are shown in **Table 7-22**.

Table 7-22 Project noise trigger levels, $L_{Aeq,15min}$

NCA / Receiver	Intrusive noise level, $L_{Aeq,15min}$, dB			Amenity noise level, $L_{Aeq,period}$, dB			PNTL, $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	51	51	47	58	48	43	51	48	43
1a	47	47	43	58	48	43	47	47	43
1b	43	43	39	58	48	43	43	43	39
2	51	49	47	58	48	43	51	48	43
3	44	42	35	58	48	43	44	42	35
4	41	41	41	58	48	43	41	41	41
4a	40	40	35	58	48	43	40	40	35
5	40	39	35	53	48	43	40	39	35
6	49	42	35	58	48	43	49	42	35
6a	45	39	35	53	48	43	45	39	35
7	40	35	35	53	48	43	40	35	35
College Admin	n/a	n/a	n/a	68	-	-	68	-	-
College Sports field	n/a	n/a	n/a	58	-	-	58	-	-
College classroom (internal)	n/a	n/a	n/a	43 (internal) 53 (external)	-	-	43 (internal) 53 (external)	-	-
Church (internal)	n/a	n/a	n/a	43 (internal) 53 (external)	43 (internal) 53 (external)	-	43 (internal) 53 (external)	43 (internal) 53 (external)	-

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.

Operational scenarios including the existing mine operations, an unmitigated Project and a mitigated Project were used to assess impacts from acoustically significant equipment and sound power levels.

Low frequency noise

Fact sheet C of the NPfI (EPA 2017) was used to provide guidelines for applying modifying factor corrections to account for low frequency noise emissions. The NPfI specifies that a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the vales in Table C2 of the NPfI.

The following modifying factor correction is to be applied where the site 'C-weighted' and site 'A-weighted' noise emission level is 15 dB or more and:

- Where any of the one-third octave noise levels in Table C2 of the NPfI are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dB positive adjustment to measured/ predicted A-weighted levels applies for the evening/ night period; or

- Where any of the one-third octave noise levels in Table C2 of the NPfI are exceedance by more than 5 dB and cannot be mitigated, a 5-dB positive adjustment to measured/ predicted A-weighted levels applies for the evening/ night period and a 2 dB positive adjustment applies for the daytime period.

Sleep disturbance

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where night-time noise levels at a residential location exceed:

- $L_{Aeq,15\ minute}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

The NPfI also references guidance regarding potential for sleep disturbance provided in the *Road Noise Policy* (RNP) (NSW DECCW, 2011). The RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels (L_{Amax}) below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels (L_{Amax}) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60–65 dB calculated at the façade of a residence is unlikely to awaken people according to the Road Noise Policy.

Based on the guidance provided in the NPfI, **Table 7-23** provides the sleep disturbance screening levels for the residential assessment locations.

Table 7-23 Sleep disturbance screening levels, residential assessment locations

NCA	Adopted RBL, dB(A)	Sleep disturbance screening levels	
		$L_{Aeq,15min}$	L_{Amax}
1	42	47	57
1a	38	43	53
1b	34	40	52
2	42	47	57
3	30	40	52
4	36	41	52
4a	30	40	52
5	30	40	52
6	30	40	52
6a	30	40	52
7	30	40	52

Construction Noise

Noise emissions from construction activities associated with mining projects are typically assessed under the NPfI. With regard to the Amended Project, construction activities (i.e. establishment of the new ventilation fans) will be different in nature to the operations that will occur at the ventilation fans sites, and those that occur at the pit-top area. Further, the proposed construction activity is temporary and will be completed within three years with both ventilation fans (TSC1-upcast and TSC2-downcast) planned to be operational by the end of 2024.

In addition, the noise associated with construction of the ventilation fans has been compared to the construction noise targets contained in the Interim Construction Noise Guideline (ICNG). The ICNG provides a quantitative noise assessment approach, which is suited to major construction project with a typical duration of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

Vibration

The assessment of potential vibration impacts completed for the EIS remain consistent for the Amended Project.

7.8.1.4 Existing environment

Since the original NVIA was prepared for the EIS, some works have been undertaken on site to reduce noise emission levels. For example, a new dozer has been purchased with a reduced sound power level and the rail loading chute has been modified. Table 6.2 in the revised NVIA (**Appendix I**) summarises the operational noise sources and associated sound power levels used in the noise model.

The equipment items and quantities are based on the current operations and those proposed for use as part of the Amended Project. Most of the sound power data used to inform the revised NVIA (**Appendix I**) were obtained from noise measurements of existing activities at the site. Where this was not possible, sound power data has been obtained from a representative database of similar plan and equipment.

Quarterly noise monitoring results obtained between Q1 2014 and Q3 2019 are summarised in the revised NVIA (**Appendix I**). Within this reporting period, 23 rounds of monitoring were undertaken. Results from these monitoring events indicate that noise levels are generally in compliance with the existing noise limits (i.e. within 2 dB) at the relevant residential monitoring locations.

Measured night-time L_{Aeq} one-third octave band centre frequency levels (10-160 Hz), low frequency noise (LFN) threshold levels (NPfI) and C-A weighted levels indicate that low frequency noise above the current relevant NPfI thresholds is present in the vicinity of Olive Lane (locations M3 and M4) and the Wollondilly Anglican Church and College (location M2). The measured LFN levels at these locations indicate that a modifying factor of +2 dB and +5dB would apply at assessment locations in these areas during day and evening/night periods, respectively.

Monitoring at an additional five unattended noise monitoring locations was undertaken in June 2019. The attended noise monitoring results found the existing noise environment west of the site, in Olive Lane, is dominated by noise from Tahmoor mine and traffic on Remembrance Drive. North of the site the existing noise environment is dominated by local traffic and some commercial activity with some contribution from Tahmoor mine. Noise levels at residences south of the project area are dominated by traffic noise from Remembrance Drive and train noise. Noise levels in residential areas west of the Project area are dominated by typically rural sounds and local traffic. These observations were considered in the assignment of representative background noise levels and ultimately for the PNTLs for all areas.

7.8.2 Revised Impacts

7.8.2.1 Construction noise

Construction activity at the proposed ventilation sites is likely to occur during the first three to four years of the Project with both ventilation shafts operational by approximately the end of 2024. This has been considered as Stage 2 of the proposed extension of the REA.

The construction noise predictions were carried out using the ISO9613 algorithms within *iNoise* software, and a simple yet conservative approach has been selected for the consideration of potentially noise-enhancing weather conditions with reference to Fact Sheet D of the NPfI.

Construction activity is expected to be undertaken concurrently with Stage 2 (refer to **Section 7.8.1**) of the Amended Project and it is predicted to result in a minor increase in the number of properties affected by noise more than 5dB above the PNTL. As expected, the largest predicted increase in noise levels as a result of construction activity are limited to those properties in close proximity to the proposed ventilation fan sites. With reference to the ICNG, the total noise emissions are predicted to be below the 'highly noise affected' level at all residential properties during the daytime.

The two nearest private residences to the south of REA and nearest to the ventilation shafts are 80 and 185 Charlies Point Road. Night-time construction noise levels, including unmitigated Stage 2 mining activities are predicted to be equal to or less than $L_{Aeq,15minute}$ 37 dB for each scenario considered at 80 Charlies Point Road. Whereas, night-time construction activity including unmitigated Stage 2 mining activities at 185 Charlies Point Road is predicted to generate up to $L_{Aeq,15minute}$ 49 dB. It is noted that Tahmoor Coal has commenced negotiations to purchase this property.

Table 7-24 provides a summary of the number of assessment locations for Stage 2 excluding construction, as well as each construction scenario that was considered, where predicted noise emissions are in the following categories:

- No more than 2 dB above PNTL;
- 3-5 dB above PNTL; and
- More than 5 dB above PNTL.

Table 7-24 Assessment locations – residual noise impacts

	Stage 2 Excluding Construction			Stage 2 + TSC1 Site Est.	Stage 2 + TSC1 Drilling			Stage 2 + TSC2 Site Est.	Stage 2 + TSC2 Drilling		
Noise-enhancing	Day	Evening	Night	Day	Day	Evening	Night	Day	Day	Evening	Night
No more than 2dB above PNTL	2745	2702	2635	2735	2743	2699	2634	2731	2744	2701	2634
3-5dB above PNTL	12	32	84	20	13	34	82	22	12	31	84
More than 5dB above PNTL	1	23	36	3	2	24	39	5	2	25	37

7.8.2.2 Operational noise

As for construction noise, operational noise predictions were assessed using the ISO9613 algorithms within *iNoise* software. *iNoise* calculates the total noise levels at assessment locations during concurrent operations at multiple noise sources. The model considers factors such as the lateral and vertical location of the noise generating sources, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions. **Figure 7-1** illustrates the noise impact categories for all stages of the Amended Project.

Revisions have been made to the noise emissions at the existing Tahmoor Mine and the unmitigated operation scenarios due to a reduction in operational acoustic plant equipment (refer to **Section 7.8.1.4**). Noise data for the new dozer was provided to EMM, which indicated a 3 dB reduction compared to the previously measured sound power level. The noise improvement, as a result of the improved rail loading chute has been estimated to be a reduction of 4 dB.

Noise generated from existing operations at Tahmoor Mine was modelled and compared to the results of operator-attended noise surveys undertaken by EMM in Olive Lane. Results of the model validation indicated that the model over-predicts impacts by approximately 2 dB. It is important to note that calibration factors were not been applied within the model thus providing a conservative assessment approach.

Results for the mitigated operations scenario for the Amended Project are provided in the NVIA **Appendix I**).

Table 7-25 provides a summary of the number of assessment locations for each operational scenario (existing mine and each of the stages considered) under the previously considered noise emissions categories.

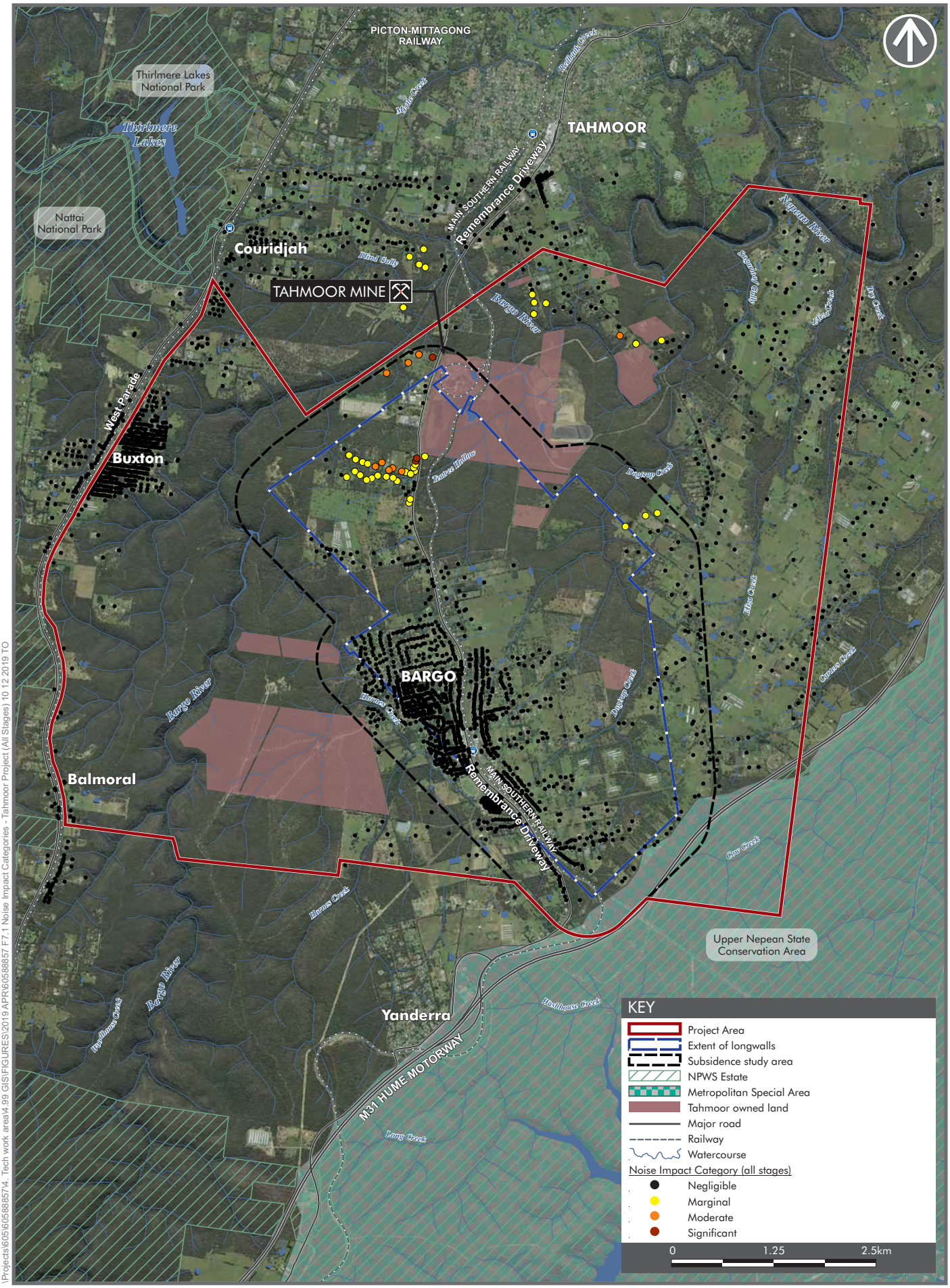
Key findings from the operational noise assessment are:

- The mitigated scenario is expected to reduce noise emissions at all assessment locations compared to existing levels by at least 2 dB and up to 18 dB at all assessment locations during the night-time period.
- Predicted noise levels from the Amended Project showed a significant reduction in the number of privately-owned dwellings affected by operational noise emissions more than 5 dB above the relevant PNTL. When compared to existing mine noise, a maximum of 6 residences for operation of the mitigated scenario whereas there were 33 for the existing Tahmoor Mine operations (as shown in **Figure 7-1**). Categorising residual noise impacts in accordance with the VLAMP noise impact categories results in three residential properties classified as significantly affected.
- Operational noise at the nearby Anglican Church and School is predicted to reduce by at least 3 dB (mitigated scenario) when compared to existing mine noise emission levels. Furthermore, mine noise including mitigation measures is predicted to achieve the relevant amenity noise levels at these locations.
- In some cases, locations categorised as significant are located further away from the mine than those with a moderate or marginal impact category. This is due to several factors including rounding of noise predictions, local topographical features and the relative PNTLs for these locations (intrusive and amenity).

The VLAMP has been applied to the amended project in relation to the assessment of residual noise impacts and the process for negotiated agreements. Tahmoor Mine has been the subject of numerous pollution reduction programs (PRPs) in relation to noise. The outcomes of which have been accepted by the EPA and evidenced by a significant reduction in noise complaints over time. The noise emissions from the Amended Project are predicted to reduce compared to existing Tahmoor Mine operational noise emissions at all noise-sensitive receptors during the night-time period.

The noise impacts for this assessment were characterised using the VLAMP, contained in **Appendix I**.

The noise trigger levels for the Amended Project are provided in the **Table 7-26** below.



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SIMEC

NOISE IMPACT CATEGORIES - TAHMOOR SOUTH PROJECT (ALL STAGES)

Tahmoor South Project
Project Amendment Report

FIGURE 7.1

Table 7-25 Assessment locations

	Existing Tahmoor Mine			Stage 2 exc Constrn			Stage 2 Mit exc Constrn			Stage 4			Stage 4 Mitigated			Stage 5			Stage 5 Mitigated		
Noise-enhancing	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**
No more than 2dB above PNTL	2753	2715	2650	2747	2704	2636	2753	2723	2734	2751	2709	2643	2757	2725	2734	2750	2711	2646	2756	2731	2735
3-5dB above PNTL	5	24	73	11	32	84	6	29	19	7	27	76	2	27	19	8	25	72	3	22	18
More than 5dB above PNTL	1	19	33	1	22	36	0	6	3	1	22	37	0	6	3	1	22	38	0	5	3
Calm																					
No more than 2dB above PNTL	2759	2745	2734	2758	2744	2734	2759	2757	2754	2759	2742	2733	2759	2754	2754	2759	2742	2733	2759	2755	2754
3-5dB above PNTL	0	12	17	1	12	17	0	1	2	0	15	18	0	4	2	0	15	18	0	3	2
More than 5dB above PNTL	0	1	5	0	2	5	0	0	0	0	1	5	0	0	0	0	1	5	0	0	0

Table 7-26 Project noise trigger levels (PNTLs)

NCA/ Receiver	Intrusive noise level, $L_{Aeq15min}$,			Amenity noise level, $L_{Aeq15min}$,			PNTL noise level, $L_{Aeq15min}$,		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	51	51	47	58	48	43	51	48	43
1a	47	47	43	58	48	43	47	47	43
1b	43	43	39	58	48	43	43	43	39
2	51	49	47	58	48	43	51	48	43
3	44	42	35	58	48	43	44	42	35
4	41	41	41	58	48	43	41	41	41
4a	40	40	35	58	48	43	40	40	35
5	40	39	35	53	48	43	40	39	35
6	49	42	35	58	48	43	49	42	35
6a	45	39	35	53	48	43	45	39	35
7	40	35	35	53	48	43	40	35	35
College Admin	n/a	n/a	n/a	68	-	-	68	-	-
College Sports Field	n/a	n/a	n/a	58	-	-	58	-	-
College Classroom	n/a	n/a	n/a	43 (internal) 53 (external)	-	-	43 (internal) 53 (external)	-	-
Church Internal	n/a	n/a	n/a	43 (internal) 53 (external)	43 (internal) 53 (external)	-	43 (internal) 53 (external)	43 (internal) 53 (external)	-

Sleep disturbance

Further assessment of the sleep disturbance showed no change to the frequency and level of impact compared to the existing operation from the implemented mitigation measures. Results indicate that the maximum noise level is not predicted to be above that which would trigger the need for a detailed assessment of maximum noise events (i.e. the NPfI L_{Amax} 52dB).

Vibration

The precise type and model of the drill rig to be used is not yet known. Notwithstanding, given the separation distance between the sites where drilling is proposed and the nearest residences (>200m), published literature shows that vibration levels from drilling activity will not be noticeable at the nearest residences. Furthermore, vibration levels from drilling are expected be below levels likely to cause damage to structures.

7.8.3 Revised Management and Mitigation Measures

Consideration of the feasibility and reasonableness of existing and additional noise mitigation measures has been undertaken with reference to the guidance provided in Section 3.4 of the NPfI. The main operation noise sources at the site contributing to off-site noise levels are the CHPP and dozers. Other significant sources that contribute to off-site noise emissions include rail loading activities (locomotives and loading coal into wagons), compressors and the reject haul truck. Mitigation options targeting these noise sources have been considered in the following hierarchical approach:

1. Control of noise at the source;

2. Once the feasible and reasonable controls at the source are exhausted, controlling the transmission of noise; and
3. Once source and transmission feasible and reasonable controls are exhausted, considering mitigation measures at the noise-sensitive receivers.

It is anticipated that all the feasible and reasonable noise mitigation measures identified in Table 6.4 of the revised NVIA (**Appendix I**) will be adopted. Tahmoor Coal will require an appropriate timeline to coordinate and implement all these measures. Further information in this regard is provided as follows:

- CHPP improvements: Tahmoor Coal will commence investigations and concept design study for this work in 2020. Feasibility study works, including consideration of various options, is anticipated to continue through the first two years of the Amended Project. It is estimated that the CHPP mitigation measures could be implemented within approximately three years of physical commencement of the Amended Project.
- Dozers: the use of only one dozer at night, as well as the restriction to operating area for the stockpile dozer would be implemented upon approval of the Amended Project. The noise suppression kit for the dozer would be procured and installed within the first 12 months after approval of the Amended Project.
- Restriction of REA operations: to enable the restriction of REA operations to day and evening only modifications are required to the conveyor, as well as procurement of a front-end loader to assist with loading the second haul truck. It is anticipated that the design, procurement and installation process would be completed within approximately three years of physical commencements of the Amended Project.
- Compressors: the upgrade to the compressor enclosure would be installed within approximately two years after approval of the Amended Project.
- Barriers: improvements to the bund shielding the rail loop, as well as design/ construction of the barrier around the stockpile area are expected to be completed within three years after approval of the Amended Project.

7.8.4 Conclusion

The NVIA for the Amended Project indicates that operational noise from Tahmoor Mine will improve as a result of the project with the incorporation of feasible and reasonable mitigation measures especially during the most sensitive night-time period.

Construction noise associated with the amended project is expected to increase general operational noise emissions in the vicinity of the proposed works; new ventilation shaft sites south of the REA. Tahmoor Coal will incorporate feasible and reasonable measures to minimise potential construction noise impacts and actively manage construction activity through the preparation and implementation of a Construction Management Plan.

7.9 Air Quality Assessment

Tahmoor Coal submitted an air quality assessment in support of the EIS prepared for the Project. An updated assessment has been prepared for the Amended Project and is presented in **Appendix J**. The updated assessment considers the changes to the Project from the EIS.

7.9.1 Revised Assessment

The methodology for the revised Air Quality Assessment is consistent with that presented in Section 11.11.3 of the EIS.

The Air Quality Assessment has been revised to include the continued use of the existing upcast shaft (T2) as part of the Amended Project. The assessment prepared for the EIS assumed that this shaft would not be required for the Project; however, a review of ventilation requirements identified the need to continue the use of T2.The number of fans in operation at upcast shaft T2 would reduce from the two fans in use for Tahmoor North operations to one fan once the new ventilation shafts are in operation for Tahmoor South. Notwithstanding, for the purposes of a conservative assessment, ventilation shaft T2 has been modelled with two fans running.

7.9.2 Revised Impacts

When comparing with results from the EIS, the results for the Amended Project were relatively the same. As such, the conclusions remain unchanged, as exceedances of impact assessment criteria are not predicted for sensitive receptors.

7.9.2.1 Existing Environment

Existing ambient air quality data identified that most air quality pollutant data is below the EPA annual average criterion. The exception is air quality data for the PM_{10} 24-hour average data. Although an annual average cannot be established for that data, several exceedances of the 24-hour average EPA impact assessment criterion of 50 µg/m^3 were identified across most data collection years at all monitoring sites. **Table 7-27** shows the updated background ambient air quality compared to the relevant criteria. In addition to the data on the table, data for NO_2 and CO were also collated. This data identified no exceedances of the relevant EPA impact assessment criteria across the monitoring periods.

Table 7-27 Amended background air quality averages

Ambient Air Quality Measurement	Period of data collection	Source of data	Average	Criterion
TSP	9 Mar 2012 to 26 July 2013 and 6 Dec 2014 to 27 March 2019	Tahmoor South HVAS	20.5 µg/m^3 (annual average over the full monitoring period)	90 µg/m^3 (EPA annual average)
PM_{10}	Jan 2012 to July 2013 and Jan 2015 to December 2018	Tahmoor South TEOM	13.1 µg/m^3 (annual average across all stations between 2007 – 2018)	25 µg/m^3 – annual average
			N/A	50 µg/m^3- 24-hour average
	2007 to 2018	EPA monitoring stations	15 µg/m^3	25 µg/m^3 – annual average
			N/A	50 µg/m^3- 24-hour average
$PM_{2.5}$	December 2012 to 2017*	EPA Monitoring Station - Camden	6 µg/m^3	8 µg/m^3
			N/A	25 µg/m^3- 24-hour average
Dust Deposition	April 2012 to May 2013 and Dec 2015 to June 2017	Tahmoor South Dust Deposition Gauges (5)	1.4 grams per square metre per month	4 grams per square metre per month
	2008 to 2018	Tahmoor Mine Dust Deposition Gauges (6)	1.1 grams per square metre per month	4 grams per square metre per month

7.9.2.2 PM_{10}

When comparing with results from the EIS, the results for this assessment were identical or a very small percentage higher. There has not been a change to the conclusions, with no sensitive receptors exceeding the relevant impact assessment criteria.

For the mine owned receptors, the results indicated that one receptor (R10), in close proximity to the REA, is predicted to experience maximum 24-hour average PM_{10} above 50 $\mu g/m^3$, due to the operation of the Project. This receptor is predicted to exceed the 24-hour average impact assessment criterion on only one day of the year as a result of emissions from the Project.

Cumulative PM_{10} 24-hour impacts at the most affected receptor locations were assessed. The analysis concluded that there was a probability that the selected receptors may exceed the EPA criterion of 50 $\mu g/m^3$ when assessed cumulatively. A mine-owned receptor had the highest estimated number of days exceeding this criterion (nine), while the privately-owned receptor with the highest estimated number of days exceeding this criterion was R1 (five). With the incorporation of the TARP and other dust management practices, these exceedances would be managed within acceptable limits.

7.9.2.3 Odour

The odour assessment followed a conventional approach commonly used for air quality assessment in Australia and outlined in the Approved Methods (NSW EPA, 2016) and is consistent with previous air quality assessments conducted for this mine.

The results of the odour modelling show that the recorded 99th percentile odour levels were below the criterion of 7 ou for receptors 1-24 and receptors 27-40, and below the criteria of 2 ou for receptor 25 and 26.

7.9.3 Revised Management and Mitigation Measures

The measures outlined in Section 11.11.6 of the EIS prepared for the Project remain applicable to the Amended Project. A Construction Air Quality Management Plan would be developed and implemented as part of the Construction Environment Management Plan for the Amended Project. The construction Air Quality Management Plan would include management and mitigation measures to minimise dust generation as a result of the Amended Project as much as possible. A TARP relating to meteorological triggers for dust generation would also be implemented.

7.9.4 Conclusion

There are no sensitive receptors that are predicted to experience annual average $PM_{2.5}$, PM_{10}, TSP concentration or dust deposition levels above the EPA assessment criteria, either from the Amended Project alone or cumulatively.

A Monte Carlo Simulation was completed to assess cumulative PM_{10} 24-hour impacts at the most affected receptor locations. The privately-owned receptor with the highest estimated number of days exceeding the 24-hour average PM_{10} criterion was at R1, with exceedances of the cumulative criteria predicted to be exceeded on up to 5 days of the year. However, with the incorporation of the TARP and other dust management practices, these exceedances would be well managed.

There are unlikely to be any additional exceedances of the cumulative 24-hour $PM_{2.5}$ criterion due to the Project. Measured exceedances are the result of regional events such as bushfires and hazard reduction burns and the contribution from the Amended Project is low.

When comparing with results from the EIS, the results for the Amended Project were identical or a very small percentage higher. There has not been a change to the conclusions with no sensitive receptors exceeding the relevant impact assessment criteria.

7.10 Greenhouse Gas

A Greenhouse Gas Assessment (GHG) was prepared in support of the EIS prepared for the Project. A revised GHG Assessment has been prepared for the Amended Project to reflect the reduced volume of ROM coal to be produced over the life of the Amended Project (43 Mt, compared to the 48 Mt assessed in the EIS. The revised GHG assessment is presented in **Appendix K**.

7.10.1 Revised Assessment

The methodology for the revised Greenhouse Gas Assessment is consistent with that presented in Section 11.12.2 of the EIS. GHG emissions have been estimated for the Amended Project based upon the method outlined in the following documents:

- The *National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2008* (as amended 2019);
- Site specific information;
- The NGER guidelines; and
- The NGA factors.

The revised Greenhouse Gas Assessment for the Amended Project incorporates the following project amendments:

- A reduction in the total amount of ROM coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal, comprising;
  - 30 Mt of coking coal product (reduced from 35 Mt);
  - 2 Mt of thermal coal product (reduced from 3.5 Mt).
- A reduction in the area of vegetation to be cleared for the Amended Project from 49.2 ha to 37.77 ha (including 14.2 ha of mine rehabilitation).

7.10.2 Revised Impacts

The following sections present the results of the revised assessment for each of the GHG scopes (being 1, 2 and 3).

7.10.2.1 Scope 1 emissions

Scope 1 emissions are direct GHG emissions that occur from sources that are owned or controlled by the reporting entity. The amended Greenhouse Gas Assessment estimates that over the life of the Amended Project, approximately 12.1 million tonnes of CO_2-e Scope 1 emissions would be generated with the WCMG Power Plant operating at Tahmoor Mine (refer to **Table 7-28**) (previously 13.5 million tonnes in the EIS). Fugitive methane emissions are the major source of Scope 1 emissions, accounting for 92.5% (previously 93.5% in the EIS) of direct (Scope 1) emissions that would be generated by the proposed development (with the Waste Coal Mine Gas (WCMG) Power Plant operating at Tahmoor Mine), followed by post-mining activities, which would generate 6.0% of total Scope 1 emissions (refer to **Table 7-28**).

7.10.2.2 Scope 2 Emissions

Scope 2 emissions are a category of indirect emissions that accounts for GHG emissions from the generation of purchased energy products by the entity. Scope 2 of the revised GHG assessment covers purchased electricity defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity. Over the life of the Amended Project, electricity consumption is anticipated to generate approximately 1.3 million tonnes CO_2-e (previously 1.46 in the EIS) (refer to **Table 7-28**). This represents a reduction in GHG emissions by approximately 11% for the Amended Project when compared against the original mine plan (considered in the EIS).

7.10.2.3 Scope 3 Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. The burning of product coal over the life of the Amended Project is anticipated to generate about 88.26 million tonnes CO_2-e of Scope 3 emissions (previously 104.55 in the EIS) as shown in **Table 7-28**.

Table 7-28 Summary of estimated Scope 1, Scope 2 and Scope 3 greenhouse gas emissions CO2-e (tonnes) for the Amended Project

Year	Scope 1 Emissions (t CO_2-e) (Based on the power plant operating)						Scope 2 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)
	Diesel	Unleaded Petrol	Fugitive Methane	SF_6	Post-mining Activities	Total	Electricity	Energy Production
2020	323	5	218,624	0.3	4,592.828	223,545	8,284	363,754
2021	489	7	94,628	0.5	6,956.303	102,082	12,546	529,770
2022	2,423	36	188,448	2.2	34,437.367	225,347	62,111	3,501,846
2023	3,911	59	600,823	3.6	55,592.227	660,388	100,266	5,934,313
2024	3,730	56	562,504	3.4	53,016.247	619,309	95,620	6,164,134
2025	3,928	59	687,207	3.6	55,835.426	747,033	100,704	7,015,311
2026	4,010	60	673,330	3.7	57,001.234	734,405	102,807	7,382,972
2027	4,078	61	813,763	3.8	57,962.141	875,868	104,540	7,537,017
2028	3,998	60	1,249,589	3.7	56,828.096	1,310,478	102,495	7,460,163
2029	3,894	58	1,351,744	3.6	55,347.635	1,411,048	99,824	7,305,632
2030	4,077	61	1,293,397	3.8	57,955.161	1,355,494	104,527	7,685,999
2031	4,088	61	1,044,492	3.8	58,104.038	1,106,750	104,796	7,818,277
2032	3,754	56	1,052,171	3.5	53,363.934	1,109,349	96,247	6,930,790
2033	3,774	57	382,693	3.5	53,641.669	440,168	96,748	6,081,808
2034	3,070	46	483,159	2.8	43,633.002	529,910	78,696	4,706,233
2035	1,107	17	609,833	1.0	15,733.348	626,691	28,377	1,841,903
Total*	**50,654**	**761**	**11,306,405**	**47**	**720,000.656**	**12,077,868**	**1,298,586**	**88,259,920**
					Annual Average	**754,867**	**81,162**	**5,516,245**

*Total values may not always equate to the sum of the numbers shown due to rounding.

Cumulative Impacts

Table 7-29 details the relative percentage contribution of each different emission scope combination (direct and indirect), to the NSW, Australian and Global GHG emissions. It is noted that combining downstream emissions (Scope 3), adds an element of 'double counting' to the carbon budget if these emissions are captured in the direct (Scope 1) emissions from those downstream operations.

Table 7-29 Project contribution to NSW, Australian and Global GHG emissions

	Annual Project emissions (Mt CO_2-e)	Contribution to total NSW[1] emissions of 128.9 Mt CO_2-e	Contribution to total Australian[2] emissions of 128.9 Mt CO_2-e	Contribution to total Global[3] emissions of 33,100 Mt CO_2-e
Scope 1	0.75	0.586 %	0.175 %	0.0023 %
Scope 1 and 2	0.84	0.649 %	0.194 %	0.0025 %
Scope 1, 2 and 3	6.35	4.93 %	1.47 %	0.0192 %

[1] NSW emissions reported in 2017, taken from the National Greenhouse Gas Inventory (2019) http://ageis.climatechange.gov.au/#

[2] Based on Australia's emission target for 2030 under the Paris Agreement https://climateactiontracker.org/countries/australia/

[3] Latest emissions data available for 2018. https://www.iea.org/geco/emissions/

It is evident that by the data provided in **Table 7-29** that the Amended Project contributes a small amount with regard to the total global carbon emissions. The Amended Projects main source of direct GHG emissions includes fugitive methane from mine ventilation, pre and post-drainage and flaring. Other Scope 1 and 2 emissions include diesel, unleaded petrol consumption, post-mining activities, electricity use and use of SF_6. The Scope 3 emissions presented for the Amended Project relate to energy used to produce both thermal and coking coal and have been considered in the Amended Project's contribution to global carbon emissions.

It was found that the Amended Projects likely contribution to projected climate change, would be proportionate with its contribution to global GHG emissions. Average annual Scope 1 emissions from the Amended Project (0.75 Mt Co_2-e) would represent approximately 0.175% of Australia's commitment under the Paris Agreement and 0.0023% of global emissions. When including all indirect emissions, these percentages are 1.47% (Australia) and 0.0192% (global).

7.10.3 Revised Management and Mitigation Measures

Tahmoor Mine is an existing mining operation, and the Amended Project relates to the continuing of mining activities at, and adjacent to, the existing mining operations.

In addition to the measures that are currently employed by Tahmoor Coal in relation to the existing mining operations, the measures outlined in Section 11.2.4 of the EIS prepared for the Project and the mitigation measures set out in Table 8.1 of the revised Greenhouse Gas Assessment (**Appendix K**) are applicable to the Amended Project and would be adopted by Tahmoor Coal as its primary measures to reduce, to the greatest extent possible, the Scope 1 and Scope 2 emissions from the Amended Project and to support the achievement of the objectives of the NSW Climate Change Policy Framework. The effectiveness of these reasonable and feasible measures would be monitored in accordance with the Energy Savings Action Plan that would be developed by Tahmoor Coal, as Tahmoor Coal would annually estimate GFG emissions and energy consumption in accordance with National Greenhouse and Energy Reporting and Energy Efficiency Opportunities requirements.

In addition to those measures, Tahmoor Coal and its affiliated companies in the Liberty Steel Group of the GFG Alliance would implement further measures to reduce Scope 1 and Scope 2 emissions from the Liberty Steel Group's consolidated operations, which would include the Amended Project and steelmaking operations in Australia. The Liberty Steel Group has publicly stated its aim to be carbon neutral by 2030 and is commencing the development of an organisational structure to investigate and implement necessary measures to achieve this aim. To date, the Liberty Steel Group has committed to developing large scale, low cost and reliable green energy capacity. At Tahmoor Coal's affiliates' steelmaking and iron ore sites in South Australia, a number of such operations are underway or in development, including:

1. A large solar farm known as "Cultana Power Station" is being installed across 740ha, to produce 210MW of electricity adjacent to the steelmaking operations. The solar farm is being developed by SIMEC Energy, an affiliate of the GFG Alliance;
2. Feasibility studies for a pumped hydro facility, to be installed in a disused iron ore pit, have been developed; and
3. The steelmaking technology has been under review since late 2017, to investigate alternative methods of steelmaking that are aligned with GFG Alliance's low-carbon metals and industrials strategy known as GREENSTEEL.

To support the Liberty Steel Group's aim to be carbon neutral by 2030, and to support the objectives of the NSW Climate Change Policy Framework, similar opportunities for the reduction of Scope 1 and Scope 2 emissions from the Amended Project to the greatest extent possible will continue to be investigated by Tahmoor Coal as part of its Energy Savings Action Plan.

In relation to Scope 3 emissions, Tahmoor Coal's current end customers include:

1. Australian consumers of metallurgical coking coal (notably the two steelmakers in Australia: BlueScope and OneSteel Manufacturing, which is an affiliated company of Tahmoor Coal);
2. Consumers of metallurgical coking coal located in Germany, Japan, India, United Kingdom and Netherlands; and

3. End customers in other locations from time to time.

Tahmoor Coal's current end customer base is located in countries that are signatories to the Paris Agreement within the United Nations Framework Convention on Climate Change. Tahmoor Coal would continue to manage the reduction of the Scope 3 emissions from the Amended Project to the greatest extent possible by continuing to sell its coal to customers with end users located in countries that are parties to the Paris Agreement, or countries with equivalent domestic policies for reducing greenhouse gas emissions.

7.11 Economic

Tahmoor Coal submitted an Economic Impact Assessment in support of the EIS prepared for the Project. An updated assessment has been prepared for the Amended Project and is presented in **Appendix L**. The updated assessment considers the changes to the Project from the EIS.

7.11.1 Revised Assessment

The methodology for the revised Economic Impact Assessment is consistent with that presented in Section 11.16.2 of the EIS.

The revised Economic Impact Assessment was prepared in accordance with the economic assessment framework set out in the G*uidelines for the economic assessment of mining and coal seam gas proposals* (the Guidelines) released by the NSW Government in December 2015. The analysis is also consistent with the *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (the Technical Notes) published in April 2018.

Consistent with the Guidelines, the assessment includes a Cost Benefit Analysis (CBA) and a Local Effects Analysis (LEA). The CBA provides an estimate of the net benefits of the Project to NSW, while the LEA is based on analysis for the Wollondilly local region (as defined by the Australian Bureau of Statistics SA3 (12303) region).

In addition to the CBA and LEA, an assessment of the economic impacts of the Amended Project on the Wollondilly region of NSW based on computable general equilibrium (CGE) modelling has also been undertaken, which represents economy-wide modelling. The CGE modelling considers the coal output, the payment of royalties from Wollondilly into the rest of NSW, the repatriation of profits overseas and that workers from the NSW would be drawn into the Wollondilly LGA.

7.11.2 Revised Impacts

7.11.2.1 Cost Benefit Analysis

Table 7-30 presents the revised estimation of the total net economic benefit of the Amended Project in net present value terms as compared to the figures presented in the EIS. The net benefit of the Project (as amended) is estimated to be $783.8 million (NPV). This is comprised of $272.1 million and $511.8 million in direct and indirect benefits respectively and an incremental cost of the Project is $0.11 million. This represents an increase in economic benefit when compared to the CBA undertaken in the EIS which was $699.5 million in NPV terms.

Table 7-30 Net economic benefit of the Project

	EIS net benefit	Amended Project net benefit
Total net benefit	$699.5 million	$783.8 million

As shown in **Table 7-30**, the net benefit associated with the Amended Project is higher than the net benefit calculated for the Project as presented in the EIS. This increase is driven by several factors including higher coal reference prices and a reduced discount period, where the net benefits of the Project are discounted to 2019 compared to 2018 for the EIS.

Direct Benefits

The Amended Project would generate the following direct benefits:

- An overall net producer surplus (NPS) of $324.3 million in NPV terms, of which zero is attributed to NSW as Tahmoor Coal is 100 per cent foreign owned;
- Total corporate taxes of $253.9 million in NPV terms for Australia, of which $81.3 million is attributed to NSW; and
- $190.9 million in other government revenue for NSW in NPV terms, the largest component of this being royalties of $161.1 million with council rates and payroll taxes contributing $5.2 million and $24.5 million, respectively.

Indirect Benefits

The indirect benefits of the Amended Project are related to the linkages that the Project has to the NSW economy through both the labour market and suppliers. The analysis shows that of the $511.8 million in estimated indirect benefits:

- Worker benefits are $264.3 million in NPV terms; and
- Supplier benefits are $247.5 in NPV terms based on NSW-based operational expenditure over the life of the development of $1,226.3 million in NPV terms.

7.11.2.2 Local Effects Analysis

The LEA considers the costs and benefits of the Amended Project on residents of the Wollondilly region of NSW. The analysis shows an estimated net benefit of $162.0 million to the Wollondilly region in NPV terms. This is driven largely by:

- Benefits to local workers of $122.3 million in NPV terms based on the assumption that 45 per cent of the mine's direct employees continue to be drawn from Wollondilly, whereas the EIS reported local worker benefits of $95.5 million;
- Benefits to local suppliers of $34.5 million in NPV terms which assumes that 12.9 per cent of the inputs to production are from the region whereas the EIS reported local supplier benefits of $29.5 million; and
- The payment of local Council rates totalling $5.2 million in NPV terms, whereas the EIS reported local Council rates at $7.0 million.

The economic assessment found that the estimated local effects are robust under the sensitivity analysis conducted with a lower bound estimate of net benefits to the Wollondilly region of $153.6 million and upper bound estimate of $171.4 million in NPV terms.

7.11.2.3 Economy-wide Modelling

Overall the Amended Project is expected to provide positive economy-wide impacts to both Wollondilly SA3 region and to NSW. The net economic impacts of the Project are shown in **Table 7-31**. In the Wollondilly region, the Amended Project is expected to increase Gross Regional Product (GRP) by $1,949.5 million in NPV terms. Gross Regional Income (GRI) or regional welfare, is projected to increase by $1,454.7 million in NPV terms. This projected increase in GRI would be significant to the relatively small Wollondilly region. In total, the Project is expected to increase welfare for each person in the region by $24,859.1 in NPV terms.

For NSW, the projected increase in Gross State Product (GSP) is $2,140.1 million in NPV terms. Gross State Income (GSI) is projected to increase by $2,539.0 million.

Total employment in the Wollondilly region is projected to increase by 265.8 full-time equivalent (FTE) workers on average, and across NSW employment is projected to increase by 136.3 FTE.

Table 7-31 Economy-wide impacts of the Amended Project

Variable	Description	Wollondilly	NSW
Real GRP	NPV - $m	1,949.5	2,140.1
Real GRI	NPV - $m	1,454.7	2,539.0
Employment	Average (FTE)[2]	265.8	136.3
Real Wages	Average	4.2	0.0
Real GRI per person	NPV - Dollars	24,859.1	237.9

7.11.3 Conclusion

The revised Economic Impact Assessment demonstrates that the Amended Project would generate significant economic benefits to the local and State economy, with a net benefit of $783.8 million.

7.12 Visual

Tahmoor Coal submitted a Visual Impact Assessment (VIA) report in support of the EIS for the Project. The impacts of the Amended Project on visual amenity have been re-assessed with a focus on the revised REA design. The assessment considers the differences in impacts compared to the original Project that was presented in the EIS. The revised Visual Assessment is included in **Appendix M**.

7.12.1 Revised Assessment

The approach for the VIA remains consistent with that prepared for the EIS. The project amendment relevant to the VIA is a proposed increase in the final landform height of the REA, from 305 m AHD proposed in the EIS to 310 m AHD (noting that the current approved height of the REA is 300 m AHD). This increase in height is to accommodate a reduction in the surface footprint of the proposed REA for the Amended Project.

7.12.2 Revised Impacts

The VIA prepared for the EIS noted that the proposed REA would have some limited visual exposure to traffic travelling along Charlies Point Road. The limited visual impact for the proposed REA is due to the partial screen created by existing tree planting alongside the road corridor. Progressing and ongoing planting during the rehabilitation and vegetation of the proposed REA sites would provide further screening potential. It was determined that the original REA would result in low visual effect and low visual significance.

The VIA assessment for the Amended Project (**Appendix M**) assessed the changes proposed to the REA extension. The amended VIA confirmed that the proposed increase in the level of REA visibility would be restricted by existing landscape characteristics surrounding the amended REA. The increased height of the REA would not result in additional visual impacts over and above the low impact determined in the VIA prepared for the Project assessed in the EIS.

7.12.3 Revised Management and Mitigation Measures

Mitigation measures for the Amended Project remain consistent with those outlined in the EIS.

7.12.4 Conclusion

The amended REA would unlikely result in a level of visual effect or visual significance over and above the low impact determined in the VIA prepared for the project assessed in the EIS. The level of visual effect and significance would continue to be mitigated by factors identified in the VIA prepared for the Project assessed in the EIS, which includes:

- Distance between the amended REA and surrounding view locations;
- The extent of existing tree cover surrounding and between the existing REA and surrounding view locations; and
- Visually consistent and contiguous gently undulating landforms extending beyond the amended REA.

7.13 Human Health

A Health Impact Assessment (HIA) has been prepared for the Amended Project (**Appendix N**), in response to a request by the NSW Health.

This section identifies potential hazards that could pose a risk to human health, the surrounding community or the human environment and outlines measures to manage the identified risks. This section is informed by **Appendix N** (Health Impact Assessment), which provides greater detail of the human health risk assessment and results.

The assessment approach was undertaken in accordance with national and international guidance that is endorsed or accepted by Australian health and environmental authorities, and includes, but is not limited to:

- *State Environmental Planning Policy No. 33 - Hazardous and Offensive Development;*
- National Environment Protection Council (NEPC) National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPC 2016);
- National Environmental Protection Measure – Assessment of Site Contamination including:
  - Schedule B1 Investigation Levels for Soil and Groundwater (NEPC 1999 amended 2013a);
  - Schedule B4 Guideline on Health Risk Assessment Methodology (NEPC 1999 amended 2013b);
  - Schedule B6 Guideline on Risk Based Assessment of Groundwater Contamination (NEPC 1999 amended 2013c);
  - Schedule B7 Guideline on Health-Based Investigation Levels (NEPC 1999 amended 2013d);
  - Schedule B8 Guideline on Community Consultation and Risk Communication (NEPC 1999 amended 2013e);
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA 2016b);
- NSW Noise Policy for Industry (NSW EPA 2017);
- National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines (NHMRC 2011 updated 2018); and
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

Where relevant, additional guidance has been obtained from relevant Australian and International guidance, such as that available from the United States Environmental Protection Agency (USEPA) and the World Health Organisation (WHO), consistent with current industry best practice. The assessment is also informed by the Noise and Vibration Assessment (**Section 7.8**) and the Air Quality Impact Assessment (**Section 7.9**) that were undertaken for the Amended Project.

7.13.1 Background

The Amended Project is situated in an area that includes existing agricultural and rural properties, as well as residential properties located on the larger towns of Bargo to the south and Picton to the north. The HIA focused on properties located within an area of 20km x 20km, which encompasses the Amended Project. These nearby residential receptors are located within the Wollondilly LGA and the Wingecarribee LGA located just to the south. Table 3-1 of **Appendix N** presents a summary of the population within the Wollondilly and Wingecarribee LGAs (based on 2016 Census and 2016 Socio-Economic data from the Australian Bureau of Statistics) with comparison to NSW and Australia.

The health of the community is influenced by a complex range of interactive factors including age, socio-economic status, social capital, behaviours, beliefs and lifestyle, life experiences, country of origin, genetic predisposition and access to health and social care. The health indicators available and reviewed in the HIA report (**Appendix N**) and presented in **Table 7-32** generally reflect a wide range of these factors.

Table 7-32 presents a summary of the general population health relevant to the area, based on currently available data. The table presents available information on health-related behaviours (i.e. key lifestyle and behaviours factors known to be important to health) and indicators for the burden of disease within the relevant LGAs (where available), the South Western Sydney Local Health District (SWSLHD) and NSW. Where available, data is also included for the smaller areas of the Wollondilly LGA and Wingecarribee LGA. The values noted in bold are those utilised in this assessment.

Table 7-32 Summary of health indicators/data

Health indicator/data	South Western Sydney Local Health District	NSW
Health behaviours and asthma incidence (% population)		
Adults - compliance with fruit consumption guidelines (2017)	45.8%	46.4%
Adults - compliance with vegetable consumption guidelines (2017)	6.1%	6.6%
Children - compliance with fruit consumption guidelines (2017)	60.5%	66.8%
Children - compliance with vegetable consumption guidelines (2017)	5.7%	7.4%
Adults - increased lifetime risk of alcohol related harm (2017)	24.7%	32.4%
Adults – body weight (overweight) (2018)	33.2%	32.9%
Adults – body weight (obese) (2018)	25.5%	21.4%
Adults – sufficient physical activity (2017-18)	51.5%	58.4%
Children – adequate physical activity (2017 – 18)	25.7%	24.2%
Current smoker (2018)	16.2%	10.3%
Adult asthma – prevalence (2017)	10.7%	10.9%
Adolescent (2015) – prevalence of current asthma (2016/2017)	13.4%	12.9%
Burden of disease (rate per 100,000 population)		
Morbidity - cardiovascular disease hospitalisations (2017/2018)	1570.3	1671.1
Cardiovascular disease hospitalisations (ages 65 years and older)	--	**Sydney = 9,235**
Morbidity – respiratory disease hospitalisations (2017/2018)	1868.2	1714.2
Respiratory disease hospitalisations (ages 65 years and older)	--	**Sydney = 4,168**

Health indicator/data	South Western Sydney Local Health District	NSW
Mortality – all causes, all ages (2017)	SWSLHD = 514.9 Wollondilly = 519.3 Wingecarribee = 563.9	508.8
Mortality (all causes, ages 30 years and older)	--	**Sydney = 1,026**
Mortality – respiratory (all ages) (2017)	52.4	51.4
Asthma – emergency department admissions (1-14 years)	--	**Sydney = 1209**

Community engagement

In relation to issues that directly or indirectly affect community health, consultation identified:

- Positive impacts include increased employment opportunities, contribution to local economy and community support/funding; and
- Negative impacts of concern included surface water (including potential damage to Thirlmere Lakes) and groundwater impacts. In addition, general environmental/cumulative impacts were identified along with concerns over traffic on local roads.

7.13.2 Impact Assessment

7.13.2.1 Air Emissions

The HIA assessed impacts on health associated with predicted air emissions relevant to the construction and operation of the Project. To inform the assessment of health impacts, the HIA relied upon information presented in the Air Quality Impact Assessment (**Appendix J**). That assessment is detailed in Section 5.0 of **Appendix N**. The emissions that were taken into consideration to form an assessment of air quality impacts upon human health as a result of the Project were:

- Particulates (PM_{10} and $PM_{2.5}$)
- Dust
- Nitrogen dioxide
- Carbon monoxide
- Hydrocarbons

Potential impacts on the health of the community have been assessed in accordance with the available data and information in relation to emissions of dust, as well as emissions from the operation of the methane flare (nitrogen dioxide, carbon monoxide and volatile organic compounds (VOCs as hydrocarbons) from the Project. The impact assessment has concluded that there are no health risk issues of concern as a result of the Project, including during construction and operation.

Notwithstanding, management measures to further reduce potential air quality impacts would continue to be applied. The management measures employed for the existing Tahmoor Mine, as described in the Tahmoor Air Quality Assessment (Appendix N of the EIS and **Appendix J** of this Project Amendment Report) and Greenhouse Gas Management Plan (Appendix O of the EIS and **Appendix K** of this Project Amendment Report) outlines relevant management measures to minimise dust generation. These measures would apply to all activities associated with the Amended Project.

7.13.2.2 Noise

The HIA assessed impacts on health associated with noise relevant to the construction and operation of the Project. The assessment relied upon the information provided in the following reports:

- Noise and Vibration Impact Assessment (EMM, 2018) – Appendix M to the EIS

- Amended Noise and Vibration Impact Assessment (EMM, 2019) - **Appendix I**.

The amended Noise Impact Assessment considered impacts at a large number of locations within 11 Noise Catchment Areas (NCAs). The locations considered as part of the assessment are shown in **Figure 7-1**. The NCAs cover a range of residential, semi-rural and agricultural areas incorporating the towns of Buxton, Bargo and Balmoral. Specific receptors modelled in the assessment include residential homes as well as noise-sensitive receivers such as places of worship and educational establishments. Receptors belonging to the same NCA are assigned the same background noise level and noise management level.

Environmental noise has been identified as a growing concern due to its negative effects on quality of life and wellbeing and has the potential for causing physiological health effects. With increasingly urbanised or developed societies, the impacts of noise on communities have the potential to increase over time. Health effects include:

- Sleep disturbance;
- Annoyance;
- Cardiovascular health;
- Hearing impairment and tinnitus; and
- Cognitive impairment.

The assessment presented in Section 7.0 of **Appendix I** discusses the potential impacts noise would have on human health as a result of construction activities associated with the Amended Project. No noise levels exceed the 'high noise affected' criteria. It should be noted that even where noise mitigation measures are implemented, noise levels during construction may be noticeable at times.

For works outside of standard operating hours, impacts in excess of the adopted noise criteria were identified at the two nearest properties on Charlie's Point Road. Noise during these activities is likely to be below the relevant sleep disturbance criteria at all locations and hence at night-time is unlikely to result in health impacts.

Regarding operational noise, based on the assessment undertaken, where the Amended Project is operational and mitigation measures are implemented:

- There would be a significant reduction in the number of private dwellings affected by night-time noise that exceed the criteria by more than 5 dB compared to existing operations (reduction from 33 dwellings for the existing Tahmoor Mine to 3 dwellings);
- Night-time noise levels at the privately-owned receptors are expected to be reduced from existing operations by 2 to 18 dB; and
- Day and evening noise levels are expected to be reduced by up to 7 dB at most privately-owned receptors. Where there are increases, these are at most 2 dBA.

The assessment of potential impacts on sleep disturbance determined that the operation of the Amended Project was unlikely to result in maximum noise events that would result in sleep awakening. Based on the predicted noise levels and potential mitigation measures, the potential for receivers to experience adverse health impacts associated with noise generated during construction and operations is low.

7.13.2.3 Surface Water

The HIA assessed impacts on health as a result of the potential impacts of the Project upon water access and water quality. To inform this assessment, the HIA relied upon the Tahmoor South Project, Surface Water Baseline Study; Flood Study; Water Management System and Site Water Balance, and Surface Water Impact Assessment (HEC, 2019) (**Appendix D**).

Based on the findings in **Appendix D**, the HIA concluded that there are no impacts to surface water quantity or quality that would be of significance to the health of the community that may access and use surface water bodies in the local area for any purpose (including recreational water and drinking water).

7.13.2.4 Groundwater

The HIA assessed impacts on health as a result of the potential impacts of the Project upon groundwater. To inform this assessment, the HIA relied upon the following information:

- Tahmoor South Project EIS, Groundwater Assessment (HydroSimulations, 2018) Appendix I of the EIS; and
- Tahmoor South Amended Project Report: Groundwater Assessment (HydroSimulations, 2019) **Appendix C**.

These assessments considered aquifer interference, baseflow impacts, drawdown and groundwater quality. For groundwater quality, it is considered that mining-induced mixing of groundwater would result in changes to the salinity of the Hawkesbury Sandstone and Bulgo Sandstone, the two most commonly utilised aquifers. Any changes in salinity or specific nutrients (e.g. iron manganese) are unlikely to alter or impact on the beneficial uses of groundwater in the Permo-Triassic rock aquifers in or around the mine lease. The risk of these impacts decreases with distance from the active mining area.

There are no anticipated risks of reduced beneficial uses of the Nepean Ground Water Management Area (GMA) porous rock aquifer as a result of the Amended Project. Where these impacts affected water quality in groundwater bores, management measures as discussed in Section 11.3.5 of the EIS and **Section 7.13.3** below would be applied. Where these measures are adopted, there are no Project related impacts that would affect the quantity and quality of groundwater that the community may access or interact with, where water may be used for domestic or recreational purposes. Hence there are no impacts of concern to community health.

7.13.2.5 Social

Health impacts associated with potential impacts of the Project on social determinants that may affect community health have been evaluated on the basis of information provided in Appendix Q (Social Impact Assessment) of the EIS.

The key impact identified in relation to the Amended Project relates to beneficial employment opportunities. Unemployment has a significant impact on physical and mental health and results in increased rates of overall mortality, including mortality from cardiovascular disease and suicide; poorer general health and poorer physical health.

The employment opportunities related to the Amended Project would be of benefit to community health. Health benefits resulting from employment include:

- Improvements to general health and wellbeing;
- Reduced social exclusion;
- Leading to lower morbidity rates; and
- Reduced risks of depression.

Tahmoor Coal acknowledges that longwall mining related subsidence impacts to private residences and privately-owned structures have the potential to increase anxiety and stress in the community. This can arise from the anticipated impacts of subsidence as well as the timing and duration of mining and the process for accessing any reparations for subsidence impacts to property. Tahmoor Coal would seek to reduce these potential impacts by providing frequent updates to the community, and affected landowners, to reduce uncertainty around timing and extent of impacts (refer **Section 7.18.3**).

7.13.3 Management and Mitigation Measures

The HIA presented in **Appendix N** of this Project Amendment Report has considered potential impacts on community health in relation to air quality, noise, surface water, groundwater and social determinants. Management measures relating to each aspect include:

- **Air Quality** - The current air quality management measures employed for the existing Tahmoor Mine, as described in the Tahmoor Air Quality (Appendix N of the EIS and **Appendix J** of this Project Amendment Report) & Greenhouse Gas Management Plan (Appendix O of the EIS and **Appendix K** of this Project Amendment Report) outline relevant measures to minimise dust generation. It is expected that these measures would apply to all activities associated with the Amended Project;
- **Noise emissions** - The current Noise Management Plan is expected to be revised to include the noise mitigation measures relevant to the Amended Project, including any additional mitigation measures identified by Tahmoor Mine to address operational noise levels from the existing mine and Amended Project; and
- **Water** - The management measures as described in the EIS and **Section 7.3.6** and **Section 7.2.3** of this Project Amendment Report would be implemented to address surface water and groundwater impacts associated with the amended are considered to remain appropriate.

With regards to social impacts, the management measures as described in the EIS are considered to remain appropriate (refer also to **Section 7.18.3**).

7.13.4 Conclusion

Based on the assessment presented in **Appendix N**, no significant health risk issues of concern have been identified for the community.

7.14 Land Use, Agriculture and Resources

Tahmoor Coal submitted an Agricultural Impact Statement in support of the EIS prepared for the Project. The purpose of the assessment was to assess the impacts of the Project on agricultural resources ad industries within the surrounding area. An updated assessment has been prepared for the Amended Project and is presented in **Appendix O**.

7.14.1 Revised Assessment

The revised Agricultural Impact Statement follows the same approach as that presented in the EIS.

The following project amendments are relevant to the Agricultural Impact Statement:

- Revised surface disturbance footprint of the Amended Project including reduction in REA extension and inclusion of the powerline easement; and
- Amended mine plan, which has resulted in a reduced area within the 20mm subsidence contour.

7.14.2 Revised Impacts

7.14.2.1 Disturbance Assessment Area

The Study Area for the AIS is the entire Project Area of 6,498 hectares. Land to be disturbed by the Amended Project is limited to areas of known and potential disturbance and is termed the Disturbance Assessment Area (DAA) for the purposes of the AIS, and includes three areas:

- The Subsidence Study Area (SSA): potential surface subsidence associated with the underground mining, including 35° subsidence angle of draw, covering an area of 2,624 hectares.
- The Ventilation Shaft Areas: the proposed new surface infrastructure comprising two ventilation shafts covering a maximum total area of approximately 6 hectares. The entire proposed surface disturbance associated with the ventilation shaft sites is contained within the Subsidence Study Area.

- Extension of the Reject Emplacement Area (REA), comprising 11 hectares. This includes land that will be permanently removed from potential agricultural production upon completion of the final landform. The REA is wholly contained within the SSA.

7.14.2.2 Agricultural Land and Resources – Permanent Impacts

There is no land within the DAA that is currently used for agricultural enterprises, which would permanently be removed from production. Notwithstanding, there is approximately 11.06 ha (previously 43 ha) within the DAA, comprising the extended REA footprint, which will be permanently removed from potential agricultural production at completion of the Amended Project. This area is mapped by OEH as LSC Class 4 land (**Table 7-33**).

Table 7-33 Land Permanently Removed from Potential Agricultural Production

Land & Soil Capability	Area Permanently Impacted		Potential Gross Margin	
Pre-REA	**Hectares**	**% of DAA**	**Per Hectare**	**Total**
4	11	<1	$296	$3,256
Rehabilitated REA	**Hectares**	**% of DAA**	**Per Hectare**	**Total**
7	11	<1	$74	$814

The amended REA footprint is proposed to be rehabilitated to LSC Class 7. This rehabilitated area would have a potential gross margin of $814 per annum (previously $3,182).

The surface infrastructure areas will be decommissioned following the cessation of mining and with a preliminary final land use of returning the land to native bushland (SLR, 2019).

Total calculated loss as a result of land permanently removed from potential agricultural production, changing from pre-REA Class 4, to rehabilitated REA Class 7 (**Table 7-33**) is now $2,442 per annum calculated over 11 ha (previously $8,658 per annum over 43 ha). When compared to the gross annual value of agricultural production for the Wollondilly LGA ($61.3 million) this amount comprises a negligible impact on agricultural enterprises, agricultural employment and related industries.

7.14.2.3 Water Resources

An assessment of impacts to water resources as a result of the Amended Project has been undertaken for both groundwater and surface water resources and has been presented previously in **Section 7.2** and **Section 7.3**, respectively. Based on the findings of these revised assessments, predicted changes in flood inundation, water flow velocity and stream profile are not considered likely to significantly impact agricultural resources or enterprises within the Amended Project area.

With respect to groundwater impacts, a total of 46 registered bores and four unregistered bores are predicted to experience drawdown of greater than 2 m as a result of the Amended Project. The groundwater model also indicates that a further 6 are already affected beyond 2 m by Tahmoor North.

Due to changes in hydraulic properties and depressurisation of the strata there is potential for mixing of groundwater between different units; however, it is considered unlikely to result in changes to beneficial uses of groundwater.

Tahmoor Coal would implement ‘make good’ measures in relation to bores identified to be impacted by water drawdown and/ or quality. Make good measures have been successfully implemented as part of existing Tahmoor Mine North operations and would continue to be applied for the Amended Project. The process allows for bore owners to apply to Tahmoor Coal if they believe their bore’s level or water quality has declined and have an assessment of whether the mine is the cause of this. If it is deemed that the mine in responsible, then remedial (i.e. make good) actions could involve deepening and/or replacing bores and wells, and/or providing an alternative water source to affected users. This process has only been required, and successfully enacted, twice in the last decade.

With the implementation of these measures, it is considered that impacts to groundwater bores can be managed. Make good measures and other groundwater mitigation and management measures are discussed in **Section 7.2.3** of this Project Amendment Report.

7.14.2.4 Impact on Agricultural Resources from Biodiversity Offsets

The proposed biodiversity offset sites for Project comprise an area of 381 ha across five properties:

- Rockford Road;
- Pit Top;
- 185 Charlies Point Road;
- Bargo Colliery Land; and
- 220 Charlies Point Road.

None of the identified offset sites are on potentially agriculturally productive land, and all are heavily timbered with native bushland. Therefore, the biodiversity offset strategy would have negligible impact on agricultural resources, enterprises or Biophysical Strategic Agricultural Land (BSAL).

7.14.2.5 Noise

Impacts on agriculture as a result of noise emissions from the Amended Project remains consistent with those identified in the EIS. Agriculture is only impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress.

The predicted noise reductions are due to a number of proposed mitigation measures regarding pit top operations and the REA. As a result, the predicted noise levels for the Amended Project would have a negligible impact on agricultural production within the area as a result of the Amended Project.

7.14.3 Revised Management and Mitigation Measures

The measures outlined in Section 11.19.5 and Appendix T of the EIS prepared for the Project remain applicable to the Amended Project.

7.14.4 Conclusion

The key findings of the revised Agricultural Impact Statement are consistent with those presented in the EIS, namely that the Project will have negligible impacts on agricultural resources, enterprises and dependent industries.

7.15 Rejects Disposal

The Amended Project includes a REA extension of 11.06 ha. This is a reduction of 31.94 ha in comparison to the REA footprint proposed in the EIS. The reduction in area greatly reduces the impacts of the Amended Project in comparison to that presented in the EIS. A description of the proposed changes to reject disposal and management for the Amended Project is included in **Chapter 2.0** and **Section 3.3.2**.

7.15.1 Revised Impacts

The reduced volume of rejects that would be generated by the Amended Project as a result of changes to the longwall extent would have the following potential impacts:

- Less surface water runoff anticipated as a result of the reduced REA footprint (from 43 ha to 11.06 ha) and water management at the base of the REA. Potential surface water impacts are assessed in **Section 7.3**;
- Reduction in required vegetation clearing (including from rehabilitated land and clearing of the TEC Shale Sandstone Transition Forest). Potential terrestrial ecological impacts are assessed in **Section 7.4**;
- Changes to the visual environment from an increased height of the RL from 305 m to 310 m to optimise the REA footprint. Potential visual impacts are assessed in **Section 7.12**; and
- Changes to noise and vibration as a result of revised traffic movements within the mine site, including no haulage at night and increasing day-time haulage from one to two vehicles. Potential noise and vibration impacts are assessed in **Section 7.8**.

7.15.2 Revised Management and Mitigation Measures

Potential impacts associated with the REA relating to surface water, biodiversity, noise, air quality and visual amenity would be minimised in accordance with the revised management and mitigation measures outlined in **Section 7.3**, **Section 7.4**, **Section 7.8**, **Section 7.9** and **Section 7.12**.

The mitigation measures relevant to management of the REA outlined in Section 11.20.3 of the EIS prepared for the Project remain applicable to the Amended Project. These include:

- The REA will be progressively rehabilitated to minimise fragmentation of vegetation;
- A biodiversity offset strategy will be developed to compensate for the removal of native vegetation;
- Impacts to threatened species within the Amended Project area will be mitigated and managed through the implementation of a Biodiversity Management Plan and an on-going monitoring program;
- A Noise Management Plan (NMP) will be developed and implemented outlining a noise monitoring program which would include attended and continuous use of the existing real time noise monitoring system; and
- The existing Soil and Water Management Plan for Tahmoor mine would continue to be implemented during operation of the proposed development.

7.15.3 Conclusion

The Project has been amended in several ways to reduce the impacts associated with the REA extension, both in terms of footprint and activities in operation.

Reducing the footprint would require an increase in the height of the REA, resulting in the potential for increased visual impacts, and the removal of some established rehabilitated areas on the northern section of the existing REA. However, the benefits of preserving 31.94 ha of SSTF are considered to outweigh the visual impacts. The overall design of the REA carefully considered balancing the impacts between vegetation removal and amenity.

7.16 Acid and Metalliferous Drainage and Spontaneous Combustion

An Acid and Metalliferous Drainage and Spontaneous Combustion Assessment was undertaken to understand the existing physical and chemical baseline status of the shallow regional groundwater up and down gradient of the existing REA and to identify the existing and potential acid and metalliferous drainage (AMD) and spontaneous combustion nature of the REA. The assessment for both potential and existing REA materials determined that no significant observable acid and metalliferous drainage, metalliferous discharge, elevated salinity or spontaneous combustion associated with the Project is anticipated. This assessment is in Appendix W of the EIS.

Since the exhibition of the EIS, an updated Acid Mine Drainage and Spontaneous Combustion Assessment has been prepared to assess the potential impacts of the Amended Project. The updated assessment was prepared to provide a response to a submission on the EIS made by the NSW EPA which requested additional information regarding the management of AMD and details of ongoing operational monitoring. The updated assessment is located in **Appendix P**.

7.16.1 Revised Impacts

The updated assessment includes data from additional monitoring and analysis conducted since the EIS submission. The analysis and results presented in the revised assessment are consistent with the EIS All tested samples were classified as non-acid forming and had a low spontaneous combustion potential.

7.16.2 Acid and Metalliferous Drainage

Analysis of the potential rejects from the CHPP after extraction of the Bulli seam within the Amended Project area indicated that the REA should be non-acid forming due to the low pyrite (chromium reducible sulphur) levels in all samples. The analysis of water chemistry from leachate samples from the CHPP rejects samples indicated no potential acid generation and a low potential salinity for the CHPP rejects from the Project. Acid and metalliferous drainage is not anticipated as a result of these materials.

7.16.3 Spontaneous combustion

Adiabatic self-heating tests were conducted on the Bulli seam rejects materials from the Amended Project area for the EIS prepared for the Project. These results are presented in Appendix W of the EIS and **Appendix P** of this Project Amendment Report. The revised Acid Mine Drainage and Spontaneous Combustion Assessment considers these results to remain accurate.

The adiabatic self-heating tests indicated that the rate of self-heating from 40°C to 70°C was 0.003°C per hour. This data indicates that spontaneous combustion of carbonaceous material is unlikely. Monitoring of the existing REA, as it has been sequentially constructed, shaped and revegetated since the early 1980's, indicates there has been no observed occurrence of spontaneous combustion. This observation supports the laboratory test results that the occurrence of spontaneous combustion from CHPP rejects within the REA from the proposed Bulli Seam extraction at Tahmoor South is unlikely.

7.16.4 Revised Management and Mitigation Measures

The following recommendations would be adopted to monitor for AMD and spontaneous combustion:

- Surface water and groundwater monitoring for AMD and spontaneous combustion would continue at the existing monitoring frequency as part of the sites surface and groundwater management plan. Surface water and groundwater monitoring would be conducted during active placement of CHPP rejects to measure any variation in salinity or contaminants of concern in the REA runoff and leachate and its surrounding environment to monitor for any effects of AMD generation;
- The REA would undergo regular visual inspections for the presence of spontaneous combustion. Inspections would observe the stockpiles for any visible signs of smoke or any other obvious signs of heat production such as steam;
- Contingency procedures would be developed as required (for surface water, groundwater and spontaneous combustion), with the measures to be developed being dependent on the issue that requires addressing. Examples of contingency measures are included in **Appendix P**;
- Performance indicators would be identified prior to extraction of the proposed underground workings and a statistical assessment would be undertaken to detect when, or if, a significant change has occurred in the surface water or groundwater system which should benchmark the natural variation in water quality and spontaneous combustion; and
- A monitoring and management strategy along with an outline of a TARP would be prepared to provide guidance on the procedures and actions required regarding the surface water and groundwater systems in the proposed REA.

7.16.5 Conclusion

The updated Acid Mine Drainage and Spontaneous Combustion Assessment confirmed that both AMD and spontaneous combustion are unlikely to occur at Tahmoor Mine. Notwithstanding, monitoring would continue to be undertaken as outlined in **Section 7.16.4**.

7.17 Rehabilitation

A Rehabilitation and Mine Closure Strategy has been prepared to outline the process for rehabilitation of the land surface following completion of mining, including dismantling and removal of infrastructure and re-contouring to reinstate the landform. The report includes amendments based on the proposed development changes presented in **Chapter 2.0** and additional information in relation to final landform details and management of impacts to subsidence of watercourse and drainage lines. The report in **Appendix Q** serves as an update to the original Mine Closure Plan prepared for the EIS. Updates to the Mine Closure Plan have been summarised in the following sections.

7.17.1 Environmental Performance Objectives

Two of the environmental performance objectives for the rehabilitation of the Amended Project area post mining have been updated as below:

- Progressive rehabilitation on areas that cease to be used for mining or mine-related activities would be undertaken *as soon as practicable* after the areas become available for rehabilitation, instead of *within two years*; and
- Cleared native vegetation would be revegetated using existing vegetation communities where appropriate.

No other objectives have changed as a result of the Amended Project.

7.17.2 Post Mining Land Use Options

Amendments have been made to the preliminary post mining land use options table presented in the Rehabilitation and Mine Closure Strategy. The preliminary land use options have been narrowed down to a single, proposed final land use for each of the domains. The proposed final land use for each domain is:

- Domain 1: Native bushland;
- Domain 2: Native bushland;
- Domain Reject Emplacement Area: Native bushland;
- Domain 4: Native bushland;
- Domain 5: Native bushland; and
- Domain 6: Native bushland, biodiversity offsets and existing land uses.

7.17.3 Risks to Rehabilitation

An assessment was conducted on behalf of Tahmoor Coal, of the risks to rehabilitation from existing and potential AMD and spontaneous combustion on the proposed REA. The findings of the assessment identified that the risk of acidic or saline runoff and seepage from the placement of Tahmoor South rejects at the REA is anticipated to be low, while the risk of spontaneous combustion of Bulli Seam rejects is unlikely.

7.17.4 Closure Domains

Amendments have been made to two of the six rehabilitation and closure domains identified for the Amended Project. These domains are:

- Domain 3: Reject emplacement area; and
- Domain 6: Other lands.

7.17.4.1 Domain 3 Reject Emplacement Area

Rehabilitation to date

The rehabilitated areas of the existing approved REA are monitored for success against the rehabilitation success criteria specified in the Mining Operations Plan (MOP). Rehabilitation monitoring was most recently conducted by Eco Logical Australia Pty Ltd in 2018, in accordance with the Tahmoor EMS-MGP-002 Biodiversity and Land Management Plan.

Monitoring results to date show that rehabilitation is, in part, achieving the success criteria. On-going maintenance and minor remedial works have been recommended to improve success and ensure rehabilitation achieves the desired success criteria, including, for:

- Maintenance; and
- Minor remedial works.

Proposed REA Extension

Following submissions on the Project, the REA has been redesigned to specifically reduce the disturbance footprint proposed. In its submissions, the Department of Industry – Lands and Water noted that the REA is on waterfront land.

The REA design includes works to existing watercourses to enable placement of rejects and provision for creation of new drainage lines to establish new natural drainage flow paths, thereby re-connecting them to existing watercourses at the REA boundary.

Under the *Water Management Act 2000* (NSW), waterfront land includes the bed of any river and the land that is 40 metres from the bed of that river. Additionally, the water management act provides clarity on what is included as a river. Relevantly, a river includes any watercourse, whether perennial or intermittent and whether it comprises a natural channel, or a natural channel that has been artificially improved.

Ordinarily, a work carried out on waterfront land would require a controlled activity approval under Section 91 of the Water Management Act. However, Section 4.41 of the *Environmental Planning and Assessment Act 1979*, stipulates that a controlled activity approval under the Water Management Act is not required for State Significant Development that is authorised by a development consent. As the Project is State Significant Development, and is seeking development consent, a controlled activity approval is not required, should the development consent be granted.

Notwithstanding, rehabilitation planning will be undertaken in accordance with the Guidelines for Working on Waterfront Land (or their replacement, should an updated version come into effect prior to the works being carried out) and in consultation with the Natural Resources Access Regulator (NRAR).

Rehabilitation planning will address the objectives of the guidelines to establish and preserve the integrity of riparian corridors (RCs). The environmental functions of riparian corridors will be maintained and rehabilitated by applying the relevant and applicable principles from the guidelines, e.g.:

- Identifying whether there is a watercourse present and determine its order in accordance with the Strahler System;
- If a watercourse is present, defining the RC/vegetated riparian zone (VRZ) on a map in accordance with Table 1 of the guidelines;
- Seeking to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1 of the guidelines;
- Seeking to minimise disturbance and harm to the recommended RC/VRZ;
- Minimising the number of creek crossings;
- Locating services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings, where possible; and
- Treat stormwater run-off before discharging into the RC/VRZ.

In addition to the above amendments, the REA is now proposed to be progressed in six stages, instead of the 15 stages originally proposed in the EIS. Where practicable, each stage of the REA will be progressively rehabilitated when it is no longer in use.

7.17.4.2 Domain 6

The final topography has changed and has been captured in the updated domain area. Subsidence modelling of each of these areas predicts the maximum slope in the final topography over the longwall panels after subsidence to be 8.7 and 10.5 millimetres (mm) per metre over longwalls LW101A to LW106A and LW101B to LW108B, respectively. The maximum subsidence predicted is 1,350 and 1,650 mm over longwalls LW101A to LW106A and LW101B to LW108B, respectively.

The remedial activities and extraction plans described in the EIS for the Project remains unchanged for this Domain.

7.17.5 Rehabilitation and Revegetation Strategy

This section focuses on the amendments made to the rehabilitation and revegetation strategy. The following have been updated or added to the strategy due to the amendments associated with the Project:

- Proposed post-mining land classification;
- Topsoil Mass Balance;
- Topsoil Stripping Assessment and Balance;
- Subsidence of Watercourse and Drainage Lines;
- Rehabilitation Monitoring; and
- Rehabilitation Maintenance.

Proposed Post-mining Land Classification

Based on the original Land and Soil Capability (LSC) classes across the project area, the proposed final landforms and soil profiles proposed for all domains are to achieve an LSC class of 7. This is land generally incapable of agricultural land use (selective forestry and nature conservation), which is consistent with the proposed final land use being primarily native vegetation across all domains.

Topsoil Mass Balance

The ‘earthy sands’ major soil type no longer occurs within the amended footprint and has been removed from the amended plan.

Topsoil Stripping Assessment and Balance

With the removal of the ‘earth sands’ major soil type, the soil stripping recommendations have been updated to support the Amended Project. The recommended topsoil stripping depths for each soil is shown in **Table 7-34**. With a total maximum disturbance area of 11.06 ha, the maximum topsoil balance has been re-calculated to be 29,695.4 cubic metres (previously 115,600 cubic metres).

Table 7-34 Soil stripping limitations

Great Soil Group	Ave. Topsoil Depth (m)	Ave. Subsoil Depth (m)	Stripping Depth (m)	Area (ha)	Volume (m^3)
Yellow Earths	0 – 0.35	0.35 – 0.9	0.35	1.57	5,507.4
Lateritic Podzolic Soil – Type 2	0 – 0.25	0.25 – 0.95	0.25	2.43	6,087.4
Lateritic Podzolic Soil – Type 3	0 – 0.25	0.25 – 0.75	0.25	6.09	15,232.0
Lateritic Podzolic Soil – Type 4	0 – 0.30	0.3 – 0.60	0.30	0.78	2,324.9
Lithosols (Slope greater than 10%)	0 – 0.30	N/A	0.30	0.18	543.6
Total:				**11.06**	**29,695.3**

Subsidence of Watercourses and Drainage

Monitoring is proposed to continue for a period following mining. The monitoring, response and action components for the subsidence of watercourses and drainage lines have been updated as a result of the Amended Project and include:

1. Monitoring

Monitoring would continue to be conducted prior to, during and post mining for the following environmental features at specified locations:

- Daily rainfall;
- Pool water level and streamflow;
- Stream water quality;
- Aquatic habitat/ecology;
- Channel bank stability; and
- First and second order tributaries.

Monitoring data would be benchmarked against historical data to determine whether changes have occurred (triggers).

2. Response

The TARP would continue to be used to determine the scale of response required in relation to any change that has been identified. Results of comparing monitoring data against historical data determines the scale of impact that has occurred. The scale of impact is based on whether the impact is:

- Within normal limits (no impact);
- Within predicted (within the range of outside-normal) limits (change that may or may not be as a result of mining and may be within natural variability); or
- Exceeds predicted (unlikely to be within the range of natural variability).

Based on the above triggers, specified actions/responses are to be followed.

Generally, the specified actions/responses for each trigger are as follows, with some variations depending on the feature and potential impact:

- Normal – continue monitoring, six-monthly assessment;
- Within predicted – continue monitoring, in some cases review and confirm existing monitoring data, cross check against other related environmental data (where relevant), then monthly assessment until trigger returns to “normal”; and
- Exceeds predicted:
    - Convene Tahmoor Coal Environmental Response Group to review response;
    - Immediately undertake the same analysis for the exceeded feature parameter to confirm exceedance or;
    - Notify OEH, DP&E and/or relevant stakeholders, as appropriate, within 7 days of current findings and proposed approach for investigation upon identification of the potential trigger;
    - Undertake investigation and take all necessary steps to ensure that the exceedance ceases and does not re-occur;
    - Implement remediation measures to the satisfaction of the relevant parties;
    - If it is concluded that there has been a mining-related impact, then implement a corrective management action plan;
    - Review mining design/predictions against mine design criteria; and

- Prepare written report to relevant regulatory agency as per consent and relevant approvals, as appropriate.

3. Actions

Potential contingency measures in the event of unforeseen impacts or impacts in excess of those predicted would include:

- Conducting additional monitoring (e.g. increase in monitoring frequency or additional sampling) to inform the proposed contingency measures;
- Implementing stream remediation measures to reduce the extent and effect of subsidence fracturing;
- Implementing revegetation measures to remediate impacts of vegetation loss due to subsidence, e.g.:
  - Provide a cover of topsoil in a weathered rock matrix to create a stable substrate for revegetation of channel banks. Weathered rock provides temporary erosion protection by covering erodible soils and minimising topsoil loss;
  - Replace sand across the channel bed, including higher sand deposits suitable for re-creation of in-channel benches;
  - Install timber groynes/pile field retards at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate creation of in-channel benches;
  - In areas where less active bank erosion develops, large woody debris could be placed in-stream to encourage the deposition of sediment and revegetation over time;
  - Design local drainage works to prevent the uncontrolled flow of runoff over channel banks. Small diversion bunds directing runoff to properly engineered rock chute structures could be installed to minimise bank erosion;
  - Topsoiling and revegetation on banks. Stock could be excluded to a width of at least 30m from the top of bank and subsided areas to minimise further impacts on vegetation cover and land condition; and
  - A targeted revegetation could be undertaken in areas where surface water patterns have been affected.
- Providing suitable offset(s) to compensate for the reduction in the quantity of water resources/flow;
- Making-good provisions, to be negotiated with the landholder if water supply from a surface water system (as designated by a Water Supply Works and Water Use Approval) is impacted; and/or
- Implementation of adaptive management measures, e.g. reducing the thickness of the coal seam extracted, narrowing of the longwall panels and/or increasing the setback of the longwalls from the affected area.

Rehabilitation Monitoring

Tahmoor Coal has developed and is implementing an annual rehabilitation monitoring program. The annual rehabilitation program consists of two parts:

- Annual rehabilitation inspection (assessment of rehabilitated areas in general to confirm trajectory towards completion criteria); and
- Long-term rehabilitation monitoring sites (detailed evaluation of permanent monitoring transects located throughout rehabilitated areas to monitor progress over time towards achieving completion criteria).

The intent of Tahmoor's rehabilitation monitoring program is to measure the success of rehabilitation, using consistent methods year to year, so results are comparable and improvement actions can be tracked over time. Rehabilitation monitoring is conducted over all phases of rehabilitation, with the greatest emphasis on the ecosystem development stage of the MOP rehabilitation phase.

Outcomes of the annual rehabilitation monitoring inspections are recorded and compiled into a report, with improvement actions that are identified as part of the inspection entered into the site action database for tracking and implementation. Improvement actions include care and maintenance activities, such as additional seeding or fertiliser, weed management, and erosion repair to improve the quality of rehabilitation areas where deficiencies are identified during annual monitoring. Improvement actions may also trigger changes to rehabilitation procedures, so rehabilitation methods and standards can be continually improved.

The annual and long-term rehabilitation inspections and monitoring aspects are outlined in **Appendix Q** of this Project Amendment Report.

Rehabilitation Maintenance

Maintenance of rehabilitated areas potentially includes fertilising, sediment and erosion control, weed control, and re-planting or re-seeding, as required. The intensity of these activities would be highest over a likely period of two years following ecosystem establishment, however, depending on the success of rehabilitation, care and maintenance may be required beyond this period to achieve the identified completion criteria for ecosystem development for each closure domain.

7.17.6 Preliminary Rehabilitation Success Criteria

Preliminary rehabilitation success criteria have been developed to provide long-term performance goals for rehabilitation activities. As the Project is within the planning phase, the rehabilitation success criteria are considered preliminary. Final rehabilitation success criteria would be developed for the proposed development during detailed closure planning.

An indicative closure timeline has also been developed for the Project. The key rehabilitation and decommissioning activities include closure planning, decommissioning and rehabilitation, maintenance and monitoring, relinquishment and post relinquishment activities. The amended preliminary rehabilitation success criteria are provided in full in **Appendix Q.**

7.18 Social

A Social Impact Assessment was submitted in support of the EIS prepared for the Project. An SIA Addendum (**Appendix R**) has been prepared to update the original SIA prepared for the EIS, following Project amendments. The assessment considers the differences in impacts compared to the original Project (as presented in the EIS) and further addresses social impacts associated with the Project in relation to issues raised in submissions:

- Subsidence, including:
  - The psychological and other indirect impacts of subsidence including stress, anxiety, uncertainty, disturbance and hardship;
  - The timeframe of subsidence impacts, from when a property owner begins to experience subsidence impacts to when those subsidence impacts conclude; and
  - The assessment of those impacts, the subsequent claims process and possible appeals.
- Social impacts on the Aboriginal community;
- Impacts to groundwater bore users; and
- Impacts on those with ties to surrounding natural features (especially Thirlmere Lakes).

7.18.1 Revised Assessment

The Methodology (Chapter 3 of the original SIA) and the Baseline Assessment (Chapter 4 of the original SIA) remains relevant and unchanged from the original SIA.

7.18.2 Revised Impacts

A summary of the changes in social impacts, resulting from the Project amendments, is provided in **Table 7-35**.

Table 7-35 Summary of impacts as a result of the amended project description (refer to Chapter 4 of the original SIA for the full impact assessment)

Environmental aspect	Change in impact	Change resulting from Amended Project compared to the EIS Project
Surroundings - Natural Features		
Surface Water	Similar impact	• Improvements in streamflow for Dog Trap Creek, Eliza Creek and Bargo River; • Increased groundwater inflow to the underground mine; • Increased discharge via LDP1; • Increased discharge via the licensed overflow points (LOPs) to Tea Tree Hollow; • Reduced predicted peak of simulated annual release to Bargo River from dam S11 based on the 95th percentile results; and • The underground stored water volume is predicted to increase from 2025 and is likely to near the storage capacity by 2032, based on 95th percentile model results.
Surroundings – Amenity		
Subsidence	Reduced impact	• Reduction in the maximum predicted subsidence, tilt and curvature by approximately 15%; and • Reduction of the maximum total conventional subsidence, upsidence and closure movements to waterways.
Noise and Vibration	Reduced impact	• A reduction in night noise emissions compared to existing noise levels from the mine by at least 2 dB and up to 18 dB; • Reduction in the number of privately-owned dwellings affected by operational noise emissions more than 5 dB above the relevant project noise trigger level; and • Operational noise at the nearby Anglican Church and School is predicted to be reduced by at least 3 dB, compared to existing noise levels.
Air Quality and Odour	Minor reduction	• Reduction in odour levels when one fan is used when compared with two fans at Vent Shaft T2.
Visual Aesthetics Impacts	No material change	• The amended REA is unlikely to result in a significant visual impact.
Traffic	No material change	• The Project amendments would not influence the traffic impacts associated with the Project.
Land use, Agriculture and Resources	No material change	• Rehabilitation of previously pre-REA Class 6 agricultural land to REA Class 7.
Way of Life	No material change	• Construction and operation workforce numbers would not be substantially altered by the Project amendments. Therefore, impacts to employment and housing would remain unchanged from that presented in the original SIA.

Environmental aspect	Change in impact	Change resulting from Amended Project compared to the EIS Project
Community Identity and Cohesion	No material change	• There would be little, if any, change in impacts as a result of the Project amendments for - Use of Existing Mine Facilities - Access - New Infrastructure - Employment and Demographics - Wollondilly Community Strategic Plan (local strategic community direction) - Community Contributions • In terms of natural features – the potential for the project to affect local natural features, resulting in impacts upon the community's sense of place – the Project amendments would result in the following reductions in impacts: - Shale Sandstone Transition Forest: reduced clearing from 43.4 ha to 23.57 ha (approximate 46% reduction); - *Persoonia bargoensis*: avoided removal of 96 individuals, leaving eight individuals that would be impacted by the Amended Project; - *Grevillea parviflora subsp. Parviflora*: avoided removal of 2,324 individuals, leaving 491 individuals that would be impacted by the Amended Project; and - *Pomaderris brunnea*: avoided removal of approximately 40 individuals, leaving one individual that would be impacted by the Amended Project.
Access to, and use of, infrastructure, services and facilities	No material change	• There would be little, if any, change in impacts as a result of the Project amendments for: - Subsidence impacts - Construction damage - Resources Workforce - Royalties
Culture	No material change	• There are three Aboriginal cultural heritage sites (comprising stone artefacts) that are now outside of the limit of subsidence; and • An addendum to the ACHA been prepared to address the additional archaeological test excavation and assessment, which identified one ironbark tree with scarring within the Project area, however specialist assessment concluded the scar was relatively modern and of European origin.
Health and Wellbeing	No material change	• There would be little, if any, change in impacts as a result of the Project amendments for: - Anxiety relating to subsidence impacts - Anxiety relating to impacts to natural systems, including greenhouse gases • Noise impacts would reduce as a result of the Project amendments.
Other Impacts	No material change	• Personal and property rights • Decision making systems • Fears and Aspirations
Cumulative Social Impacts		
Direct Cumulative Social Impacts	No material change	• Workforce for the Project, and extent of other mining operations are largely unchanged by the Project amendments.

Environmental aspect	Change in impact	Change resulting from Amended Project compared to the EIS Project
Indirect Cumulative Social Impacts	Slight reduction	• Reduction in impacts on terrestrial ecology may reduce concerns in the community regarding the overall environmental impact of the Project. • Additional commitments made by Tahmoor Coal to reduce the greenhouse gas impacts of the Project (i.e. a parent company target to achieve zero carbon emissions by 2030) may reduce concerns in the community regarding the overall environmental impact of the Project.
Economic	Increased net benefits	• Increase in net benefit from $699.5 million to $783.8 million.

Whilst it is recognised that the Project amendments would reduce the overall impact of the Project, a review of the social consequences of these changes against the original SIA indicates that there would be no subsequent reduction in the level of social impact. This is based on the fact that impacts have not been fully removed or avoided by the amendments and that the community is deemed to remain highly sensitive to social consequences of these issues. As such the overall social significance of the Project has remained unchanged and would remain consistent with those of the already operational mine.

The additional social impact assessment of issues raised in submissions identified:

- Subsidence related social impacts - The likelihood of indirect impacts from subsidence (stress, anxiety, uncertainty, disturbance, hardship) is considered to be *almost certain* with *moderate* consequences on affected community members, resulting in a significance/ risk rating of *extreme* (without mitigation). With the implementation of a subsidence management process (designed to inform and support affected community members through the subsidence management and claims process) the likelihood rating can be reduced to *likely*, with the consequence rating likely to remain at *moderate*. This would result in a residual post mitigation significance/ risk rating of *high*.
- Social impacts to the Aboriginal community - The likelihood of social impacts to the Aboriginal community has been rated as *possible* with *moderate* consequences resulting in a significance/ risk rating of *high* (without mitigation). With the implementation of cultural heritage management and consultation measures, the likelihood rating would remain as *possible*, and the consequence of rating can be reduced to *minor* resulting in a residual post-mitigation significance/ risk rating of *moderate*.
- Social impacts to groundwater bore users - The likelihood of indirect social impacts to groundwater bore users is considered to be *possible* with *moderate* consequences of impact without mitigation, resulting in a significance/ risk rating of *high* (without mitigation). With the implementation of groundwater management and consultation processes, designed to make-good affected bore users and support their claims process, the likelihood rating would remain as possible, while the consequence rating of impacts can be reduced to *minor* resulting in a residual post-mitigation significance/ risk rating of *moderate*.
- Social impacts to community with ties to surrounding natural features – The likelihood of social impacts on community with ties to the natural environment is considered to be *possible* and *moderate* in consequence, resulting in a significance/ risk rating of *high* (without mitigation). With the implementation of mitigation and consultation measures aimed at ensuring that the community has input and buy-in into decision making, it is considered that the consequence rating would reduce to *minor* resulting in a post-mitigation risk rating of *moderate*.

7.18.3 Revised Management and Mitigation Measures

The management and mitigation measures outlined above are identified in Section 7 of the Tahmoor South Project Response to Submissions Report and are considered sufficient and adequate to address the above social impacts and no additional mitigation measures have been identified.

In particular, prior to mining operations commencing for a new longwall, potentially affected residents would receive a Resident Information Pack which includes:

- Longwall information;
- An explanation of subsidence and the potential effect of subsidence on houses and other structures;
- Anticipated levels of subsidence for longwall;
- A description of property inspections, surveys and monitoring including how to access free pre-mining property inspections;
- A description of rights and responsibilities relevant to subsidence; and
- Emergency contact details.

The Resident Information Packs include specific information on the role of Subsidence Advisory NSW (SA NSW) in administrating the *Coal Mine Subsidence Compensation Act 2017*; comprising contact details; the subsidence claims process where damage by subsidence is suspected and details for access to free counselling services in relation to subsidence impacts. SA NSW is also responsible for reducing the risk of mine subsidence damage to properties, through its assessment and control of the types of buildings and improvements which can be erected in Mine Subsidence Districts.

Tahmoor Coal's existing operations have mined beneath approximately 1890 residential homes and commercial premises. The majority of the homes and premises experienced little or no damage from mine subsidence impacts. A small percentage experienced more significant impacts addressed via the *Mine Subsidence Compensation Act 1961* and subsequently the *Coal Mine Subsidence Compensation Act 2017* and approved procedures. All claims lodged with SA NSW are managed by a SA NSW Case Advisor who provide property owners with focussed support and a dedicated point of contact through the process. As noted above, specific amendments have been made to the proposed mine plan to ensure the longwall geometry for the Amended Project is consistent with the longwall mining undertaken at Tahmoor North.

Tahmoor Coal would also continue to engage with the community through its existing Community Consultative Committee Meetings and other processes to address community concerns on subsidence and other matters. Consultation processes that are currently implemented in relation to subsidence management (and would continue to be applied for Tahmoor South) are detailed in Section 3.8 and 11.1 of the EIS.

7.18.4 Conclusion

It is considered that the social impacts identified in the original SIA and the SIA Addendum can be managed by Tahmoor Coal through the implementation of proposed measures. These have been informed by over 40 years of mining in the Southern Coalfields and through significant experience gained in managing social impacts in consultation with the community and other stakeholders.

8.0 Evaluation of Merits

8.1 Summary

Tahmoor Mine is an established underground coal mine which has operated since 1979. As a result of historical and current operations, Tahmoor Coal has a strong understanding of mine design principles and requirements for the protection of surface features, including the natural and built environment, and is experienced in the management of potential environmental impacts particularly relating to subsidence.

The Amended Project seeks to continue the life of underground mining at the Tahmoor Mine until approximately 2035. Without approval, completion of mining in the Tahmoor North mining area would result in closure of Tahmoor Mine by approximately 2022 which would result in the cessation of the extraction of the coking coal resource. The Amended Project would enable mining to be undertaken within the southern portion of Tahmoor Coal's (and its wholly owned subsidiary Bargo Collieries Pty Ltd) existing mining lease areas, and operations and employment to continue for approximately a further 13 years.

The Amended Project has the following key attributes:

- Extraction of premium quality coking coal;
- Utilisation of existing pit top infrastructure (brownfield site);
- Continuation of employment at an established mine site;
- A strong relationship with the local community and demonstrated support for the Project;
- The careful evaluation of environmental and community impacts in designing and amending the Project;
- Amendments to key issues raised in submissions on the EIS; and
- Incorporation of ESD principles to reduce environmental impacts.

These features are discussed in detail below.

8.2 Premium Quality Coking Coal

Coking coal is used to create coke, which is one of the key inputs for the primary production of steel. The quality of the resultant coke is determined by the qualities of the coking coals used, as well as the coke plant operating conditions.

Tahmoor Mine is recognised in the steel production industry as one of the existing mines in Australia that produce high fluidity (maximum of approximately 1000 dial divisions per minute (DDPM)) coking coal, making it of optimum quality and suitability for steel production.

This is a valued resource that is important to the state, given the increased demand for higher quality coal since the early 2000s. This follows reforms in the international steel production industry, including the closure of inefficient steel mills and stricter environmental standards.

Steel is an important part of society, used in healthcare, telecommunications, transport, infrastructure, construction and agricultural equipment.

8.3 Continuation of Established Mine Site

Australian coal mines operate to some of the highest environmental standards in the world. The continuation of mining into the Tahmoor South area would utilise a brownfield development, facilitating demand through existing facilities rather than to establish a separate, new mine to access the coal resource. The use of an existing site is considered preferable to a new mine from an environmental, economic and social perspective to maximise production and supply of product coal to established domestic customers and export markets.

8.4 Economic Support and Benefits

Tahmoor Coal has been a major employer in Wollondilly for over 40 years, employing approximately 400 people with around half being local residents. Further, Tahmoor Coal has a long history of successful engagement with the local community in which it operates. This is reiterated through the overall strong support expressed in the majority of submissions during the exhibition period in favour of the Project.

Key benefits to local, Regional and State economies include continued provision of employment for Tahmoor Mine's workforce until 2035, as well as additional employment through the construction phase of the Project. It is predicted the Project would generate a net benefit of up to $784 million over its life; $162 million of which would flow through to the local Wollondilly region (in Net Present Value terms).

8.5 Design Considerations

The Project has been carefully developed by Tahmoor Coal through collaboration with a variety of specialists including mining engineers, ecologists, heritage specialists, hydrologists and hydrogeologists which included consideration of predicted subsidence impacts on built and natural features. Prior to lodging the EIS, Tahmoor Coal made a number of revisions to the original mine plan, including shortening Longwalls 105 to 108 from the commencing ends of the longwalls such that they do not encroach into the Metropolitan Special Area.

8.6 Amendments to the Project

Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, the associated subsidence impacts, greenhouse gas emissions and the extent of vegetation clearing required for the extension of the rejects emplacement area (REA). In response to these and other issues raised in submissions, and as a result of ongoing mine planning, several amendments have been made to further reduce the predicted environmental impacts of the Project.

This Amendment Report documents the changes made to the Project in response to submissions from Government agencies and the community, as well as to report on the environmental impacts of the Amended Project. By amending the Project, extending the life of underground mining at the Tahmoor Mine is considered to have merit for the following reasons:

- The Amended Project demonstrates compliance with statutory controls;
- The Amended Project is important to maintaining the continued operations of Tahmoor Mine, ensuring the ongoing generation of employment and increased economic activity locally and within the wider NSW community;
- The REA extension footprint has been reduced by approximately 74% and thereby resulting in:
    - A reduction in biodiversity impacts: including required vegetation clearing (including from rehabilitated land and clearing of the TEC Shale Sandstone Transition Forest); reducing the removal of 96 *Persoonia bargoensis* individuals down to 8*;* reducing the removal of 2,324 *Grevillea parviflora* subsp. *Parviflora* individuals down to 491; and, reducing the removal of 40 *Pomaderris brunnea* individuals down to 1;
    - Less surface water runoff anticipated as a result of the reduced REA footprint (from 43 ha to 11.06 ha) and water management at the base of the REA;
- The Amended Project has reduced operation hours for reject haulage timing to fall between 7am and 10pm to reduce noise impacts to nearby housing during night-time hours;
- The amended mine plan has reduced the predicted maximum total conventional subsidence, tilt and curvatures by approximately 15% from the predicted maxima within the EIS mine plan;
- Tahmoor Coal is a subsidiary of Liberty Steel Group, part of the GFG Alliance, who has made a global commitment to be carbon neutral across its operations by 2030, including its mining activities. This will be achieved through a combination of investment in renewable energy such as solar and pumped hydro as well as process improvements and offsets;

- The reduction in the mine plan has resulted in the reduction of Scope 1, 2 and 3 emissions; and
- Removal of LW109 reducing impacts to Dog Trap Creek.

8.7 The Precautionary Principle

The design has incorporated the principles of ESD to reduce environmental impacts. The principles are discussed below in the context of the Amended Project:

- **The Precautionary Principle**: Specialist assessments that were undertaken for the EIS have been revised to ensure consistency with the Amended Project. Careful and thorough evaluation undertaken in order to recognise the potential for, and to avoid where possible, serious or irreversible damage to the environment has continued for the Amended Project;
- **Intergenerational Equity**: The re-engagement of suitably qualified and experienced consultants has ensured that the planning, design and environmental assessment phases of the Amended Project have been transparent. Revised management strategies, mitigation measures and monitoring programs have been identified to minimise short- and long-term potential impacts on the local environment and nearby communities;
- **Conservation of Biological Diversity and Ecological integrity**: As explained in **Section 7.4** and **Section 7.5** the Amended Project would have a reduced impact to native vegetation and a reduction in vegetation clearing. A number of revised mitigation measures to minimise direct and indirect ecological impacts would be implemented as part of the Amended Project; and
- **Improved Valuation and Pricing of Environmental Resources**: The value placed on avoiding and minimising environmental impacts is demonstrated in the reduction in the REA footprint proposed in the Amended Project. The smaller disturbance area also adds to this value by minimising noise through adoption of noise reduction measures, for protecting biodiversity by assessing and managing impacts on habitat, reducing emissions and reducing overall waste. Tahmoor Coal continues to acknowledge and accept the financial costs associated with all the measures required to avoid, minimise and manage potential environmental and social impacts for the Amended Project.

8.8 Conclusion

The Amended Project has sought to address and resolve matters raised during the public exhibition period to deliver a superior outcome. The Amended Project meets environmental performance requirements, would result in direct and indirect economic benefits to the local community, and has been considered in accordance with the principles of ESD.

9.0 References

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