Hunter Valley Operations South - Modification 5

ENVIRONMENTAL ASSESSMENT

Prepared for HV Operations Pty Ltd | February 2017

VOLUME 1 | Main Report and Appendices A – D

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Hunter Valley Operations South - Modification 5

Environmental Assessment | Section 75W Modification to PA 06_0261

Prepared for HV Operations Pty Ltd | 1 February 2017

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Public exhibition

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Executive Summary

ES1 Context

Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the Hunter Valley Operations (HVO) mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied). Coal & Allied seeks a modification to its project approval (PA) (PA 06_0261) for its HVO South mine.

Situated 24 kilometres north-west of Singleton, HVO is the oldest mine in Coal & Allied's portfolio, operating since 1949 (refer to Figure E.1). HVO operates under two planning approvals, one for HVO North and one for HVO South, geographically divided by the Hunter River. However, the two operate as one site, HVO, and provide work for approximately 1,500 employees and contractors.

HVO South is currently able to extract up to 16 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal and has project approval until 2030. HVO South comprises the Riverview, Cheshunt and South Lemington Pits 1 and 2 (yet to be mined), Lemington Coal Preparation Plant (yet to be constructed) and all related mining activities and infrastructure such as overburden and fine reject emplacement areas (refer to Figure E.2).

The proposed modification will enable:

- the Cheshunt Pit to continue mining through the Riverview Pit, extracting the deeper Bayswater seam below the Vaux seam; and
- mining down to the base of the Vaux seam below the Bowfield seam in South Lemington Pit 2.

Mining of the deeper seams will occur within the existing State-approved disturbance footprint. This will avoid any direct impacts on aspects such as biodiversity and Aboriginal heritage. Design of the proposed modification within the constraints of the existing State-approved disturbance footprint necessitates an increase in height in some areas of the overburden emplacement up to 240m above Australian Height Datum (AHD), or an additional 80m to accommodate the additional volume of overburden material. The proposed modification has provided an opportunity to redesign the overburden emplacement strategy to incorporate micro-relief design techniques. Although the overburden emplacement will be higher in places, the final landform has been designed to look more consistent with natural landforms in the area.

The proposed modification also seeks to increase the maximum rate of extraction and processing from 16Mtpa to 20Mtpa of ROM coal during peak production.

ES2 Existing operations

Current mine sequencing at HVO South has the Cheshunt and Riverview Pits operating concurrently. The Riverview Pit is designed to extract the seams down to the base of the Bowfield seam. Cheshunt Pit, which is approved to mine to the base of the Bayswater seam, is designed to advance through the mined areas in Riverview Pit, stepping up from the deeper Bayswater seam to extract the seams from below the Bowfield to the Vaux seam (refer to Figure E.3). South Lemington Pits are mined separately to Cheshunt and Riverview and are approved to mine to the base of the Bowfield seam. The approved mining depths are shown in Figure E.4.

The operations of HVO South and HVO North are integrated with the ability to move material and associated equipment around HVO including ROM coal, product coal, coal rejects, overburden and water as required. Environmental aspects of the integrated operations are managed under Rio Tinto Coal Australia's accredited ISO 14001 Environmental Management System (EMS) which forms part of the Health, Safety, Environment and Quality Management System. The EMS utilises an overarching environmental policy, risk register, objectives and targets, a series of regulatory required management plans, a monitoring programme and environmental standards and procedures to ensure that the operations are compliant with their various environmental obligations.

Due to the long history of operations at HVO, the regional and local social, physical and economic environments are well understood and the site has well established environmental management systems and community connections. An extensive air quality, noise and vibration, surface and groundwater monitoring network supports environmental management at HVO.

ES3 Proposed modification

The application to modify the HVO South project approval (PA 06_0261) is to allow:

- the progression of mining to the base of the deeper Bayswater seam from Cheshunt Pit into Riverview Pit and mining to the base of the Vaux seam below the Bowfield seam in South Lemington Pit 2;
- a modification to the currently approved overburden emplacement strategy to enable an increase in height in some areas up to 240mAHD and incorporation of micro-relief to provide a more natural final landform;
- an increased rate of extraction from 16Mtpa to 20Mtpa ROM coal at peak production and an increased processing rate of coal extracted from HVO South from 16Mtpa to 20Mtpa of ROM coal across HVO coal preparation plants; and
- the update of the Statement of Commitments within PA 06_0261 with removal of commitments that are redundant or inconsistent with measures prescribed in approved management plans. This includes the transition from prescriptive blasting conditions and replacement with contemporary outcome based conditions.

Figure E.5 shows the proposed mining depths and the proposed location of the final void in the context of the HVO South mining operations and surrounds. When designing the indicative mine plans for the proposed modification, HVO South underwent a mine plan review process which considered avoidance and minimisation of environmental impacts on surrounding sensitive receptors consistent with the precautionary principle. The optimisation process resulted in improvements in the mine plan design, which include:

- no extension to the State-approved mining disturbance areas and utilisation of the State-approved disturbance footprint to access the deeper coal seams;
- micro-relief incorporated into overburden emplacement area design with consideration given to sensitive residences to the west (Jerrys Plains) and east (Maison Dieu and Long Point) as well as the Hunter Valley Glider Club;
- emplacement of additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the nearby Wollemi National Park for sensitive receivers to the east of HVO South;

- mining strip alignment to minimise potential noise emissions received at Jerrys Plains;
- increased distance between the Hunter River and the proposed evaporative basin within the final void;
- minimisation of surface water catchment area draining to the final void; and
- reduction in the low-wall slope to enable greater land use optionality within the final void.

ES4 Legislative framework

The existing project approval, PA 06_0261, was granted under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) which prior to its repeal allowed for a project approval to be modified under section 75W of the EP&A Act. Transitional provisions within the EP&A Act enable 'transitional Part 3A projects' to continue to be subject to Part 3A of the EP&A Act. As HVO South is a transitional Part 3A project the proposed modification is made under the now repealed section 75W of the EP&A Act.

The proposed modification also considers matters identified in Part 3 of the NSW *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP). Specifically, clause 12AB of the Mining SEPP identifies non-discretionary development standards for mining that focus on local environmental and amenity matters such as cumulative noise and dust levels. The proposed modification meets the non-discretionary development standards for mining.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* aims to protect matters deemed to be of national environmental significance, which include actions of development for coal seam gas or large coal mining on water resources. The proposed modification was referred to the Commonwealth Department of the Environment for potential impacts on water resources in February 2016 (EBPC 2016/7641). The referral considered the *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources* (DoE 2013).

A second referral was submitted to DoE for State-approved disturbance areas within Riverview and Cheshunt Pits that contained vegetation communities that were listed in May 2015 subsequent to PA 06_0261 being granted in 2009 by the NSW Minister for Planning. This referral (EPBC 2016/7640) also comprised State-approved disturbance areas within HVO North.

ES5 Stakeholder engagement

An ongoing stakeholder engagement strategy is in place for HVO's existing operations and this includes the below.

- A freecall information line (1800 727 745) to provide the community with the opportunity to provide feedback or gather information relating to Coal & Allied's operations in the Hunter Valley.
- Coal & Allied's website (www.riotinto.com) which contains information on mine operations and management, environmental monitoring results, project applications, community investment and engagement and contact details.
- Advertorials in the Singleton Argus and Hunter Valley News which provide information on Coal & Allied's mining operations, including upcoming projects.

- HVO's Community Consultative Committee (HVOCCC) which is used to discuss mining operations and environmental performance, and comprises representatives of the community, Singleton Council and Coal & Allied.

- Regular letters to residents in the areas surrounding HVO which include updates from the General Manger on HVO's operations, environmental results and community programmes.

- One on one engagement with near neighbours regarding existing operations as well as the proposed modification.

- Regular formal and informal updates to HVO employees from the General Manager and site leaders.

Initial stakeholder engagement has been undertaken with near neighbours (Maison Dieu, Long Point and Jerrys Plains), the HVOCCC, Singleton Council, the workforce and relevant State and Commonwealth departments during preparation of the Environmental Assessment Report. A summary of the proposed modification and outcomes of the technical studies was presented to the HVOCCC in November 2016 and to potentially affected near neighbours during December 2015 and November 2016. The presentation also provided tailored information in response to a request for further information regarding potential noise, air quality and visual amenity impacts to private dwellings in Maison Dieu. Stakeholder engagement will be ongoing throughout the assessment process including engagement on the outcomes of the Environmental Assessment Report with the broader community during public exhibition.

ES6 Impact assessment

The Environmental Assessment Report has assessed the potential impacts of the proposed modification on noise and vibration; air quality and greenhouse gas; visual amenity; groundwater; surface water; ecology; final landform, rehabilitation and landuse; heritage; and socio-economics. A summary of the outcome of the assessment is provided below.

ES6.1 Noise

The noise and vibration study was undertaken for the proposed modification in accordance with the *NSW Industrial Noise Policy* (the INP, EPA 2000) and the *NSW Voluntary Land Acquisition and Mitigation Policy* (the VLAMP, DP&E 2014). The findings of the study are summarised below.

- The proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from neighbouring mine operations.

- The proposed modification is predicted to have significant impact on one property (remaining residence in Warkworth village, ie location 77) with noise levels greater than 5dB above PSNL. This residence is currently entitled to mitigation within the project approval (PA 06_0261) and entitled to voluntary acquisition due to impacts from other neighbouring mining operations (ie Wambo Mine, United Wambo Open Cut Coal Mine Project (United Wambo Project) and Warkworth Mine).

- The proposed modification is predicted to have moderate impacts on twelve additional properties with noise levels 3-5dB above PSNL (contributing more than 1dB to the total industrial noise level). Eight of these properties are west of the proposed modification on Jerrys Plains Road and the remaining four properties are east in Maison Dieu. According to VLAMP these properties would be entitled to treatment measures such as upgraded façade elements like windows, door, roof insulation to further increase the ability of the building facade to reduce noise levels. It should be noted that the eight properties on Jerrys Plains Road are predicted to experience noise impacts from the United Wambo Project. Six of the properties would be afforded acquisition rights and the remaining two would be afforded mitigation rights should the United Wambo Project be approved.

- The proposed modification is predicted to have negligible impacts on four additional properties with noise levels 0-2dB above PSNL. Three of these properties are west of the proposed modification and one to the east. Noise exceedances would not be discernible by the average listener and, therefore, would not warrant receiver based treatments or controls.

- All residents residing at properties identified as being impacted by the proposed modification have been contacted and feedback sought on the proposed modification and outcomes of the assessments.

- The Mining SEPP (clause 12AB(3)) non-discretionary standard for acceptable night-time (ie amenity) criterion of 40dB $LA_{eq,9hour}$ is met at all but one assessment location. This location (location 77) is in Warkworth village and already entitled to voluntary acquisition due to operations at Wambo Mine (refer to Condition 3 of Schedule 3 of the project approval (PA 06_0261)) and is also predicted to be afforded acquisition rights due to the recently exhibited United Wambo Project should it be approved. HVO South's contribution at this location is predicted to be between one and four per cent of all expected noise levels.

- The Mining SEPP (clauses 12AB(5) and (6)) non-discretionary standards for acceptable air-blast overpressure and ground vibration, respectively, are predicted to be satisfied at all privately owned residences.

- No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

ES6.2 Air quality and greenhouse gases

The air quality and greenhouse gas study was undertaken for the proposed modification in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005) and VLAMP (DP&E 2014). The findings of the study are summarised below.

- The proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from neighbouring mine operations.

- Under the VLAMP, no additional private dwellings are impacted that are not already afforded acquisition rights from neighbouring mine operations as the VLAMP significant impact criteria correspond with the Mining SEPP (clause 12AB(4)) non-discretionary standard with respect to cumulative air quality at private dwellings.

- It should be noted that the proposed modification is predicted to exceed the VLAMP and Mining SEPP PM_{10}, annual average cumulative criteria of 30ug/m^3 at four properties, three within Warkworth village and one south-west of Camberwell village. Two of these three Warkworth properties are non-residences (102 - Warkworth Hall and 264 - St Phillip's Church) and the third property (assessment location 77) is entitled to acquisition upon request from Wambo Mine, United Wambo Project and Warkworth Mine. The property south-west of Camberwell village (assessment location 471) is entitled to acquisition upon request from Ashton Coal's South East Open Cut project.

- No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

- Impacts from blast fume emissions are unlikely to occur due to management of blasting activities by mine operators.

- The proposed modification is predicted to increase greenhouse emissions by approximately 0.03 per cent, in terms of Australia's annual emissions, over the approved HVO South.

ES6.3 Visual amenity

The visual assessment for the proposed modification considered the potential impacts on the visual amenity of representative viewpoints as the result of changes to the approved final landform as well as changes to the viewscape during operations. Potential viewpoints for sensitive receivers are generally limited to the east of the existing operations, such as Maison Dieu and Long Point. Views from the north, south and west are generally constrained due to intervening topography and distance.

The findings of the assessment are summarised below.

- The proposed modification requires an increase in height in some areas of the overburden emplacement up to 240mAHD, or approximately 80m to accommodate the additional volume of overburden material and enable micro-relief. The proposed maximum height of 240mAHD is similar to the current approved maximum height for Ravensworth Operations and HVO North.

- The proposed modification has provided an opportunity to redesign the overburden emplacement strategy to incorporate micro-relief design techniques. Although the overburden emplacement will be higher in places, the final landform has been designed to look more consistent with natural landforms in the area.

- Given the importance afforded to visual amenity by HVO's near neighbours, it was an important consideration in the mine optimisation process. The proposed modification will emplace the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the nearby Wollemi National Park for sensitive receivers to the east of HVO South. In addition, the incorporation of microrelief to the surface enables the visual contrast to the National Park in the background to be minimised.

- During the first six years of the proposed modification moderate impacts are predicted associated with establishment activities, for sensitive receivers to the east in Maison Dieu and Long Point. However, once these activities are completed by the end of Stage 2 or approximately Year 2022, final rehabilitation activities will commence and reduce visual impacts. Overall, the proposed modification will result in a moderate/low visual impact at all viewpoints.

- It should be noted that in the longer term, existing visual amenity impacts are anticipated to be reduced through the incorporation of a more natural landform with micro-relief design incorporated into the post mining landform design.

- Condition 34 of the existing project approval (PA 06_0261) requires rehabilitation at HVO South to be undertaken progressively in a manner that is generally consistent with the final landform set out in the EA (shown conceptually in Appendix 6 of PA 06_0261). The progressive rehabilitation will continue to be overseen by an on-site specialist who, along with mine planners, ensures that future rehabilitation resource requirements are available to enable the objectives of rehabilitation domains to be met. Final landform and rehabilitation are discussed further in Chapter 9.

- Progressive rehabilitation will provide for the development of a more natural landscape that includes large areas of connected native vegetation and grassland to support land suitable for agriculture.

- Redesigning the final landform will result in an overall aesthetic improvement to the mine area at the cessation of mining.

- Although the technical assessment has identified a low to moderate impact on visual amenity, community consultation has highlighted concerns regarding impacts to views. HVO will continue to work with neighbours on mitigation and management.

ES6.4 Groundwater

A groundwater study was undertaken for the proposal in accordance with the Department of Primary Industry Water's (DPI Water) *Aquifer Interference Policy* (the AIP).

The hydrogeological setting of the project area comprises two key stratigraphic units, the Quaternary alluvium and Permian aged Wittingham Coal Measures. The coal measures contain groundwater that is generally moderately saline and not suitable for stock water supply or irrigation.

A numerical groundwater model was developed and remodelled the existing approval and proposed modification, as well as including all currently approved and foreseeable mine plans within the region (ie HVO North, United Wambo Project, MTW, Cumnock, Ashton and Ravensworth Operations) allowing the assessment of cumulative impacts. The model was calibrated with a pre-mining steady state run (1970 to 2003), and a transient run for the period (2003 to 2015) using existing groundwater levels at representative bores. The groundwater model was independently peer reviewed by Dr Frans Kalf of Kalf and Associates Pty Ltd (KA) who has over 47 years of experience in hydrogeological investigations and specialises in peer reviews. The peer review concludes that the model is fit for purpose.

The findings of the study are summarised below.

- The model predicts a peak take from the Permian strata of 1,591ML/year at Year 11 under North Coast Fractured and Porous Rock WSP. The model predicts a peak indirect take of 423ML/year under the Hunter Unregulated WSP and 584ML/year under the Hunter Regulated WSP. These volumes are within previously predicted maximum water takes for the currently approved operations stated in ERM (2008) and accommodated by licensed water entitlements currently held.

- The proposed modification will not impact groundwater levels within any private bores by more than the trigger of 2m specified within the AIP and meets the relevant non-discretionary standards in clause 12AB(7) of the Mining SEPP.

- There are no groundwater dependent ecosystems (GDEs) in the vicinity of the existing approval and proposed modification as mapped in the Commonwealth Government's *National Atlas of Groundwater Dependent Ecosystems*. Ecosystems that potentially use groundwater have been identified at six locations from surveys in the area by the proponent as part of previous assessment processes. These comprise the vegetation communities and populations of River Red Gums, Hunter Flood Plain Red Gum Woodland and Hunter Valley River Oak, as well as the ephemeral wetland, Carrington Billabong. Drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium. However, in areas adjacent to South Lemington Pit 2 (which is north of Wollombi Brook) where the existing approved operations are expected to result in drawdown of up to 7m, the proposed modification is predicted to further decrease groundwater levels by up to an additional 2.8m (refer to Section ES6.6). Groundwater levels within alluvium south of Wollombi Brook are predicted to decrease by less than 1m due to the proposed modification.

- The proposed void has been designed to achieve its primary objective of functioning as a groundwater sink, maximising groundwater flow across back-filled pits to the final void, preventing release of saline water into the surrounding environment. This has the indirect benefit of reducing the inflow of saline Permian water into the Hunter River and Wollombi Brook under natural gaining conditions.

- The independent peer review concluded that 'the predictions of drawdown due to the proposed modification together with the existing approved mine plan and cumulative effects will have minimal influence on the environment'.

- Existing management and monitoring measures currently implemented through the relevant management plans required PA 06_0261, such as the HVO Water Management Plan, will continue under the proposed modification, with regular review, optimisation and reporting.

ES6.5 Surface water

A surface water study was undertaken to assess the potential impacts of the proposed modification. The study included an update of the water balance for HVO to include the proposed modification. The findings of the study are summarised below.

- Potential impacts of the proposed modification on surface water resources (water quality and quantity) can be effectively managed by the updating and continued implementation of the existing Water Management System.

- There is no increase in the amount of captured catchment area at HVO as a result of the proposed modification and, therefore, it will not cause additional impacts on downstream flows.

- No significant change to the frequency or magnitude of releases under the Hunter River Salinity Trading Scheme is predicted.

- Water will recover in the final void and reach an equilibrium level of around 30mAHD, over 42m below the natural surface, meaning there will be no overflow into the Hunter River as the final void will remain a permanent sink.

- No additional management measures are required as a result of the proposed modification.

ES6.6 Ecology

The proposed modification does not change the approved disturbance footprint and therefore there will be no additional direct impacts on ecology as a result of the proposed modification. Changes to the groundwater regime have the potential for indirect impacts on ecosystems that potentially use groundwater. Accordingly, the ecology assessment for the proposed modification considered the potential impacts on these ecosystems.

As noted in Section ES6.4, there are no GDEs in the vicinity of the project area as mapped in the Commonwealth Government's *National Atlas of Groundwater Dependent Ecosystems*. Ecosystems that potentially use groundwater were identified at six locations from surveys in the area by the proponent as part of previous assessment processes. These comprise the vegetation communities and populations of River Red Gums, Hunter Flood Plain Red Gum Woodland and Hunter Valley River Oak, as well as the ephemeral wetland, Carrington Billabong.

As stated in Section ES6.4, drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium. However, in areas adjacent to South Lemington Pit 2 (which is north of Wollombi Brook) where the existing approved operations are expected to result in drawdown of up to 7m, the proposed modification is predicted to further decrease groundwater levels by up to an additional 2.8m. Groundwater levels within alluvium south of Wollombi Brook are predicted to decrease by less than 1m due to the proposed modification. Irrespective of the drawdown, the ecosystems at these locations were shown to be opportunistic groundwater users only, inhabiting the niche on the floodplain due to the flooding regime rather than water supplied directly from the groundwater system. The proposed modification does not change the local flooding regime and, therefore, impact on these ecosystems is not expected. This is consistent with previous assessments.

The proposed modification will therefore have no additional impacts on ecology other than those already approved and offset for the existing operations. No additional management and monitoring measures will be required under the proposed modification.

ES6.7 Final landform, rehabilitation and final landuse

Mining of the deeper coal seams has been designed to occur within the existing State-approved disturbance footprint. The additional volume of overburden material to access the deeper coal seams requires a revision of HVO South's overburden emplacement strategy. The change in overburden emplacement strategy has provided an opportunity to develop a more natural landscape into the post mining landform design using micro-relief design techniques. That is the final landform has been designed with slopes, undulations, grassland and vegetation that better replicates and assimilates with the natural landscape in the area.

The proposed landform aims to reflect the natural features and complement the previously created landforms. The rehabilitated landform will be vegetated to areas of grassland, trees over grassland and woodland, consistent with the *Synoptic Plan – Integrated Landscapes for Coal Mine Rehabilitation for the Hunter Valley of NSW* (Department of Mineral Resources 1999) which aims to integrate biodiversity enhancement with sustainable agricultural practices.

The proposed modification will have a single final void with a surface area of approximately 523ha measured at a ground surface level of 70mAHD. This compares to a surface area of approximately 404ha for the existing approval. The increase in area is due to the use of a shallower low wall slope in the void of 10 degrees or less for the proposed modification compared to a slope of 14 to 18 degrees for the existing approval.

An Operational Simulation Model (OPSIM) daily time-step model was used to developed a water balance for the evaporative basin in the final void. The assessment found a long term equilibrium water level for the proposed modification of approximately 30mAHD with a surface area of approximately 372ha. The OPSIM model remodelled the long term equilibrium water level for the current approval at approximately 32mAHD with a surface area of approximately 403ha.

The useable area above the evaporative basin at the long term equilibrium water level with a slope of 10 degrees or less for the proposed modification has been assessed at an additional 150ha compared to the remodelled approval. That is, the proposed modification would result in an increase in useable area within the final void with a slope of 10 degrees or less. The evaporative basin is located further from the Hunter River compared to its approved location which will remain as a groundwater sink in perpetuity preventing the release of stored water into the Hunter River and Wollombi Brook.

The catchment area draining to the final void is slightly smaller for the proposed modification (1,145ha) compared to the remodelled approval (1,190ha).

Rehabilitation and final landform development will continue to be undertaken in accordance with the HVO South MOP and the HVO South Rehabilitation and Landscape Management Plan. A final void management plan and mine closure plan will also be prepared in consultation with the relevant agencies at least five years prior to the completion of mining, as required by Conditions 37 and 38 Schedule 3 of project approval (PA 06_0261), respectively.

ES6.8 Heritage

The proposed modification does not change the State-approved disturbance footprint. Therefore, the proposed modification will have no additional impacts on Aboriginal cultural heritage or historic heritage other than those approved for the existing operations. Management of cultural heritage will continue to be implemented in conformance with the Aboriginal Cultural Heritage Management Plan and Coal & Allied's Cultural Heritage Management System.

ES6.9 Socio-economic

The proposed modification seeks to optimise the existing operations which will enable the mine's socio-economic benefits to be maintained.

Mining of the deeper coal seams enables the extraction of approximately 56.8Mt of additional state resource, with the increased rate of extraction from 16Mtpa to 20Mtpa of ROM coal during peak production.

The existing socio-economic benefits of HVO South that will continue under the proposed modification include:

- ongoing direct and indirect employment;
- continued community engagement and investment through the HVO CCC and programmes such as the Coal & Allied Community Development Fund, sponsorships and donations, with current community contributions commitments being approximately $4 million for the period between January 2015 and December 2017; and
- additional direct economic benefits and flow-on economic effects of HVO South including $243 million in royalties and $160 million in taxes (discounted at 7 per cent).

No changes to the State-approved disturbance footprint, levels of direct employment or the project approval period are proposed. The proposed modification aims to sustain mine employment at current levels and does not result in social impacts arising from workforce influx, population change and associated impacts on infrastructure.

Potential environmental and amenity impacts associated with the proposed modification were assessed and are outlined in the sections above. The proposed modification satisfies the non-discretionary standards for privately owned residences not already entitled to acquisition from surrounding mine operations. There are no additional exceedances of cumulative noise levels and air quality due to the proposed modification and airblast overpressure, ground vibration and aquifer interference meet appropriate criteria.

Feedback received through community consultation has identified a perceived amenity impact irrespective of the technical assessment outcomes which predict a low to moderate impact on amenity (noise, air quality and visual). In response to this stakeholder feedback, HVO will establish a Near Neighbour Amenity Resource which will fund works and services to improve amenity for near neighbours. The scope of the programme will be developed in consultation with local stakeholders and will be in addition to the technical mitigation and management measures outlined elsewhere in this EA.

The community will continue to be consulted throughout the life of the project. Feedback received regarding frequency and method of engagement will be to further improve and update HVO's community engagement programme in 2017.

ES6.10 Justification and conclusions

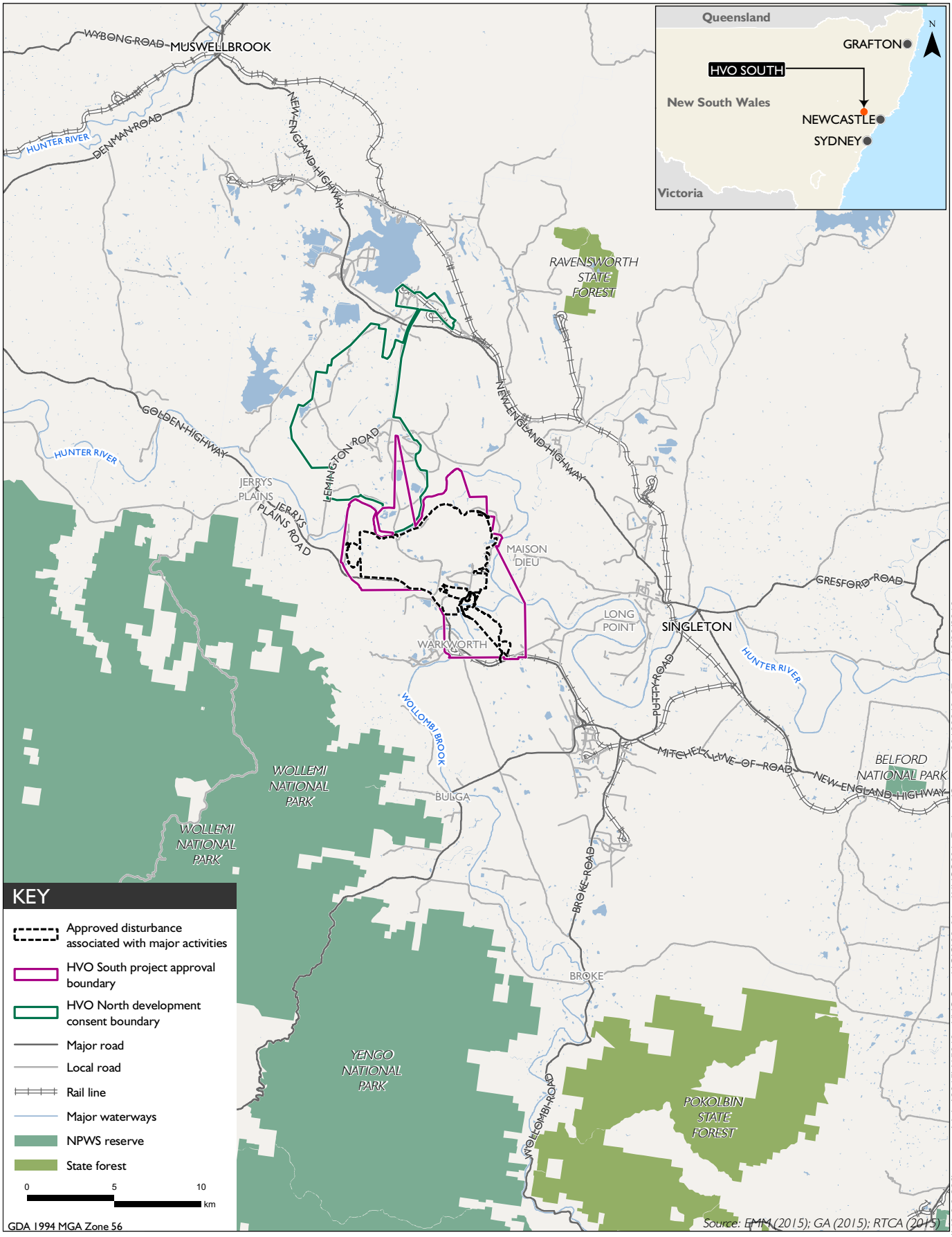
The proposed modification will enable the additional extraction of approximately 56.8Mt of ROM coal over the remaining project approval period within the existing State-approved disturbance footprint and enable more coal to be produced from the HVO South.

It is considered that the proposed modification is justified, for the following reasons:

- it will enable the implementation of an efficient and flexible mine plan;
- it will add to the important regional and local economic and social benefits from the mine's operation;
- the site is suitable for the proposed modification given that it is an existing mining operation and there will be no change to the State-approved disturbance footprint;
- it meets the Mining SEPP's non-discretionary standards for noise and air quality amenity at all privately owned residences not already entitled to acquisition from surrounding mine operations;
- potential environmental and social impacts are largely consistent with those approved under the project approval (PA 06_0261) such that the existing management controls implemented by HVO South require only minor amendments; and
- it is aligned with the principles of ecologically sustainable development, consistent with the contemporary legislative requirements and meets all relevant government policies.

The proposed modification will facilitate the extraction, processing and transportation of a state resource by an existing mining operation. This can be efficiently achieved by Coal & Allied because of the hundreds of millions of dollars invested in the operation and its existing access to product transport and distribution infrastructure such as road, rail and port.

The proposed modification will add to the important regional and local economic and social benefits from the mine's operation. It would add to the economic benefits to the NSW Government in the form of royalties, and to the Commonwealth Government in the form of company and income taxes.



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Regional context

HVO South Modification 5
Environmental Assessment

Figure E.1

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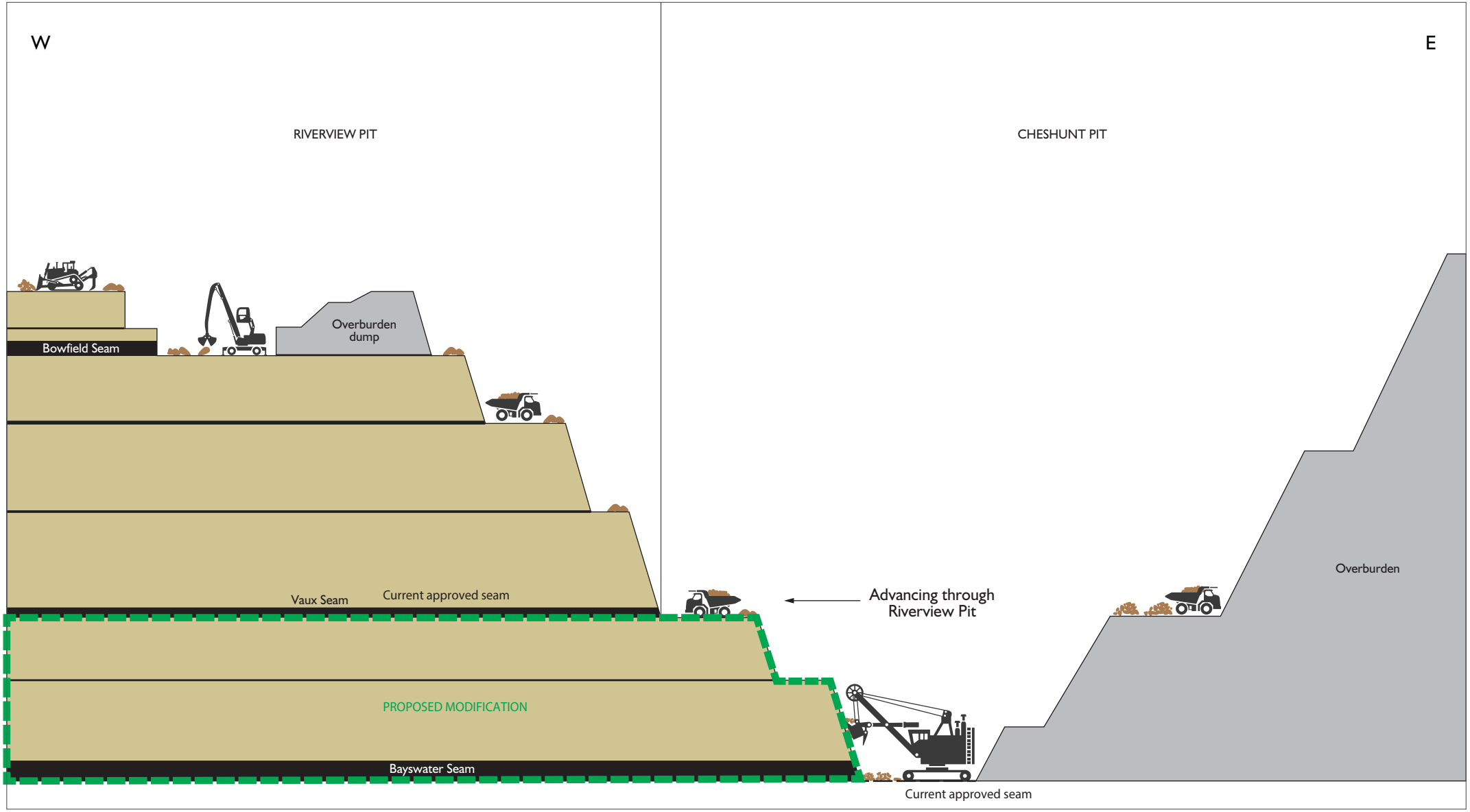
Current and approved operations and infrastructure

HVO South Modification 5
Environmental Assessment
Figure E.2



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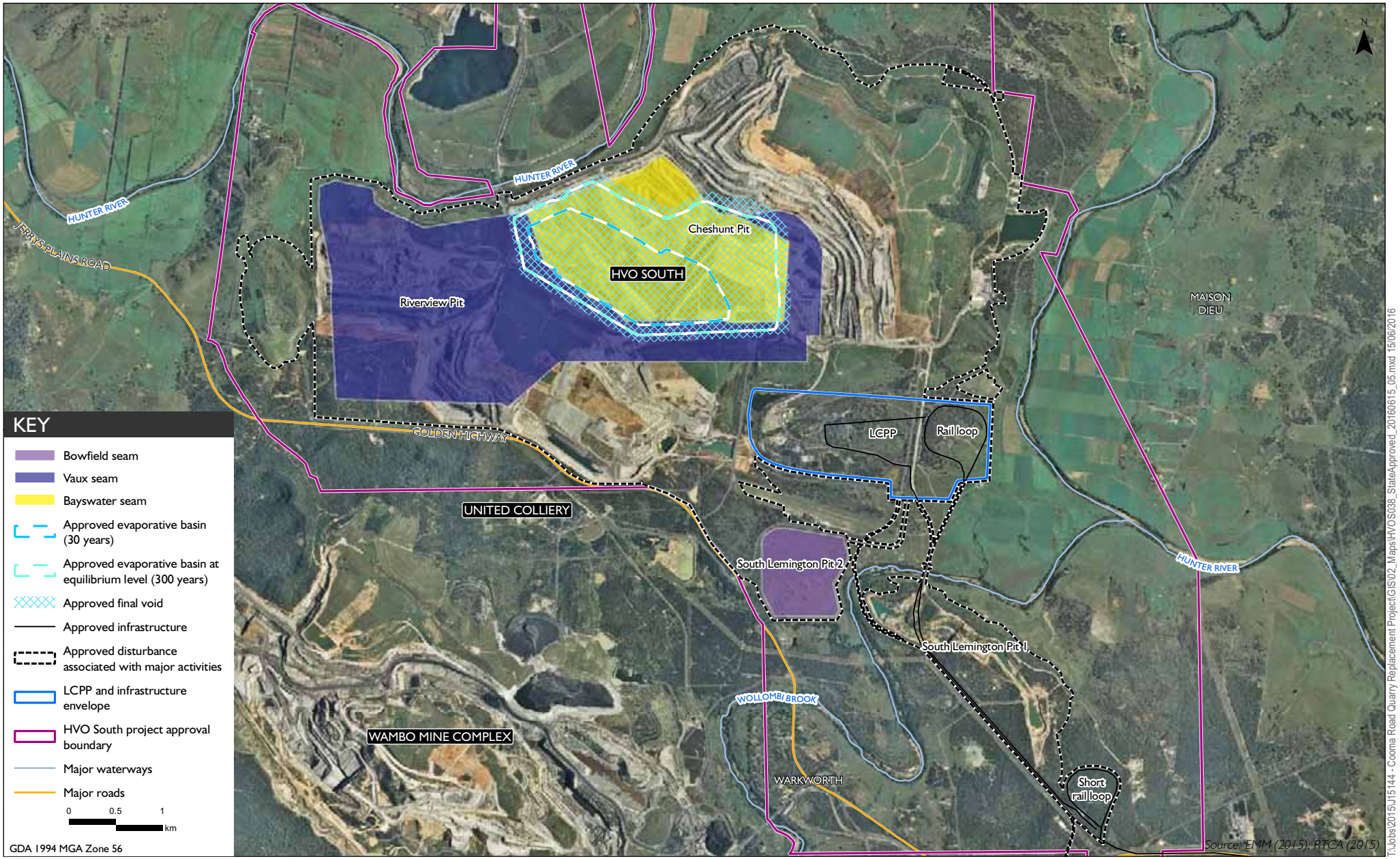
Conceptual mine sequencing

HVO South Modification 5
Environmental Assessment

Figure E.3



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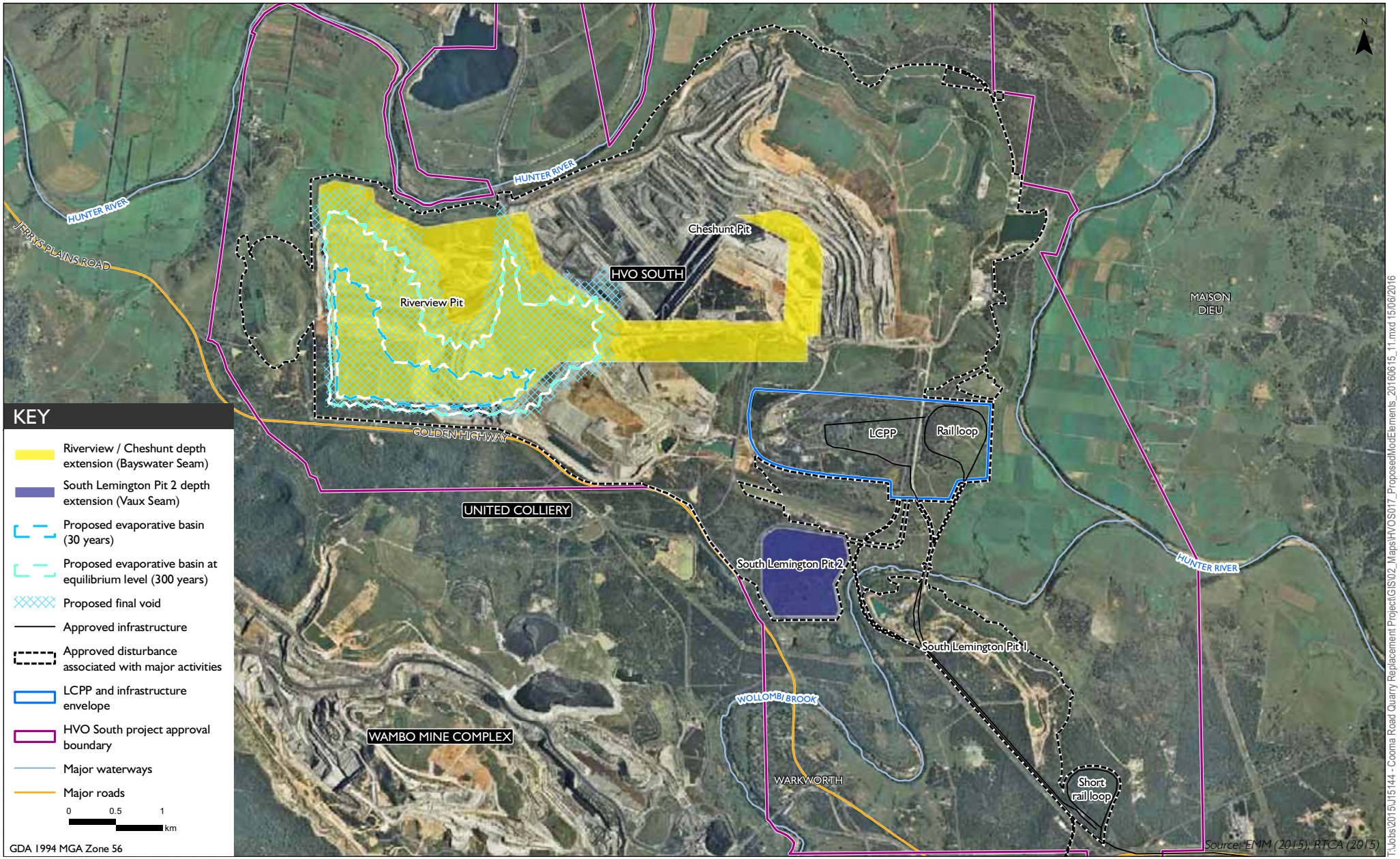
Approved mining seams and final void location

HVO South Modification 5
Environmental Assessment
Figure E.4



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Proposed mining seams and final void location

HVO South Modification 5
Environmental Assessment
Figure E.5

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Appendices

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1 Context

Hunter Valley Operations South (HVO South) has a project approval (PA) 06_0261 (PA 06_0261) (Appendix A) under Section 75J of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

PA 06_0261 authorises mining in four main areas, namely:

- Cheshunt Pit;
- Riverview Pit;
- South Lemington Pit 1; and
- South Lemington Pit 2.

Mine sequencing at HVO South has the Cheshunt and Riverview Pits operating concurrently. The Riverview Pit is designed to extract the coal seams down to the base of the Bowfield. Cheshunt Pit which is approved to mine to the base of the Bayswater seam is designed to advance through the mined areas in Riverview Pit, stepping up from the deeper Bayswater seam to extract the seams from below the Bowfield to the base of the Vaux seam. South Lemington Pits are mined separately to Cheshunt and Riverview and are approved to mine to the base of the Bowfield seam.

HVO South is integrated at an operational level with HVO North (together described as 'HVO') and has the ability to move material and associated equipment around HVO including run-of-mine (ROM) coal, product coal, coal rejects, overburden and water as required.

A modification under Section 75W of the EP&A Act is proposed to enable the Cheshunt Pit to continue mining through the Riverview Pit area extracting the deeper Bayswater seam below the Vaux seam. This is shown conceptually in Figure 1.1. The proposed modification will also enable mining down to the base of the Vaux seam below the Bowfield seam in South Lemington Pit 2.

Mining of the deeper seams will occur within the existing State-approved disturbance footprint. This will avoid any direct impacts on aspects such as biodiversity and Aboriginal heritage. Design of the proposed modification within the constraints of the existing State-approved disturbance footprint necessitates an increase in height in some areas of the overburden emplacement up to 240m above Australian Height Datum (AHD) to accommodate the additional volume of overburden material. The proposed modification has provided an opportunity to redesign the overburden emplacement strategy to incorporate micro-relief design techniques. Although the overburden emplacement will be higher in places, the final landform has been designed to look more consistent with natural landforms in the area. That is the final landform has been designed with slopes, undulations, grassland and vegetation that better replicates and assimilates with the natural landscape in the area.

The proposed modification also seeks to increase the rate of extraction and processing from 16Mtpa to 20Mtpa of ROM coal during peak production.

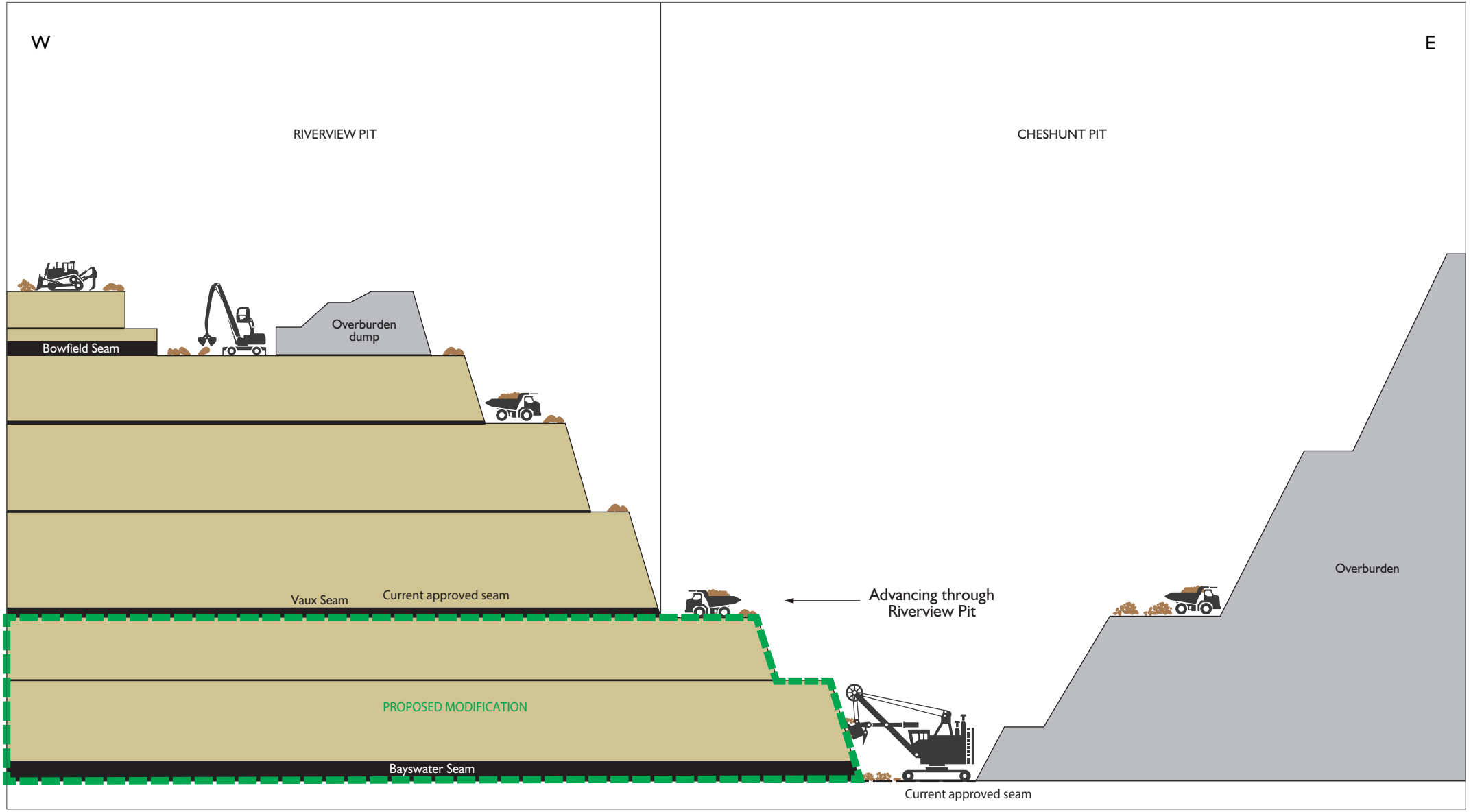
The proposed modification will not change the State-approved footprint of disturbance, mining method, employee numbers, integrated tailings and water management across HVO or extend the project approval period.

The proposed modification will enable the extraction, processing and transportation of a state resource by an existing mining operation. This can be efficiently achieved by the proponent because of the hundreds of millions of dollars invested in the operation and its existing access to product transport and distribution infrastructure such as road, rail and port.

The proposed modification will add to the important regional and local economic and social benefits from the mine's operation. It would add to the accrual of economic benefits to the New South Wales (NSW) Government in the form of royalties, and to the Commonwealth Government in the form of company and income taxes.

As substantiated in Chapters 7 to 15, potential environmental and social impacts arising from the proposed modification will be largely consistent with approved operations. The design of the proposed modification therefore achieves its objective of development of an economic mine plan that minimises adverse potential environmental and social impacts.

The proposal is aligned with the principles of ecologically sustainable development (ESD), consistent with the contemporary legislative requirements and meets all relevant government policies.



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Conceptual mine sequencing

HVO South Modification 5
Environmental Assessment

Figure 1.1

2 Introduction

2.1 Background

HVO is an existing open cut coal mine approximately 24 kilometres (km) north-west of Singleton, NSW (see Figure 2.1). The mining activities at HVO are geographically divided by the Hunter River into HVO North and HVO South. While HVO is managed as one operation, HVO North and HVO South each have separate planning approvals.

Mining operations first commenced at the now HVO over 65 years ago, in 1949. Since its inception, HVO has been, and will continue to be, an important economic driver in the Hunter Valley economy. It provides work for approximately 1,500 employees and contractors, all of which reside in the Hunter region.

HVO South operates under PA 06_0261, which was granted by the then Minister for Planning on 24 March 2009, under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The original approval has been modified on four occasions, predominately relating to administrative matters (see Chapter 4). The mine is within the Singleton local government area (LGA).

The HVO South project approval authorises the Riverview Pit, Cheshunt Pit and South Lemington Pits 1 and 2, Lemington Coal Preparation Plant (LCPP) and all related mining activities and infrastructure such as overburden and tailings emplacement areas as well as options to transport coal from the LCPP to the Wambo rail spur including conveyor or hauling to a short or long loop (see Figure 2.2). There are aspects of project approval PA 06-0261 that are yet to be constructed and, under current market conditions, there are no foreseeable plans to do so. These include rebuilding the LCPP and the option to transport product coal to the Wambo rail spur and recommencing mining in South Lemington Pit 1. The mine plans developed include these aspects to retain flexibility if market conditions change and to enable an assessment of worst case impacts.

Due to the long history of operations at HVO, a significant volume of environmental baseline data has been obtained. Numerous environmental assessments have been undertaken for the activities that have occurred across the site and, as such, the regional and local social, physical and economic environments are well understood. An overview of HVO's approach to environmental management is provided in Section 3.1.4.

Progressive rehabilitation is an important aspect of mining and establishment of the post-mining landform and land uses. Photographs 2.1 and 2.2 show an example of land in the process of being rehabilitated and land where rehabilitation has been completed within HVO South's approved disturbance footprint for agricultural purposes. Rehabilitation at HVO South is described in Chapter 13.

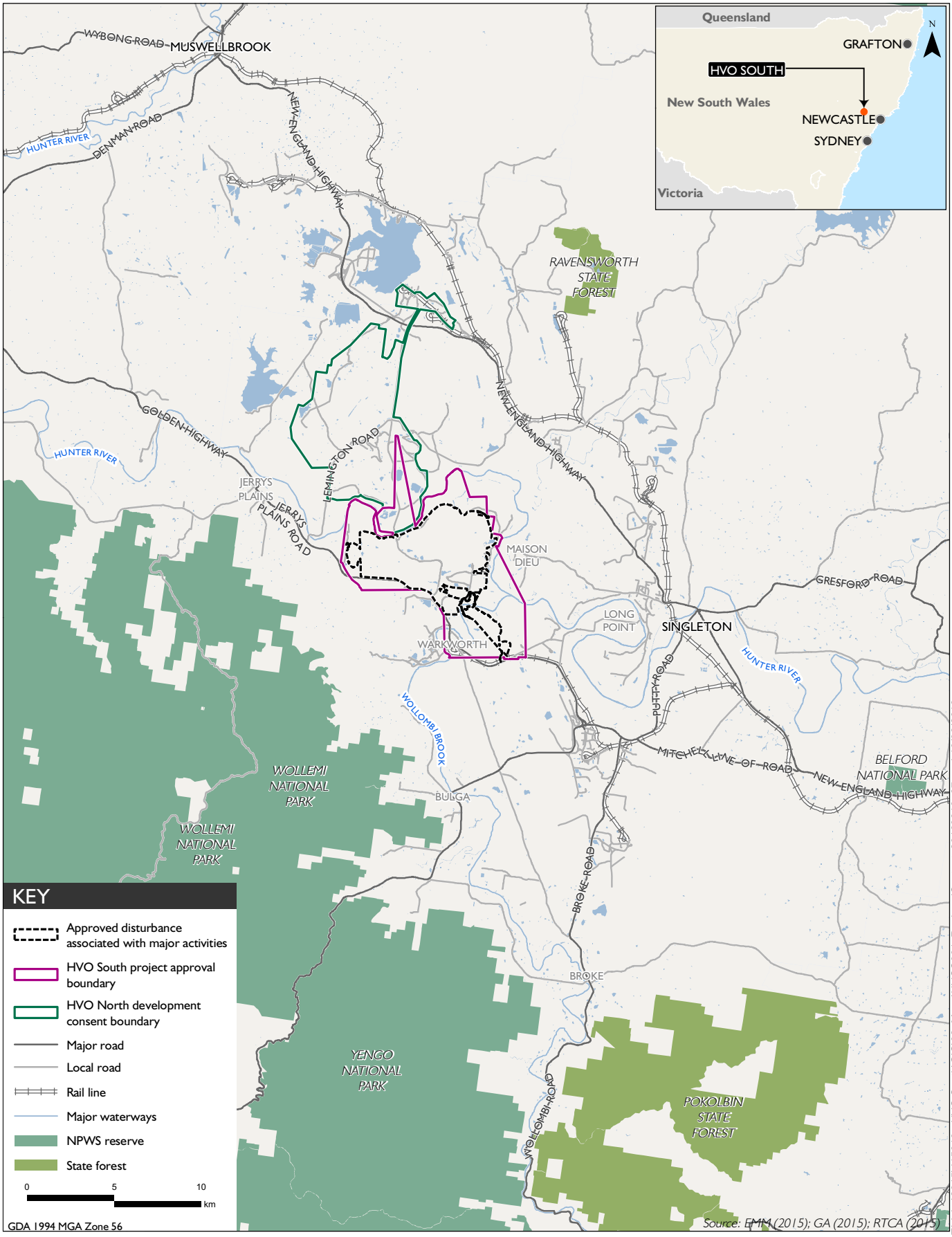
2.2 Local context

The general area surrounding HVO South is comprised of various open cut coal mining operations, agriculture, woodland, national park and rural residential areas. Existing open cut pits, mine-related infrastructure and rehabilitated former mining areas are to the north, south-east and south-west of HVO South. Mine operations include HVO North, Ravensworth Operations (inclusive of Ravensworth West, Ravensworth South and Narama), Warkworth Mine, Wambo Mine and United Colliery. Bayswater power station is to the north-west of HVO North. These features are shown in Figure 2.3.

Grazing and cropping land are to the north-east and west and vegetated areas are immediately to the south of Riverview Pit and south of South Lemington Pit 1 and further afield to the south of Warkworth village. The closest residences are in Maison Dieu to the east, Long Point to the south-east, Warkworth village to the south and Jerrys Plains to the west.

Photograph 2.1 **Example of rehabilitation being progressed at HVO South**

Photograph 2.2 **Rehabilitated land at HVO South**



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Regional context

HVO South Modification 5
Environmental Assessment

Figure 2.1

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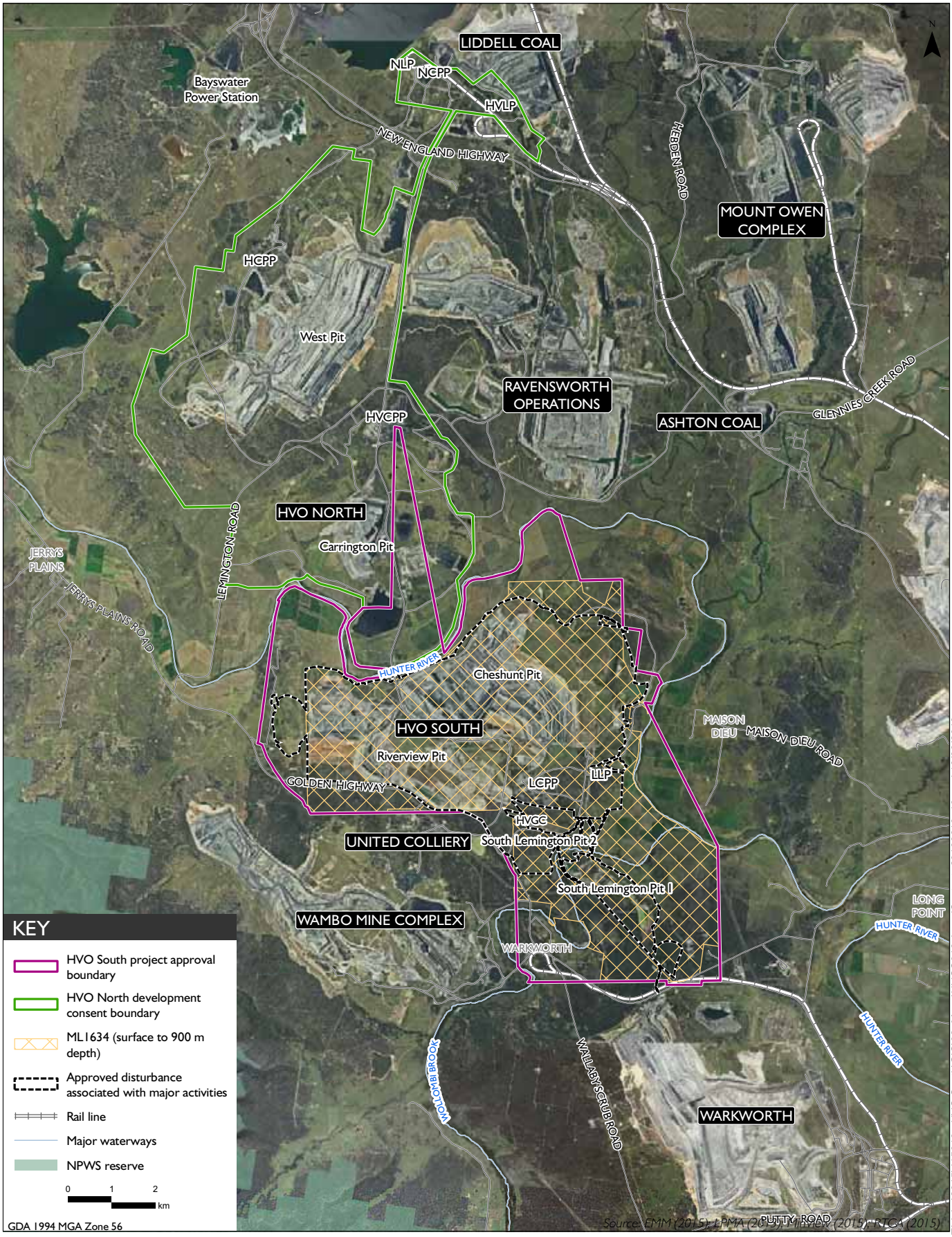
Current and approved operations and infrastructure

HVO South Modification 5
Environmental Assessment
Figure 2.2



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Local context

HVO South Modification 5
Environmental Assessment

Figure 2.3

The surrounding topography is characterised by the steep escarpment to the south-west which forms part of the Wollemi National Park. To the north and east, the terrain is generally open to form the Hunter Valley.

It should be noted that United Collieries Pty Limited (United) and Wambo Coal Pty Limited (Wambo) are currently seeking development consent for a state significant development (SSD) for a joint venture project, the United Wambo Open Cut Coal Mine Project (United Wambo Project), to open cut mine an area south of HVO South and immediately south of the Golden Highway. This is discussed further in Section 3.2.5. The United Wambo Project is shown in Figure 3.7. The Environmental Impact Statement of the United Wambo Project was publically exhibited between 11 August and 22 September 2016.

2.3 Proposed modification overview

The application to modify PA 06_0261 is to allow:

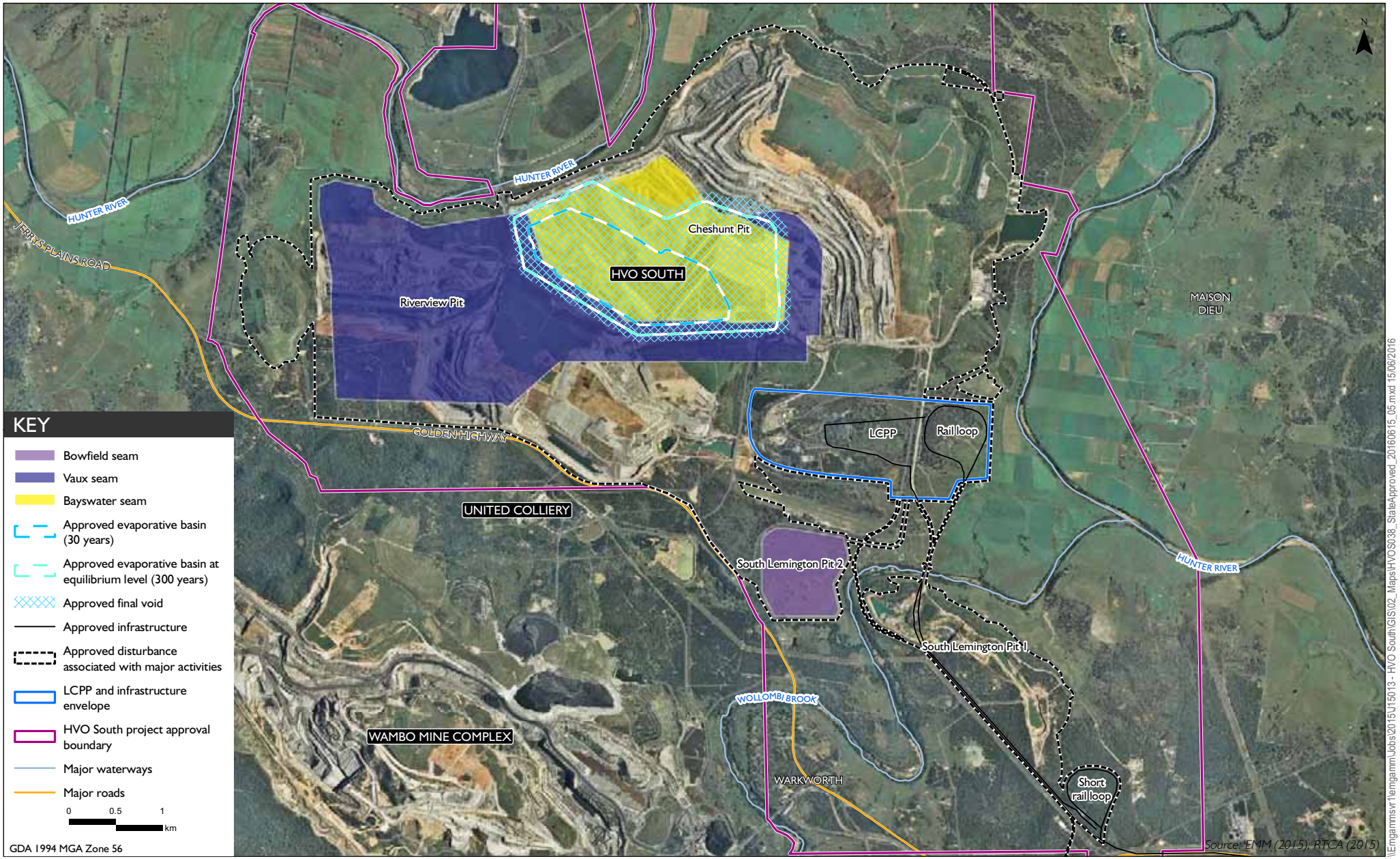
- the progression of mining to the base of the deeper Bayswater seam from Cheshunt Pit into Riverview Pit and mining to the base of the Vaux seam below the Bowfield seam in South Lemington Pit 2;
- a modification to the currently approved overburden emplacement strategy to enable an increase in height in some areas up to 240mAHD and incorporation of micro-relief to provide a more natural final landform;
- an increased rate of extraction from 16Mtpa to 20Mtpa ROM coal at peak production and an increased processing rate of coal extracted from HVO South from 16Mtpa to 20Mtpa of ROM coal across HVO coal preparation plants (CPPs); and
- the update of the Statement of Commitments within PA 06_0261 with removal of commitments that are redundant or inconsistent with measures prescribed in approved management plans. This includes the transition from prescriptive blasting conditions and replacement with contemporary outcome based conditions.

The proposed modification will not change the approved footprint of disturbance, mining method, employee numbers, integrated tailings and water management across HVO or extend the project approval period.

The components listed above are taken collectively to form the modification. This is the fifth modification of PA 06_0261 and therefore the proposal is named 'HVO South - Modification 5' which is referred to herein as the 'proposed modification'. Further detail on the proposed modification is provided in Chapter 3.

Figures 2.4 and 2.5 show the approved and proposed mining depths (at the pits the subject of the proposed modification) and the approved and proposed location of the final void. The 'project area' comprises the depth extension of the Riverview Pit and South Lemington Pit 2 and the modification of the overburden emplacement strategy within the existing approved disturbance area of HVO South. All land the subject of the modification is owned by the proponent. It is noted that minor activities and associated disturbance may occur beyond the boundary of 'disturbance associated with major activities' shown in Figure 2.4 and subsequent figures, as approved. Examples of minor activities include pipeline and discharge point maintenance and light vehicle movements.

The proposed modification will include consolidation of the above with all the operational and environmental activities approved under PA 06_0261, including all aspects of integration with HVO North.



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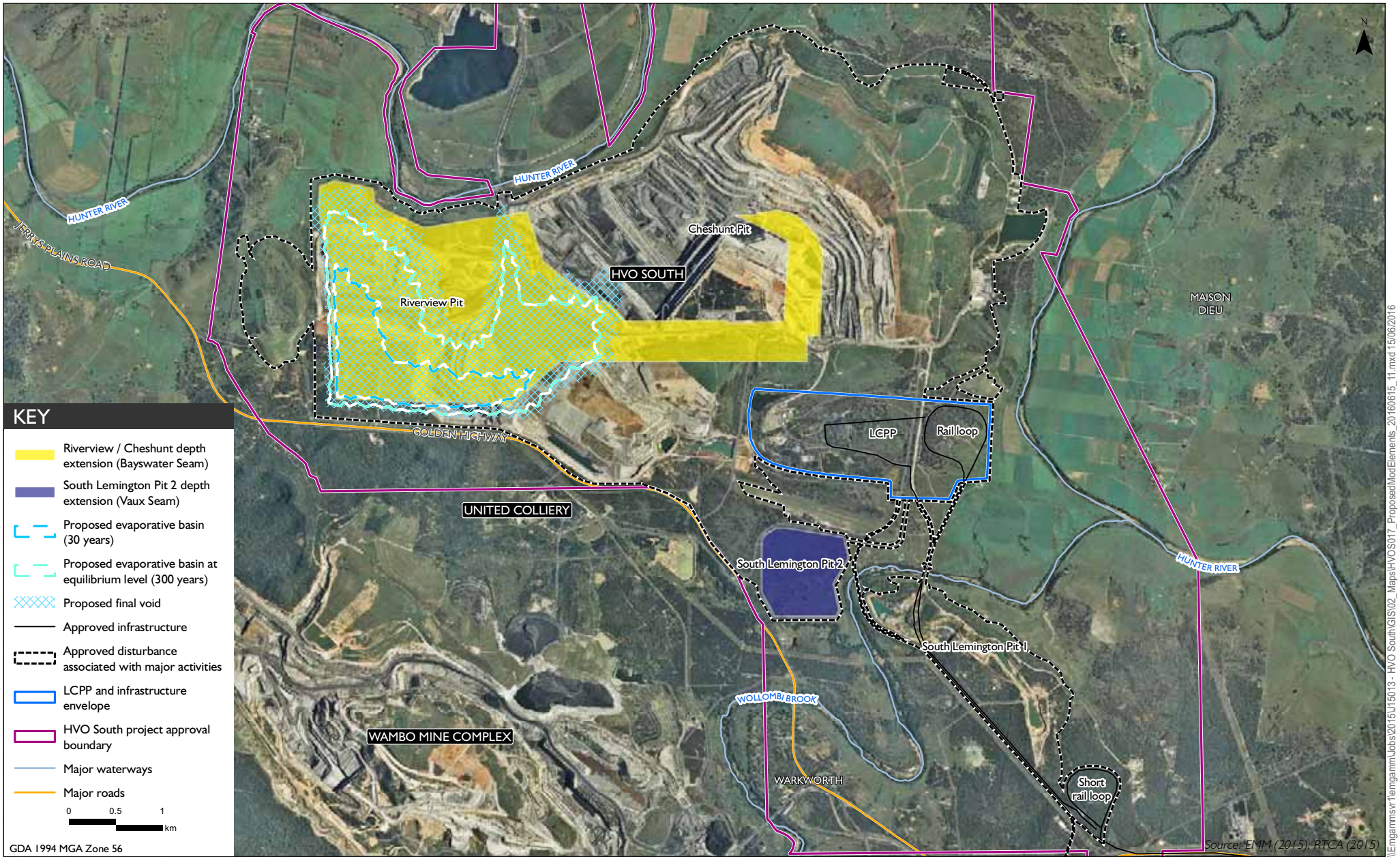
Approved mining seams and final void location

HVO South Modification 5
Environmental Assessment
Figure 2.4



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Proposed mining seams and final void location

HVO South Modification 5
Environmental Assessment
Figure 2.5

2.4 Modification need

The application for PA 06_0261 sought approval for the mining of all coal seams within HVO South to unlimited depth. This is consistent with Mining Lease (ML) 1634 issued under the *Mining Act 1992* (Mining Act) which covers the HVO South mining areas from surface to a depth of 900m (see Figure 2.3). Indicative mine plans presented in the ERM (2008) EA that accompanied the application assessed a mine design that extracted seams at varying depths in the respective pits (as described in Section 3.1.2). The ERM (2008) EA sought qualitatively approval to mine to unlimited depth, however approval was limited to the base of the Bowfield seam within South Lemington Pits; base of the Vaux seam within the Riverview Pit; and base of the Bayswater seam in the Cheshunt Pit as these were the depths assessed.

The proposed modification will enable the Cheshunt Pit to continue mining through the mined areas in Riverview Pit to extract the deeper Bayswater seam below the Vaux seam (see Figure 1.1). It will also enable mining the deeper Vaux seam below the Bowfield seam in South Lemington Pit 2. The proposed modification is therefore consistent with the original intent that previously contemplated depth extensions at HVO South.

Mining of the deeper seams will occur within the existing disturbance footprint avoiding potential direct impacts on aspects such as biodiversity and Aboriginal heritage. It will, however, provide for the implementation of a mine plan that is efficient and flexible.

The final landform requires modification to accommodate the additional overburden needing to be emplaced as a result of access of the deeper coal seams. The proponent has worked to develop a more natural landform using micro-relief design into the post-mining landform design.

The change in the mine design also enables the optimisation of the final void. The optimised final void results in an evaporative basin located further from the Hunter River with a gentler low-wall slope, providing for greater land-use optionality. The proposed indicative final landform has also been shaped to minimise the surface water catchment draining to the void, resulting in a surface water catchment area under the proposed modification slightly smaller than under the current approval. The final void will remain as a groundwater sink in perpetuity which prevents the release of stored water into the Hunter River and Wollombi Brook.

The proposed modification allows for the additional extraction of approximately 56.8Mt of ROM coal to be mined over the existing project approval time limit (23 March 2030) and within the approved disturbance footprint. The proposed increased rate of extraction from 16Mtpa to 20Mtpa of ROM coal during peak production provides HVO South with flexibility for production interactions with HVO North. It is also proposed to increase the processing rate of coal extracted from HVO South from 16Mtpa to 20Mtpa across HVO CPPs.

The modification proposes contemporising the Statement of Commitments with the removal of commitments that are redundant due to the proposed modification or are inconsistent with measures prescribed in approved management plans. This includes the transition to contemporary conditions of approval for best practice blasting. These would align with the best practice blast management plan (BMP) implemented at HVO and improve flexibility in blast management in accordance with current best practice to protect safety of people, property, public infrastructure and livestock. An updated Statement of Commitments is provided in Chapter 16.

2.5 EA purpose

The purpose of this EA is to accompany an application to modify PA 06_0261 under Section 75W of the EP&A Act. This document provides a description of the existing environment, an assessment of the potential impacts resulting from the proposed modification and detailed measures that would be implemented, subject to approval, to avoid and/or minimise potential impacts. The EA provides information to allow the NSW Department of Planning and Environment (DP&E), in consultation with other relevant NSW Government authorities, to assess the merits of the proposed modification and make a recommendation to the Minister for Planning (or delegate) as to whether or not to grant approval.

This EA was prepared by EMM Consulting Pty Limited (EMM), with input from a number of external technical specialists. The study team is presented in Appendix B.

2.6 The proponent

Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the HVO mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied). Coal & Allied operates HVO with management services provided by Rio Tinto Coal Australia. Further information on Rio Tinto Coal Australia can be found at:

http://www.riotintocoalaustralia.com.au/

3 Existing operations and proposed modification

3.1 Existing operations

3.1.1 Overview

Mining methods implemented at HVO South were described in the ERM (2008) EA. A link to the EA is provided below.

http://www.riotinto.com/copperandcoal/documents-10401.aspx?tx=120,7?q=South

The sections below focus on those aspects of the operation proposed to be modified in the context of operations approved under PA 06_0261.

3.1.2 Approved mine plan

i Extraction and emplacement activities

HVO South has approval to extract up to 16Mtpa of ROM coal. Open cut mining is approved within Cheshunt Pit, Riverview Pit and South Lemington Pits 1 and 2. Continuous highwall mining and auger highwall mining are also approved.

Extraction is approved to the base of the Bowfield seam within South Lemington Pits; base of the Vaux seam within the Riverview Pit; and base of the Bayswater seam in the Cheshunt Pit.

The mining process at HVO South comprises:

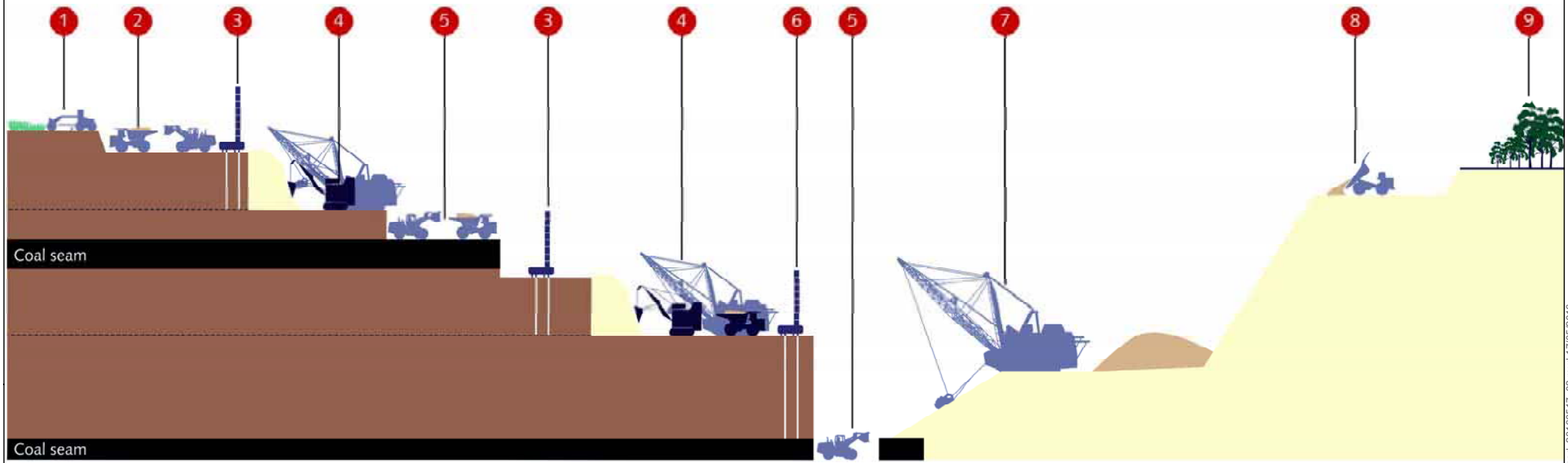
- vegetation stripping and topsoil removal;
- open cut mining to remove overburden, interburden and coal; and
- overburden shaping and rehabilitation.

This process is shown in Figure 3.1 with the direction of current strip mining also shown.

The main sections of Cheshunt Pit are progressing to the south-west towards Riverview Pit. Mining is currently focussed in the Cheshunt and Riverview Pits. Strips within Cheshunt Pit have already reached the approved Bayswater seam with other parts of Cheshunt Pit yet to reach the approved Bayswater seam with the northern section well advanced of its southern section as per the currently approved mine design.

Mining of the western portion of Riverview Pit is progressing to the north and south. Mining is also occurring in the satellite pit in the south-eastern corner of the Riverview Pit. There is no active mining in either of the South Lemington Pits.

Overburden is the term given to the strata between the top most coal seam and the surface which is unsuitable for processing. Interburden is the strata between subsequent coal seams where there are multiple seams, as is the case at HVO South. Both overburden and interburden are ripped, drilled and blasted to allow the material to be removed by dragline, shovel, excavator or front end loader, depending on the thickness. Overburden and interburden are collectively described in this document as overburden.



1. Vegetation clearing and topsoil removal.
2. Overburden removal using front-end loader, shovel or excavator and trucks.
3. Overburden drilling and blasting.
4. Overburden removal using shovel or excavator and trucks or dragline.
5. Coal will be either drilled and blasted or ripped with dozers, depending on the thickness. Coal removal using front-end loader or excavator and trucks.
6. Overburden drilling and blasting, including highwall pre-split and throw blasting.
7. Dragline, shovel, excavator or front-end loader and truck operations.
8. Overburden placed into completed mine areas by trucks.
9. Shaping, topsoiling and revegetation.

Note: only two coal seams shown for indicative purposes

Source: Coal & Allied (2010)

T:\Jobs\2015\J15013 - HVO South\GIS\02_Maps\HVOS026_OpenCutMiningMethod_20160517_02.mxd 17/05/2016

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Open cut mining method

HVO South Modification 5
Environmental Assessment
Figure 3.1

The overburden material is hauled to the overburden emplacement areas. Removal of the overburden opens up the coal seam which is also ripped and excavated. The coal is hauled to the CPP for processing as discussed in Section 3.1.3 below.

Overburden from HVO South mining activities is approved for disposal within all pits and out-of-pit emplacement areas within HVO.

Emplacement of overburden from both Cheshunt and Riverview Pits currently occurs at the western section of the Riverview Pit. Overburden from the Cheshunt Pit is also hauled to the north-east of the current Cheshunt Pit extraction area.

The mine is progressively rehabilitated (noting that some rehabilitation is temporary) to minimise the amount of land that is disturbed and exposed as well as to ensure a stable landform after mining for the community into the future. Rehabilitation and final landform (including final void) are considered further in Chapter 13.

3.1.3 Approved processing

The LCPP at HVO South has been decommissioned. PA 06_0261 authorises the rebuilding of the LCPP at a capacity of 16Mtpa of product coal within an infrastructure envelope.

As noted in Table 3.2 below, PA 06_0261 allows for the transport of ROM coal from all HVO South pits via internal haul roads to all coal processing plants within HVO (Hunter Valley CPP, Howick CPP, Newdell CPP and LCPP) for processing. ROM coal from HVO South may also be transported via an unconstructed overland conveyor to Hunter Valley CPP. PA 06_0261 allows for processing of up to 16Mtpa of ROM coal extracted at HVO South.

Reject material is produced as a by-product of the coal washing process. ROM coal often contains part of the rock strata above and below the coal seam together with thin rock bands within the seam. The rock is removed from the product through the washing process in the CPP. As a result, two forms of reject are produced: coarse reject and fine reject (or tailings). Coarse reject, together with overburden, is hauled to active overburden emplacement areas. Tailings are pumped as slurry from CPPs to tailings storage facilities via pipeline. The movement of rejects between mining areas and facilities across HVO (in either direction) is approved.

PA 06_0261 provides approved options to facilitate transfer of product coal from the LCPP to the Wambo rail spur. These are:

- construction of a coal loader and new rail loop adjacent to the LCPP. The loop and associated rail line would connect to the Wambo rail spur;
- transport of product coal to a new loop proposed for construction south of South Lemington Pit 1. Coal would be hauled by truck to the loop via an existing haul road that runs adjacent to South Lemington Pit 1; and
- construction of a conveyor that would be utilised to transport coal a new loop as described above. The conveyor would be constructed adjacent to the existing haul road described above.

There are no current plans to construct this infrastructure; however, the option has been retained.

3.1.4 Environmental management

Environmental aspects of the integrated operations are managed under Rio Tinto Coal Australia's accredited ISO 14001 Environmental Management System (EMS) which forms part of the Health, Safety, Environment and Quality (HSEQ) Management System.

The HSEQ Management System enables the operations to apply specific tools that support the implementation, execution and effectiveness of the Rio Tinto health, safety and environmental performance standards.

The HSEQ Management System is designed on the principles of continuous improvement and generally follows the layout of common international standards (including ISO14001) and the Plan, Do, Check and Review cycle:

- Plan – identify what is required;
- Do – implement the activities;
- Check – monitor performance through checking and corrective action; and
- Review – evaluate the suitability, adequacy and effectiveness of the system through the management review.

The EMS relies upon an environmental policy, risk register, objectives and targets, a series of regulatory required management plans, a monitoring programme and environmental standards and procedures. The EMS forms the basis for rigorous and consistent environmental management. The EMS is subject to independent compliance audits every three years. The effectiveness of the system has been demonstrated through audits, which have shown a consistent trend in environmental improvement throughout the business, including HVO South.

Environmental management at HVO South is undertaken in accordance with a number of approvals, licences, policies and procedures, including, but not limited to:

- PA 06_0261, as modified;
- EPL 640;
- water licences;
- various mining authorities;
- MOP;
- various environmental management plans; and
- dam licences.

An overview of existing management and monitoring procedures for the various environmental attributes are provided as appropriate in respective chapters in this EA. This includes Chapters 7 and 8 which describe operational management of noise and dust emissions, respectively.

As per existing policies and procedures, an extensive air quality, noise and vibration, surface and groundwater monitoring network supports environmental management at HVO. Two real-time meteorological stations have been installed and are referred to as HVO Corporate Meteorological Station and the Cheshunt Meteorological Station (refer to Figure 8.1). Data obtained from this monitoring network was used in relevant assessments presented in this report.

Independent environmental audits are undertaken every three years to assess the environmental performance of the development and determine whether it is complying with the requirements of the development consent and any other relevant approvals, EPLs and mining leases, including any assessment, plan or programme required under these approvals. The audits also review the adequacy of any strategy, plan or programme required under the above mentioned approvals and recommend measures or actions to improve the environmental performance of the development and/or any strategy, plan or programme. The audits are to be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General (now Secretary) and include consultation with relevant agencies.

An annual review is produced each calendar year in accordance with the existing consent conditions. The operations environmental performance with respect to the relevant monitoring requirements is documented in the annual review and made available to the community on the Coal & Allied website.

3.1.5 Sensitive receptor locations

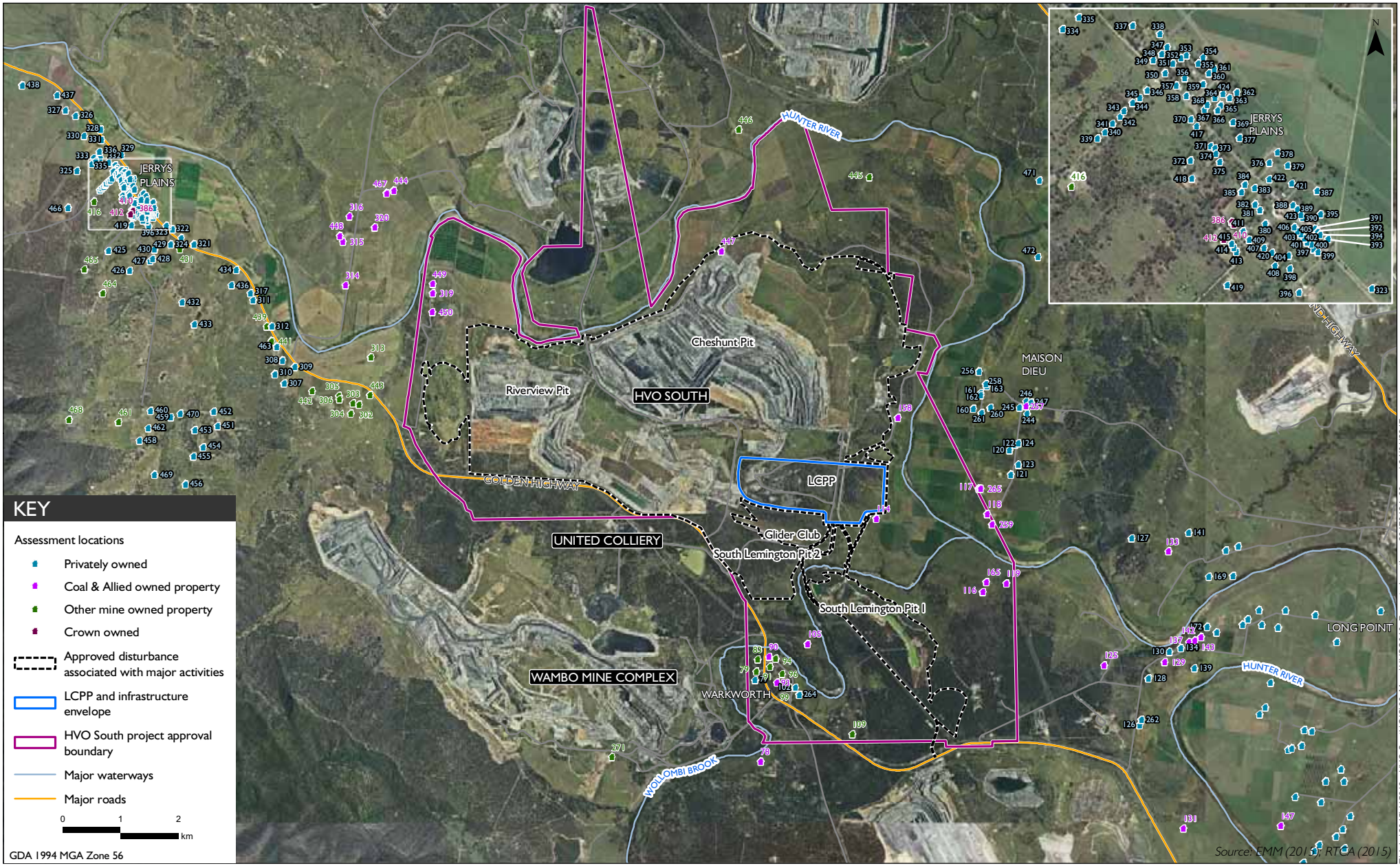
The sensitive receptor assessment locations (privately owned, mine owned and Crown owned) used in the technical studies for the proposed modification are shown in Figure 3.2. The details of land ownership are provided in Appendix C.

This EA has considered impacts at 163 (predominantly privately owned) assessment locations (shown in Figure 3.2) and 58 mine owned assessment locations which is a substantial increase on the 2008 noise and air studies (ERM 2008) which considered 22 representative locations. These 22 representative locations included eight properties in Maison Dieu to the east, five properties in Warkworth village to the south, six properties along Jerrys Plains Road to west and three isolated locations generally to the north. The proposed modification's assessment locations are consistent with the localities used in the ERM (2008) EA.

It should be noted that two of the 163 (predominantly privately owned) assessment locations used in the proposed modification the Warkworth Hall and St Phillip's Church in Warkworth village.

The Hunter Valley Gliding Club (HVGC) is adjacent to South Lemington Pit 2 and operates infrequently as a single grass airstrip. In accordance with Conditions 47 to 49 of the project approval (PA 06_0261), an Amenity Management Plan has been prepared by Coal & Allied in consultation with HVGC as part of the Concessions and Mitigation Agreement, which also acts as a negotiated noise and air quality written agreements in accordance with Conditions 2 and 19 within Schedule 3 of the project approval (PA 06_0261). This plan requires Coal & Allied to manage the HVO South mining operations to meet the relevant noise and dust criteria when notified by the HVGC that the facility will be in use.

In addition to the substantial increase in assessment locations considered in this EA, Coal & Allied has consolidated its dataset for sensitive receptors surrounding its operations in the Hunter Valley (ie HVO and MTW). Therefore, new individual identifiers have been assigned to these assessment locations. Appendix C provides the details of land ownership and their previous identifiers and source assessment documentation.



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Sensitive receptor assessment locations

HVO South Modification 5
Environmental Assessment

Figure 3.2

3.1.6 Properties entitled to voluntary acquisition upon request

A small number of properties are entitled to voluntary acquisition upon request under Condition 1 Schedule 3 of PA 06_0261. Details of the properties are provided in Table 3.1.

Table 3.1 Land subject to acquisition upon request

Receptor number (PA 06_0261)	Receptor number (EA)	Name
16	118	Algie
32	117	Algie (Curlewis)
38	109	Henderson
Keys (vacant land – Lot 2 DP 770905 and Lot 84 DP 753792) – now consolidated as Lot 84 DP 1124139		

Source: PA 06_0261; EMM 2016.

Three of the properties in Table 3.1 have been subsequently acquired. Properties 117 and 118 are now owned by Coal & Allied, and property 109 is owned by Glencore.

The only remaining properties entitled to acquisition upon request are the two vacant lots owned by Keys (Lot 2 DP 7709905 and Lot 84 DP 753792). Since approval was granted in 2009, the landowner has consolidated these two lots into a single parcel of land, referenced as Lot 84 DP 1124139. This consolidation does not affect the existing acquisition rights.

3.2 Proposed modification

3.2.1 Overview

Table 3.2 provides a comparison of the current approved operations and the proposed modification. The components of the proposed modification compared to the existing approval are discussed in the sections below.

Table 3.2 Comparison of key components of the proposed modification with current approval

Key component	Current approval	Proposed modification
Approval period	• Operations at HVO South are approved until 23 March 2030.	• No change to the project approval period.
Mining areas	• Extraction is approved to the base of the Bowfield seam within South Lemington Pits; base of the Vaux seam within the Riverview Pit; and base of the Bayswater seam in the Cheshunt Pit. • Approved disturbance areas are shown in Figure 2.2.	• Extraction to the base of the deeper Bayswater seam in the Riverview Pit. • Extraction to the base of the deeper Vaux seam in South Lemington Pit 2. • No change to approved disturbance areas: mining of the deeper seams will occur within the existing approved disturbance footprint.
Extraction rate	• HVO South has approval to extract up to 16Mtpa of ROM coal.	• Maximum rate of ROM coal extraction increased to 20Mtpa.
ROM coal processing and transport	• The ROM/product coal may be transported from all HVO South pits via internal haul roads to all coal processing plants within HVO (HVCPP, HCPP, NCPP and LCPP) for processing. ROM coal from HVO South can also be transported via overland conveyor to HVCPP.	• No change to transport methods or destinations. • Increase processing of ROM coal to 20Mtpa.

Table 3.2 Comparison of key components of the proposed modification with current approval

Key component	Current approval	Proposed modification
Product coal transport	• Transport product coal by truck or overland conveyor (OLC) from all coal preparation plants to all loading points (LP) (Hunter Valley LP, Newdell LP and Lemington LP and/ adjacent to short rail loop south of South Lemington Pit 1).	• No change to volumes, methods or destination of load out of product coal.
Overburden emplacement	• Ability to dispose of overburden within all pits and out-of-pit emplacement areas within HVO.	• No change to the ability to dispose of overburden within all pits and out-of-pit emplacement areas within HVO.
Coarse reject	• Ability to emplace coarse rejects within overburden emplacement areas across HVO.	• No change to coarse rejects management.
Tailings	• Approved and integrated tailings management with HVO North.	• No change to tailings management.
Water	• Approved and integrated water management with HVO North. • Approved water transfers with other mining operations (eg MTW).	• No change to water management.
Infrastructure	• Infrastructure includes: workshops; vehicle washing facilities; bulk oil and fuel storages and explosive magazines; water and tailings management infrastructure; storage hoppers and crushers; coal stockpiles; LCPP; erection pads; bathhouse; general stores; administration offices; and other facilities and incidental activities.	• Potential upgrades to infrastructure as part of normal operations.
Operating hours	• Continuous operations, 24 hours per day, seven days per week.	• No change to operating hours.
Employee numbers	• Approximately 1,500.	• No change to employee numbers.
Rehabilitation	• Progressive rehabilitation. • Final land use and final landform described in a number of approval documents. Final landform consists of trees and grassland, with height varying across the site up to a maximum of 155mAHD.	• Continued progressive rehabilitation. • Indicative final landform as shown in Figures 13.1 and 13.2 with an increase in height up to 240mAHD in Cheshunt overburden emplacement area on the eastern side of the site required to accommodate micro-relief. The landform has been designed with micro-relief to provide a more natural looking final landform that complements the existing environment. • It also includes relocating the evaporative basin in the void further away from the Hunter River and a reduction in the low-wall slope to enable greater land use optionality.
Final void (including evaporative basin)	• One final void in Cheshunt Pit with an equilibrium water level of 32mAHD estimated to be reached after 250 years (refer to Section 13.2.2).	• One final void in Riverview Pit with an equilibrium water level of 30mAHD estimated to be reached after 300 years (refer to Table 13.3 for further comparison).

3.2.2 Mine plan revisions

i Indicative mine plans

Indicative mine plans for four stages of mining are presented in Figures 3.3 to 3.6. The indicative plans are referred to as Stage 1, Stage 2, Stage 3 and Stage 4, corresponding to nominally Year 2019, Year 2022, Year 2026 and Year 2028, each indicating the approximate time after the anticipated commencement date of operations under the proposed modification in 2017. The final rehabilitated landform is discussed in Chapter 13.

The indicative mine plans were chosen as representative mining snapshots as the basis for technical assessments. The mine plans show the different activities being undertaken within the footprint during that indicative year, including mining, emplacement and rehabilitation.

As currently occurs, mining operations at HVO South will consist of dragline with truck and shovel operations to remove overburden material and extract the coal resources. Overburden emplacement will typically occur behind the progression of the mine extraction with rehabilitation of emplacement areas progressing as soon as practical.

There are three types of rehabilitation areas shown on indicative mine plans in Figures 3.3 to 3.6. These comprise rehabilitation to final landform; active rehabilitation which includes rehabilitation activities for all years between each indicative mine plan snapshot year; and temporary rehabilitation which is rehabilitation on areas that are not yet constructed to final landform but have been temporarily rehabilitated for other reasons, such as dust and visual management purposes.

It is noted that the planned progression of mining is influenced by historical mining activities at HVO South. HVO South as it exists today has resulted from the amalgamation and extension of a number of separate mines. This was reflected by the numerous separate development consents that applied to HVO South (25 separate consents and 10 project modifications) that were consolidated under PA 06_0261. As follows, a number of pits are mined concurrently at HVO South with each pit progressing extraction and emplacement in a particular direction assessed and approved in these separate development consents that were consolidated under PA 06_0261. The current (2016) directions of strip mining activities are shown within the inset in Figure 3.1. Due to the historical nature of amalgamation and extension, mining at HVO South occurs in a number of separate pits with different rates of advancement and subsequent rehabilitation.

The area of disturbance and rehabilitation areas for the four indicative stages of mining (Figures 3.3 to 3.6) are summarised in Table 3.3.

Table 3.3 Disturbance and rehabilitation areas

Mining activity	Area (ha)			
	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**
Active mining	597	728	452	299
Emplacement	788	846	1,008	765
A: Sub-total mining disturbance areas	***1,385***	***1,574***	***1,460***	***1,064***
Infrastructure	159	116	200	205
Water storage	133	58	49	44
B: Sub-total – infrastructure disturbance areas	*292*	*174*	*249*	*249*
C: Total disturbance areas (A + B)	***1,677***	***1,748***	***1,709***	***1,313***
Rehabilitation (active)	26	13	6	99
Rehabilitation (final)	764	926	1,152	1,480
Rehabilitation (temporary)	258	175	44	26
D: Sub-total – rehabilitation areas	***1,048***	***1,114***	***1,202***	***1,605***
Ratio - rehabilitation (D): mining disturbance (A)	**0.76**	**0.71**	**0.82**	**1.5**
Ratio - rehabilitation (D): total disturbance (C)	**0.62**	**0.64**	**0.7**	**1.2**

A review of Table 3.3 indicates that there is a general increase in the rehabilitation to mining disturbance area ratio over time, however there is a small reduction from Stage 1 to Stage 2. This is a result of extending mining to the deeper Bayswater seam in the Riverview Pit which takes a period of time for the subsequent overburden emplacement area behind mining to reach final height in order for it to be available for rehabilitation. The ratio of rehabilitation to total disturbance increases for each progressive stage including from Stage 1 to Stage 2 due to a reduction in in-pit water storage areas.

During operations, alternative mine plans to the indicative plans may be used, provided that the environmental impacts remain within the envelope of effects assessed in this EA. This enables the mining operations to retain some flexibility within the constraints of the identified and assessed environmental envelope. In particular the construction of the LCPP and associated infrastructure represents a significant investment of capital. This capital is unlikely to be available in current market conditions. The construction of the LCPP, associated infrastructure, and the mining of South Lemington Pit 1 are not currently scheduled in the near to mid-term but are included in the mine plans so that worst case impacts can be modelled and assessed.

All four indicative mine plan stages were modelled for the noise assessment to represent plausible worst case snapshots with equipment placed at various locations and heights, representing realistic operating conditions in each of these indicative stages of the mine.

Indicative mine plan Stages 2 and 3 were selected for air quality modelling to represent the worst case operating scenarios in respect of the potential impacts on surrounding receivers from dust emissions as material handling is greatest during these stages and mining generally occurs closest to potentially impacted residences.

An overview of each stage is provided in the following sections.

a. Stage 1

Stage 1 nominally represents operations in 2019.

Extraction is planned to progress from the Cheshunt Pit to the south-west into the central part and south-eastern parts of Riverview Pit in Stage 1. Mining is planned to have been completed in the north of the western portion of Riverview Pit and continue in its south-western corner. No active mining in either of the South Lemington Pits is planned at this stage.

The continued emplacement of overburden in the Cheshunt and Riverview Pits is expected in Stage 1. The raising of the eastern portions of the Cheshunt overburden emplacements area to the final landform heights shown in Figure 13.2 is planned to be substantially completed in Stage 1.

It is planned for rehabilitation to be complete in the north-eastern section of Cheshunt Pit, central portion and north-western section of Riverview Pit and to the west of the LCPP and infrastructure envelope. It is noted that the rehabilitation in Riverview Pit is temporary, as the area will be re-mined, subject to approval of the proposed modification, to enable access of the deeper Bayswater seam. The ratio of rehabilitation to mining disturbance for this indicative stage is 0.76 and the rehabilitation to total disturbance area is approximately 0.62.

Water management infrastructure is described in Section 11.2.3. Figure 3.3 shows larger storages comprising the western section of South Lemington Pit 1, a southern section of Riverview Pit and the eastern limit of the approved disturbance area (referred to as Lake James).

b. Stage 2

Stage 2 nominally represents operations in 2022.

Mining is planned to occur in four areas across HVO South in Stage 2 and mining activities are closest to receivers in the south and south-east during this stage.

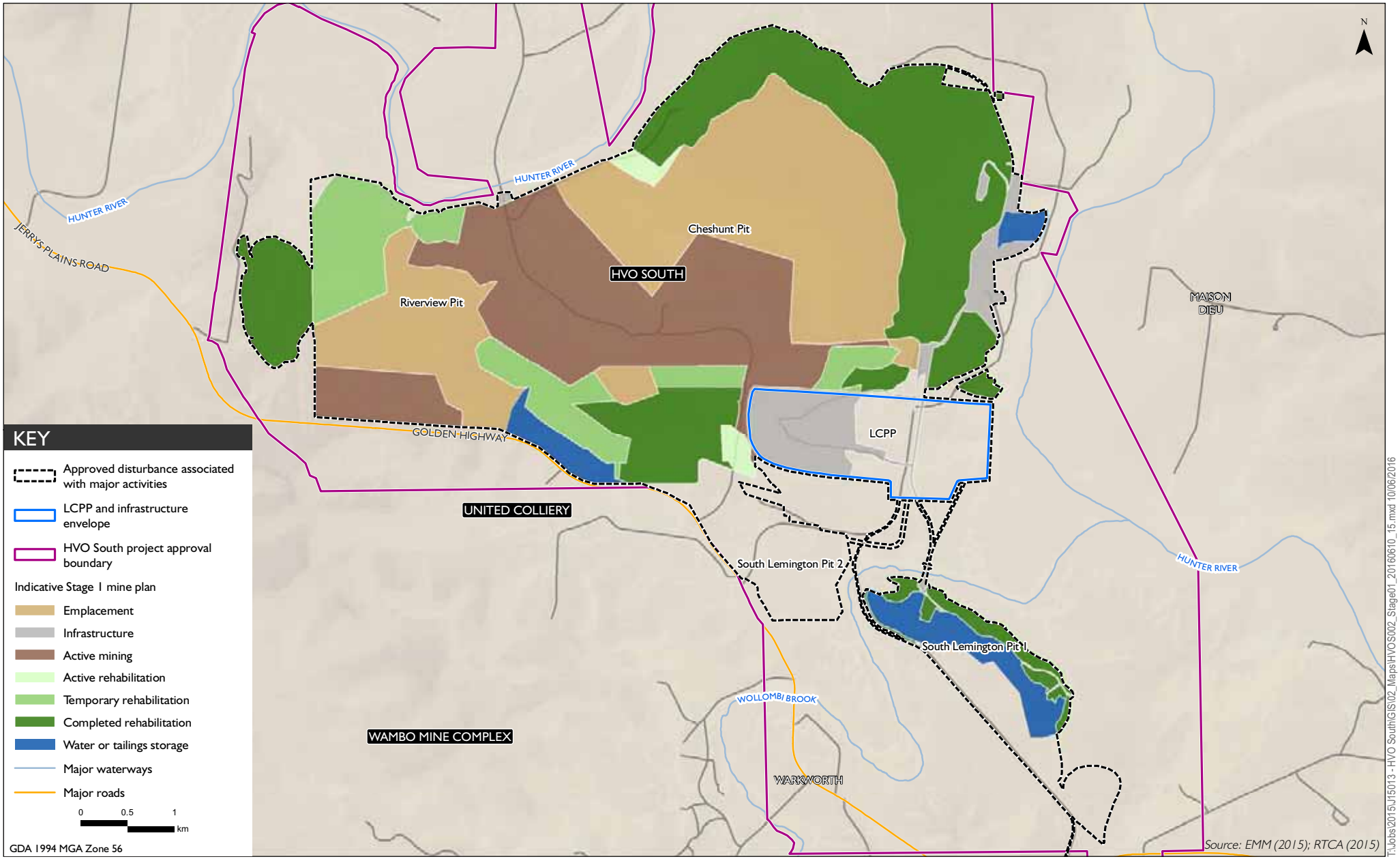
Mining is expected to have commenced in South Lemington Pit 2, with coal being extracted and hauled for processing. Mining is expected to recommence in South Lemington Pit 1 in the south-western section with ROM coal emplaced in the vicinity of the LCPP in preparation for its operation which occurs in Stage 3. South Lemington Pit 1 is expected to have been dewatered and is no longer used for water storage. Mining activities are also planned to continue to progress in the Cheshunt and Riverview Pits.

Overburden removed from the Cheshunt Pit and South Lemington Pit 2 is expected to be generally emplaced behind the progression of these pits.

The area of completed rehabilitation is planned to expand to the north and east of Cheshunt Pit.

There is expected to be a small decrease in the rehabilitation to active mining and emplacement disturbance area ratio when compared with the indicative Stage 1 mine plan (0.71 compared with 0.76). As noted in Section 3.2.2i, this is due to extending mining to the deeper Bayswater seam in Riverview Pit which takes a period of time for the subsequent overburden emplacement areas behind mining to reach final height in order for it to be available for rehabilitation. However, during this period there is a reduction in the in-pit water storage which results in an increase in the rehabilitation to total disturbance ratio (0.62 to 0.64).

Water management infrastructure is described in Section 11.2.3. Larger storages remain as per Stage 1 with the exception of the change of use in South Lemington Pit 1.



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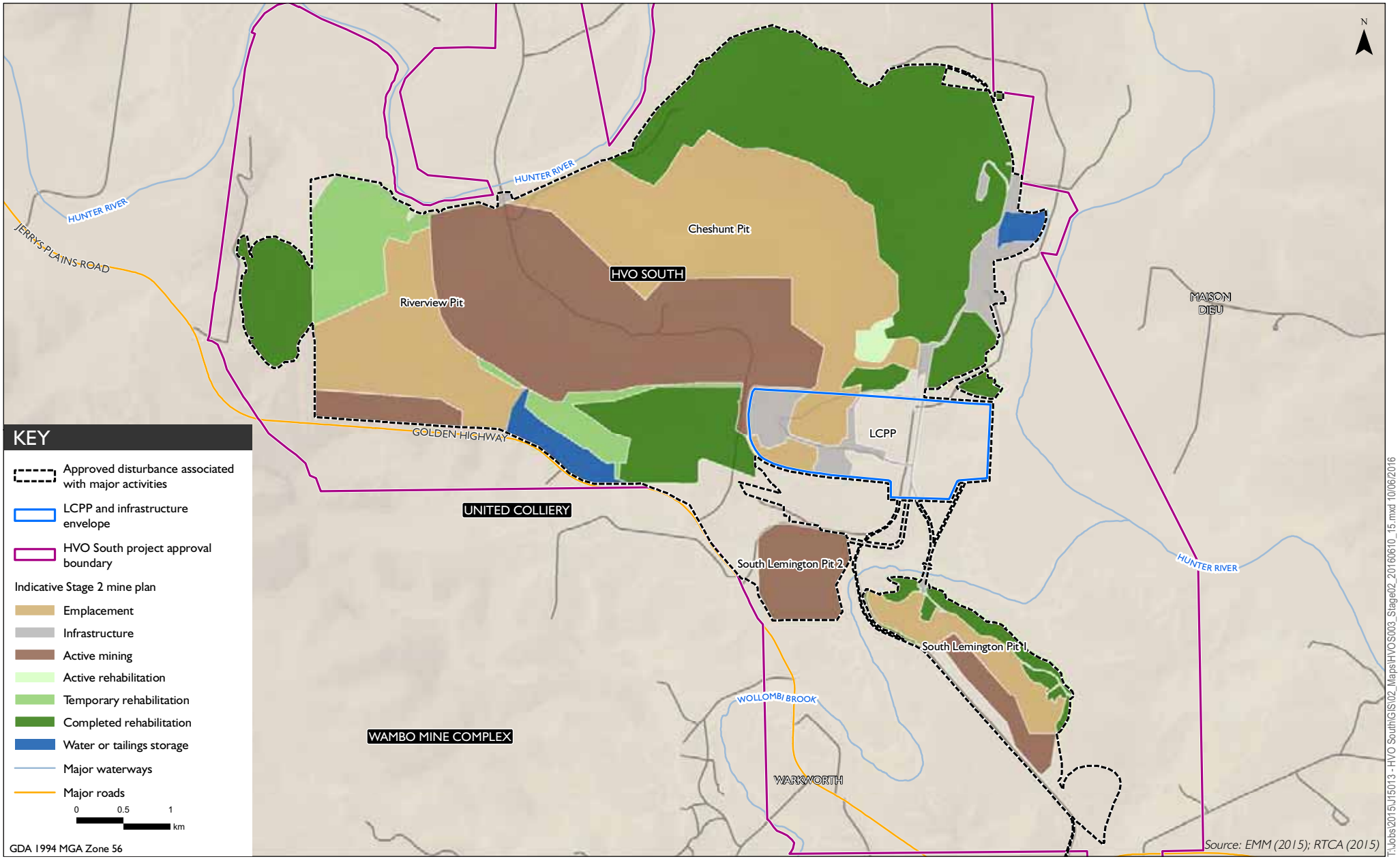
Indicative Stage 1 mine plan

HVO South Modification 5
Environmental Assessment

Figure 3.3



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Indicative Stage 2 mine plan

HVO South Modification 5
Environmental Assessment

Figure 3.4

c. Stage 3

Stage 3 nominally represents operations in 2026.

Cheshunt Pit has progressed into Riverview Pit in the indicative Stage 3 mine plan, mining through the previously mined areas and temporary rehabilitation. Extraction is expected to be limited to the Riverview Pit and the southern section of South Lemington Pit 1 with mining in the Cheshunt Pit and South Lemington Pit 2 completed. Stage 3 generally represents mining closest to the north-western and western residences.

Overburden emplacement is expected to extend to the southern and western parts of Cheshunt Pit, South Lemington Pit 2 and remain in the central part of South Lemington Pit 1.

Completed rehabilitation is planned to extend towards the central parts of Cheshunt Pit.

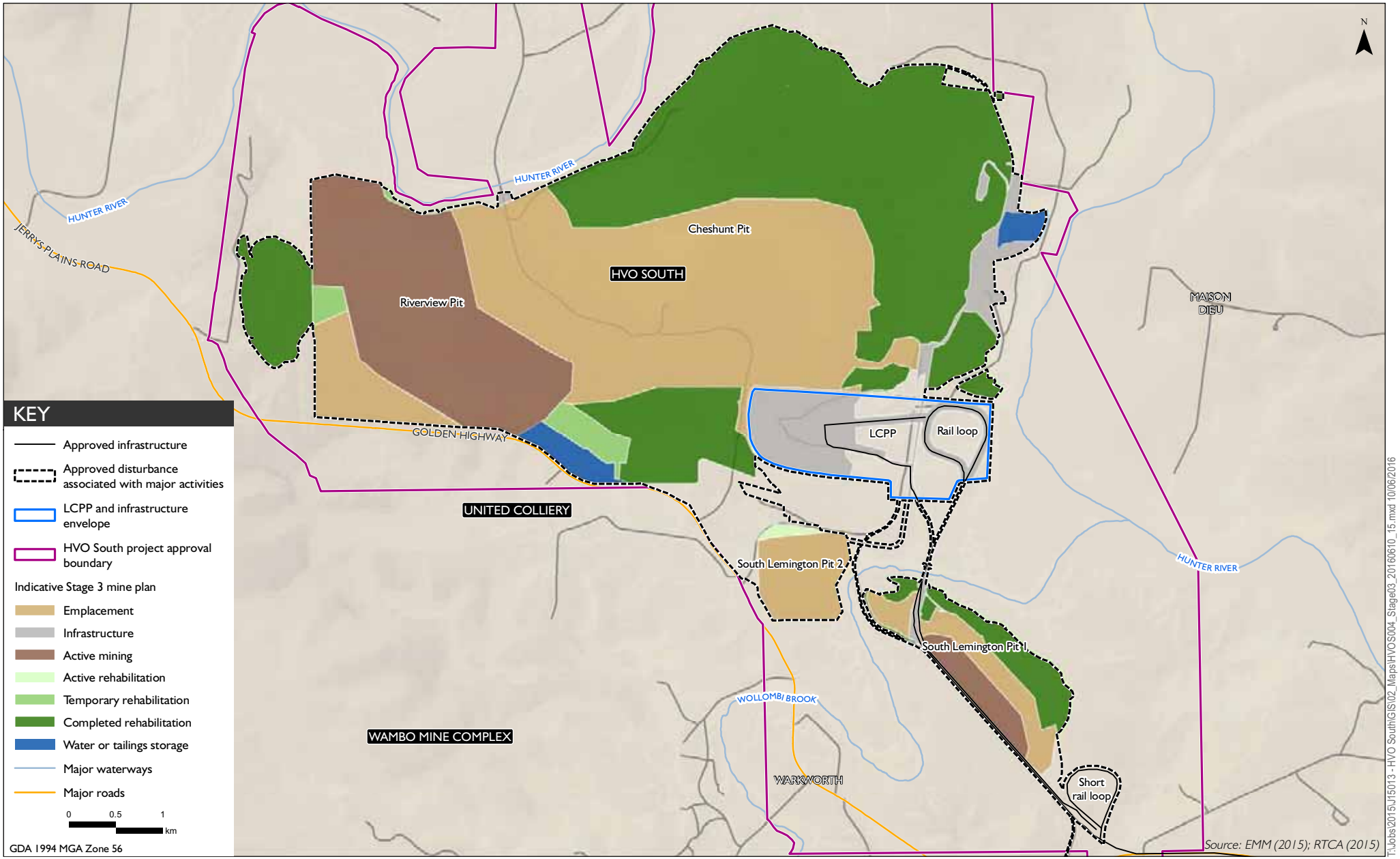
The pit floor of Riverview Pit is expected to have been reached in Stage 3 with the conventional sequence of rehabilitation recommencing. This is reflected in the increase in the rehabilitation to mining disturbance area ratio when compared with the indicative Stage 2 mine plan (0.82 compared with 0.76).

The ratio of rehabilitation to total disturbance area for this indicative stage is approximately 0.7 compared to 0.64 in Stage 2.

As noted in Section 3.2.2i, to enable assessment of potential worst case impacts, the indicative mine plan makes an allowance for the approved LCPP and tailings storage. Under this scenario, the construction period for the LCPP and associated infrastructure has been allowed for between Stages 2 and 3 with operations occurring in Stage 3. Noise from these construction activities will be significantly less than that from mining operations and would, therefore, not contribute to the total overall received noise at surrounding residences. Nonetheless, construction activity was modelled for the noise assessment together with indicative Stage 2 and Stage 3 mining to represent a worst case noise scenario during these stages.

Dust emissions associated with construction activities are typically from a large range of different, short duration activities and arise from a small construction area. The dust emissions can be managed effectively through commonly applied mitigation measures such water sprays. As such, emissions associated with construction activities would generally be too low relative to the rest of the operational coal mine to generate any significant off-site concentrations and are impractical to model in detail. Therefore, the construction activity was not included in the dust model.

As noted in Section 3.1.3, there are three approved options to facilitate the transfer of product coal from the LCPP to the Wambo rail spur of which one will be operating in Stage 3. As a worst case scenario, the noise assessment allowed for hauling of product coal to the rail loop option (and associated train load out) to the south of the South Lemington Pit 1. This would result in the longest haul distances and hence greatest noise emissions of the three options. As discussed in Section 3.1.3, there are no foreseeable plans to construct this infrastructure.



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Indicative Stage 3 mine plan

HVO South Modification 5
Environmental Assessment

Figure 3.5

d. Stage 4

Stage 4 nominally represents operations in 2028.

Extraction is expected to be centred on the south-western section of Riverview Pit in Stage 4, with extraction in all other pits complete.

Emplacement of overburden is planned to be focussed on the central part of the Riverview Pit.

The ratio of rehabilitation to active mining and emplacement disturbance area ratio significantly increases when compared with the indicative Stage 3 mine plan (1.5 compared with 0.82). Areas of completed rehabilitation are expected to cover the north-eastern section of HVO South, the majority of South Lemington Pit 1 and areas to the west of the LCPP and infrastructure envelope and Riverview Pit.

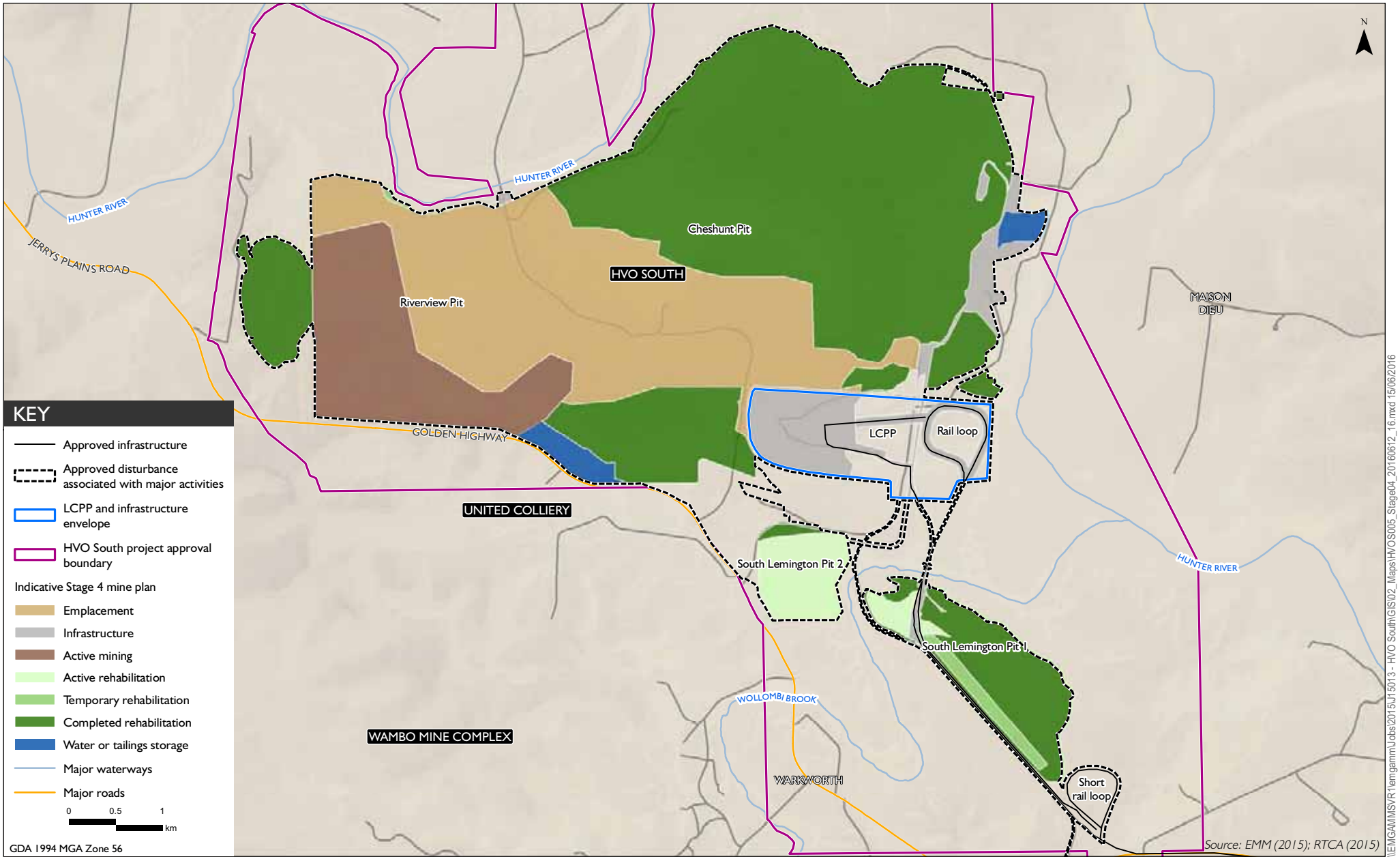
The ratio of rehabilitation to total disturbance area for this indicative stage is approximately 1.2 compared to 0.7 in Stage 3.

ii Extraction rate

An increase in rate of extraction is proposed from 16Mtpa to 20Mtpa ROM coal at peak production. It is noted that the extraction rate will vary throughout the remaining life of the project approval period dependent on market conditions, operational needs and other factors. The indicative mine plans are based on extraction of 12.5Mtpa ROM coal for Stage 1, 20Mtpa in Stages 2 and Stage 3 and 15.5Mtpa ROM coal in Stage 4. These rates may change to enable the mining operations to retain some flexibility within the constraints of the identified and assessed environmental envelope and allow for mining at the peak production of 20Mtpa at any time during the remaining life of the project approval. Changes to extraction rates may change the timing and sequencing of mining and rehabilitation shown in the indicative mine plans, however the indicative plans shown allow for an assessment of worst case impacts.

3.2.3 Processing

An increased processing rate of coal extracted from HVO South from 16Mtpa to 20Mtpa of ROM coal across all HVO CPPs is proposed to align with the proposed increase in the rate of extraction.



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Indicative Stage 4 mine plan

HVO South Modification 5
Environmental Assessment

Figure 3.6

3.2.4 Contemporary Statement of Commitments

Blast management at HVO South is undertaken in accordance with a BMP and the blasting and vibration conditions contained in PA 06_0261. The conditions include that best blasting practice is implemented at the site to protect safety of people, property, public infrastructure and livestock. The BMP incorporates all relevant conditions of PA 06_0261 (together with relevant legislation, EPL conditions and relevant standards and guidelines).

As referenced in Section 2.4, Appendix 3 of PA 06_0261 outlines commitments made in the ERM (2008) EA that, in accordance with Schedule 2 Condition 2(b), apply to the operation of HVO South. In relation to the blasting and vibration, the Statement of Commitments states:

> In addition to the mitigation measures undertaken at HVO for blast and vibration management, blasts will be designed to minimise impacts on neighbouring mine ventilation structures and minimise the potential for fracture development along pit walls to assist with pit wall stability:
>
> - blast vibration will be managed through design and modelling;
> - bench heights will be managed to not significantly exceed 15m;
> - no throw blasts will take place adjacent to final walls;
> - high density explosives will be toe loaded;
> - blast monitoring and post blast analysis will be undertaken where required;
> - presplit blasting will be implemented on final walls where this indicates improved wall conditions; and
> - visual monitoring by way of regular highwall and pit inspections will be undertaken.

As part of the proposed modification the blasting and vibration commitments from the ERM (2008) EA Statement of Commitments are requested to be removed and replaced with contemporary conditions of approval which require best blasting practice to be implemented as currently occurs at HVO South (refer to Section 2.4). The contemporary conditions are described in Section 8.3.2vi.

There are a number of commitments made in the ERM (2008) EA that are now inconsistent with measures prescribed in approved management plans. It is proposed that these commitments are removed as shown in Chapter 16.

3.2.5 Interactions with the United Wambo Project

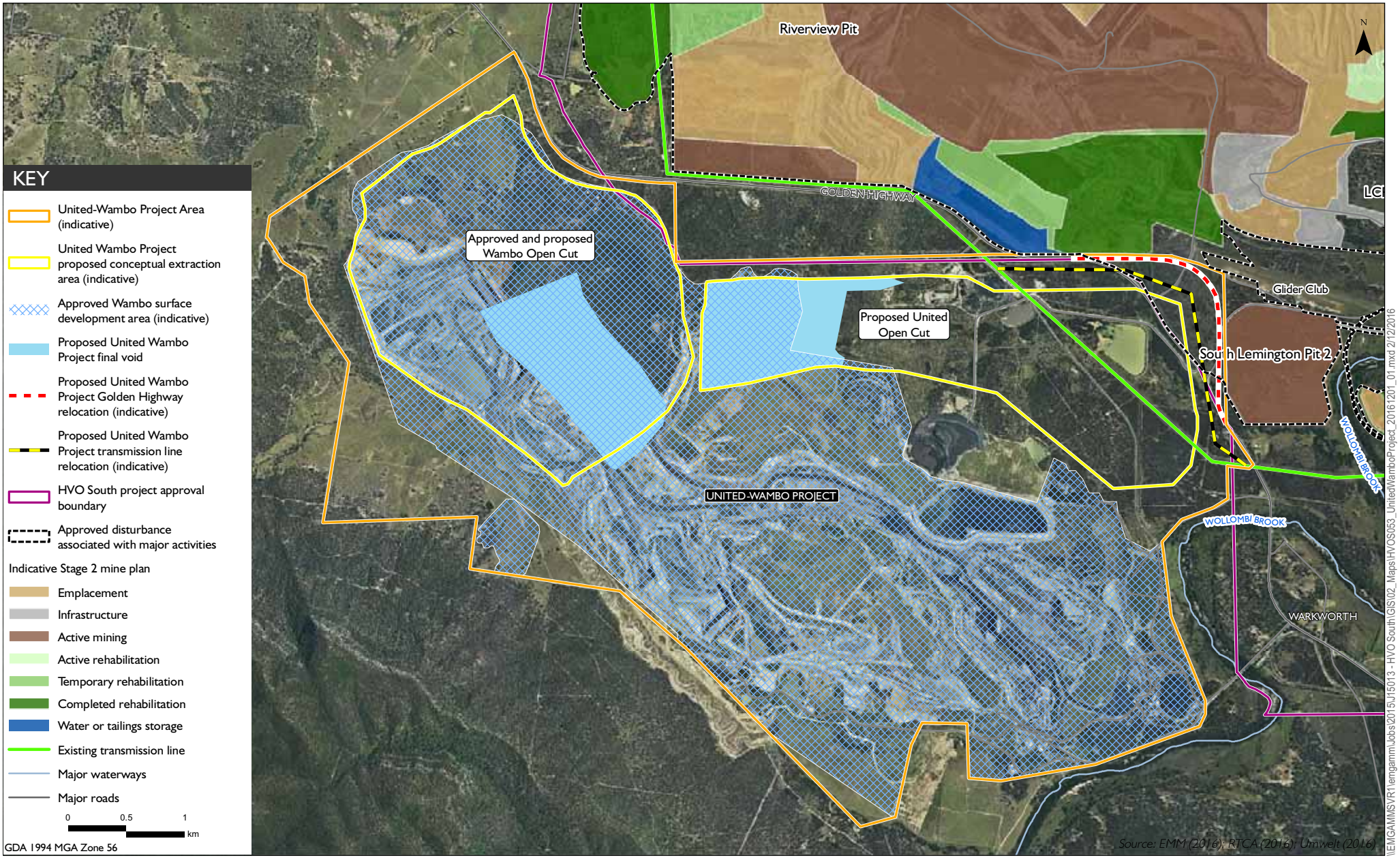
The United Wambo Project proposes to mine an area south of HVO South and immediately south of the Golden Highway as shown in Figure 3.7. The SSD application seeks development consent to mine up to 10Mtpa of ROM coal for 23 years. There will be no change to the currently approved maximum production rate at the Wambo CHPP of 14.7Mtpa ROM coal. It will combine the existing open cut operations at Wambo with a proposed new open cut coal mine at United under a Joint Venture arrangement. The existing Wambo underground mine is not part of the United Wambo Project and will continue to operate separately under its existing development consent. The United Wambo Project EIS was publically exhibited from 11 August 2016 to 22 September 2016.

The primary components of the United Wambo Project are:

- open cut mining within a new pit immediately south of the Golden Highway. The outer extent of this pit shell will be approximately 300m from South Lemington Pit 2;
- ongoing mining of the approved Wambo Open Cut with a proposed minor surface boundary extension in addition to a depth increase to maximise coal recovery; and
- a number of changes to existing mining and public infrastructure, such as realignment of a 2km section of the Golden Highway, approximately 55m from South Lemington Pit 2 (some 65m closer than the current alignment), and relocation of a 330kV transmission line, approximately 165m from South Lemington Pit 2.

This EA has considered the information contained within the publically exhibited EIS of the United Wambo with regard to potential cumulative impacts. Discussion and conclusions of potential cumulative impacts for noise and vibration, air quality, visual amenity and groundwater are discussed in Chapters 7, 8, 9 and 10, respectively.

In summary, it is considered that, should both projects be approved, the potential for cumulative impacts to result for the interaction of the proposed modification with the United Wambo Project is minimal.



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Proposed modification and United Wambo Project

HVO South Modification 5
Environmental Assessment

Figure 3.7

3.3 Alternatives considered

3.3.1 Optimisation process to avoid and minimise impacts

When designing the indicative mine plans for the proposed modification, HVO South underwent a mine plan review process which considered avoidance and minimisation of environmental and amenity impacts on surrounding sensitive receptors as its guiding design principles.

An opportunities and constraints analysis of conceptual mine plans for HVO South was undertaken by technical specialists. The main objective of the analysis was to enable the operators to make informed decisions on the proposed modification of the development consent and the scope of mining activities to be addressed by that modification and for recommendations to be further considered in the mine planning process.

Specialists' recommendations formed the basis of a series of workshops between mine planners, approvals team and technical specialists to facilitate optimisation of the mine plan to avoid and minimise environmental and amenity impacts on surrounding receptors, with particular focus given to noise, air quality and visual amenity. On completion of the preliminary final mine plan, technical specialists again reviewed the mine plans with consideration to potential impacts prior to their finalisation.

The extensive analysis resulted in improvements in the mine plan design. For example, the development of the proposed modification's mine plan to date has realised the following:

- no extension to approved mining disturbance areas and utilisation of the approved disturbance footprint by accessing the deeper coal seams;
- micro-relief incorporated into overburden emplacement area design with consideration given to sensitive residences to the west (Jerrys Plains) and east (Maison Dieu) as well as the Hunter Valley Glider Club;
- emplacement of the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the nearby Wollemi National Park for sensitive receivers to the east of HVO South.
- emplacement of material further north in the Cheshunt emplacement areas also results in reduced potential for noise and air quality impacts on sensitive receivers to the east;
- mining strip alignment to minimise potential noise emissions received at Jerrys Plains;
- increased distance between the Hunter River and the proposed evaporative basin within the final void;
- minimisation of surface water catchment area draining to the final void; and
- reduction in the low-wall slope to enable greater land use optionality within the final void.

The analysis has provided a platform for the later, detailed assessment of the key environmental matters contained within this EA.

3.3.2 Design considerations

As described in Section 2.4, the application for PA 06_0261 sought approval for the mining of all coal seams within HVO South to unlimited depth as outlined in the ERM (2008) EA. The proposed modification is a logical step towards the previously contemplated depth extensions at HVO South.

Chapter 4 of the ERM (2008) EA details alternatives that were considered for HVO South. Options considered related to:

- mining areas and approach, including: extension of open cut mining in Cheshunt Pit, including 50m closer to the limit of the Hunter River alluvium; and combining highwall, auger, punch longwall and conventional longwall mining of areas covering much of HVO South;
- final void, including two final voids, either within Cheshunt Pit and South Lemington Pit 1, or Cheshunt Pit and Riverview Pit;
- tailings disposal/management, including: in-pit co-disposal of fine and coarse reject; and ability to reprocess tailings; and
- product coal transport, including truck haulage or conveyor transport of product coal from LCPP direct to Wambo rail spur.

3.3.3 Not proceeding with the proposed modification

The ‘do nothing’ option would avoid the environmental impacts under the proposed modification which are, notably, largely consistent with those under approved operations.

The 'do-nothing' option would not allow 56.8Mt of ROM coal to be extracted from HVO South and provide flexibility to increase the mining rate from 16Mtpa to 20Mtpa of ROM coal during peak production. Additionally, HVO South would not realise the opportunity to implement methods to access deeper coal seams within the same disturbance footprint through operational efficiencies. The economic benefits of the additional coal produced during the remaining project approval would not be realised.

Although there will be an increase in emplacement height in some areas to accommodate the additional volume of overburden material, this provides an opportunity to develop a more natural landscape into the post mining landform design using micro-relief design techniques. Further, the increased distance between the Hunter River and the proposed evaporative basin and the reduction in the low-wall slope to enable greater land use optionality within the void would not occur.

4 Legislative considerations

4.1 Introduction

This chapter describes the relevant Commonwealth and State legislation and regulatory framework under which the proposed modification has been assessed and will be determined.

4.2 Planning approval history

PA 06_0261 was granted on 24 March 2009 by the then NSW Minister for Planning. The project, amongst other things, consolidated 25 separate consents and 10 project modifications that applied to HVO South with a single project approval. PA 06_0261 has been modified four times with the modifications summarised below.

- Modification 1 approved on 17 December 2009: modification of project elements related to the storage dam Lake James and other administrative amendments.
- Modification 2 approved on 3 February 2012: the reallocation of 140ha of remnant woodland vegetation and native enhancement areas within the Archerfield Biodiversity Enhancement Area to an alternative site within the Goulburn River Biodiversity Area.
- Modification 3 approved on 31 October 2012: administrative amendments.
- Modification 4 approved on 31 October 2012: the dedication of HVO South land as offsets for other mines.

The proposed modification the subject of the current modification application is, therefore, Modification 5.

4.3 State approvals

4.3.1 NSW Environmental Planning and Assessment Act 1979

PA 06_0261 was granted under Part 3A of the EP&A Act. It was deemed a 'major project' by the provisions of Clause 6 and Schedule 1 of the *State Environmental Planning Policy (Major Development) 2005* (Major Development SEPP). The consent authority for 'major projects' was then the Minister for Planning. At the time, an approved Part 3A major project could be modified under section 75W of the EP&A Act.

Part 3A was repealed by the *Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011* (Part 3A Repeal Act). However, transitional provisions were introduced (Schedule 6A of the EP&A Act) enabling a 'transitional Part 3A project' to continue to be subject to Part 3A of the EP&A Act (as in force immediately before the repeal and as modified by the Part 3A Repeal Act). Transitional Part 3A projects include projects that were the subject of an existing approval under Part 3A. Therefore, HVO South (PA 06_0261) is a transitional Part 3A project and the proposed modification may be made under section 75W of the EP&A Act which continues to apply to HVO South. Section 75W enables a proponent to request the Minister (or delegate) to modify a project approval granted under Part 3A.

Section 75W states:

(1) In this section:

Minister's approval means an approval to carry out a project under this Part, and includes an approval of a concept plan.

modification of approval means changing the terms of a Minister's approval, including:

(a) revoking or varying a condition of the approval or imposing an additional condition of the approval, and

(b) changing the terms of any determination made by the Minister under Division 3 in connection with the approval.

(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.

(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.

(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.

Clause 2(8) of Schedule 6A to the EP&A Act states that a transitional Part 3A project is not SSD or State significant infrastructure (SSI), unless it becomes SSD or SSI and ceases to be a transitional Part 3A project.

The proposed modification is considered to be consistent with the objects of the EP&A Act as demonstrated in Section 17.3.

4.3.2 Other State legislation

HVO South has an existing ML 1634 issued under the NSW Mining Act. The extent of ML 1634 is shown in Figure 2.3. The lease covers the surface to a depth of 900m. The increase in extraction depth proposed is covered by the existing ML 1634 and, therefore, no extension is required for the lease area.

The NSW *Protection of the Environment Operations Act 1997* (POEO Act) is the principal NSW environmental protection legislation and is administered by the NSW Environment Protection Authority (EPA). HVO (which includes HVO South) has an existing EPL 640 issued under the POEO Act.

The NSW *Water Act 1912* (Water Act) and NSW *Water Management Act 2000* (WM Act) regulate the use of and interference with surface and groundwater in NSW. The WM Act applies to water sources where a water sharing plan (WSP) is in force.

4.3.3 Environmental planning instruments

Prior to the repeal of Part 3A, environmental planning instruments other than SEPPs did not apply to an approved Part 3A project by virtue of Section 75R(3) of the EP&A Act. However, Section 75J(3) of the EP&A Act stated that the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of Section 75R) apply to the project if approved.

The relevant environmental planning instruments are considered below.

i State Environmental Planning Policy (Major Development) 2005

The Major Development SEPP previously defined classes of development to which Part 3A of the EP&A Act applied. The Major Development SEPP was amended by *State Environmental Planning Policy (State and Regional Development)* 2011 (the S&RD SEPP) when Part 3A was repealed, though it is still relevant to the proposed modification as it continues to apply to transitional Part 3A projects. Prior to the repeal of Part 3A of the EP&A Act, Clause 6 of the Major Development SEPP stated:

> (1) Development that, in the opinion of the Minister, is development of a kind:
>
> (a) that is described in Schedule 1 or 2, or
>
> …
>
> is declared to be a project to which Part 3A of the Act applies.

Coal mining was a form of development described in Schedule 1 of the Major Development SEPP and, therefore, Part 3A of the EP&A Act applied to the project approval.

ii State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of the State. The Mining SEPP establishes appropriate planning controls to, amongst other things, encourage ESD. The Mining SEPP has limited application to the modification application but remains a relevant consideration.

The proposed modification is consistent with the aims of the Mining SEPP which are:

> ... in recognition of the importance to New South Wales of mining, petroleum production and extractive industries:
>
> (a) to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and
>
> (b) to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and
>
> (b1) to promote the development of significant mineral resources, and

(c) to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources, and

(d) to establish a gateway assessment process for certain mining and petroleum (oil and gas) development:

(i) to recognise the importance of agricultural resources, and

(ii) to ensure protection of strategic agricultural land and water resources, and

(iii) to ensure a balanced use of land by potentially competing industries, and

(iv) to provide for the sustainable growth of mining, petroleum and agricultural industries.

Part 3 of the Mining SEPP identifies matters to be considered in development applications for mining, petroleum and extractive industries. Clause 12AB of the Mining SEPP identifies non-discretionary development standards for mining. Subclause (1) states that if a proposed development for the purposes of mining satisfies a development standard set out in this clause, the consent authority cannot require more onerous standards for those matters but does not prevent the consent authority granting consent even though any such standard is not complied with. It is noted that this is a section 75W application and, accordingly, such non-discretionary development standards do not strictly apply to the application, but remain relevant considerations that can be taken into account in determining the application.

The proposed modification satisfies the non-discretionary development standards for mining as detailed in Table 4.1 and described further in the relevant chapters and technical studies.

Table 4.1 Assessment against Mining SEPP non-discretionary development standards for mining

Development standard	Comments on compliance
The development does not result in a cumulative amenity noise level greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings.	The Mining SEPP (clause 12AB(3)) non-discretionary standard for acceptable night-time (ie amenity) criterion of 40 dB $LA_{eq,9hour}$ is met at all but one assessment location. This location (assessment location 77) is in Warkworth village and already entitled to voluntary acquisition under Wambo Mine (refer to Condition 3 of Schedule 3 of the project approval (PA 06_0261)). HVO South's contribution at this location is predicted to be between one and four per cent of all expected noise levels (see Chapter 7). Consideration was also given to the United Wambo Project with additional cumulative impacts on private dwellings unlikely.

Table 4.1 Assessment against Mining SEPP non-discretionary development standards for mining

Development standard	Comments on compliance
The development does not result in a cumulative annual average level greater than 30µg/m^3 of PM_{10} for private dwellings.	The Mining SEPP (clause 12AB(4)) non-discretionary standard with respect to cumulative air quality at private dwellings is met at all but two assessment locations. These locations (assessment location 77 and 471) are in Warkworth village and south-west of Camberwell village, respectively. Assessment 77 is already entitled to voluntary acquisition under Wambo Mine (refer to Condition 3 of Schedule 3 of the project approval (PA 06_0261)) and Warkworth Mine (see Chapter 8). Assessment location 471 is already entitled to voluntary acquisition under Ashton Coal's South East Open Cut project. Consideration was also given to the United Wambo Project with additional cumulative impacts on private dwellings unlikely.
Airblast overpressure caused by the development does not exceed: (a) 120dB (Lin Peak) at any time; and (b) 115dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.	The proposed modification will not result in airblast overpressure levels greater than the limits at all privately owned assessment locations (see Chapter 7).
Ground vibration caused by the development does not exceed: (a) 10mm/sec (peak particle velocity) at any time, and (b) 5mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.	The proposed modification will not result in ground vibration levels greater than the limits at all privately owned assessment locations (see Chapter 7).
Any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified for item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy (AIP) for each relevant water source listed in column 1 of that Table.	The proposed modification will not exceed the respective water table, water pressure and water quality requirements of the AIP (see Chapter 10).

In addition to the non-discretionary development standards for mining in clause 12AB, Part 3 of the Mining SEPP sets out a number of matters the consent authority must consider before determining an application for consent for the purposes of mining. Assessment of the proposed modification against the relevant matters has been undertaken as part of this EA, as summarised in Table 4.2.

Table 4.2 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Addressed in this EA
12 Compatibility of proposed mine, petroleum production or extractive industry with other land uses	
Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:	

Table 4.2 Consideration of relevant Mining SEPP, Part 3 matters

Matter		Addressed in this EA
(a)	consider:	
	(i) the existing uses and approved uses of land in the vicinity of the development, and	The area surrounding HVO South contains a number of open cut coal mines (see Chapter 2), including the proposed United Wambo Project (refer to Section 3.2.5). There are also a number of rural/residential land uses east, west and south of the mine. It is considered that the proposed modification is appropriate having regard to the existing and approved uses of land in its vicinity.
	(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and	This EA has considered the likely impacts of the proposed modification on existing land uses, particularly on rural/residential land uses. As discussed in Chapter 17, subject to the implementation of the commitments, the proposed modification is unlikely to have a significant impact on these existing land uses.
	(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and	Mining has occurred at the now HVO since 1949. The proposed modification is compatible with surrounding land uses, particularly the mining and industrial land uses.
(b)	evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	There are clear continued public benefits associated with the continuation of mining within the footprint of existing mining lease. The additional benefits, discounted at 7 per cent, include: • $243 million in royalties; and • $160 million in taxes. Taxes remain at 21 per cent of revenue consistent with the ERM (2008) EA.
(c)	evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	A range of existing commitments are in place for PA 06_0261 and the additional commitments associated with the proposed modification are outlined in Chapter 16). These measures mitigate the potential impacts of the proposed modification and are, therefore, unlikely to have a significant impact on surrounding land uses.
12A	**Consideration of voluntary land acquisition and mitigation policy**	
(2) Before determining an application for consent for State significant development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider any applicable provisions of the voluntary land acquisition and mitigation policy and, in particular: (a) any applicable provisions of the policy for the mitigation or avoidance of noise or particulate matter impacts outside the land on which the development is to be carried out, and (b) any applicable provisions of the policy relating to the developer making an offer to acquire land affected by those impacts. (3) To avoid doubt, the obligations of a consent authority under this clause extend to any application to modify a development consent for State significant development for the purposes of mining, petroleum production or extractive industry. (4) This clause extends to applications made, but not determined, before the commencement of this clause.		HVO South is a transitional Part 3A project and, is therefore, not SSD by virtue of Clause 2(8) of Schedule 6A to the EP&A Act. However, the VLAMP has been considered in the assessment of noise and air impacts (see Chapters 7 and 8 and Appendices E and F, respectively). It is also discussed further in Section 4.3.4iii.

Table 4.2 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Addressed in this EA
13 Compatibility of proposed development with mining, petroleum production or extractive industry	
2) Before determining an application to which this clause applies, the consent authority must:	
(a) consider:	The proposed modification does not increase the disturbance footprint and is within the boundaries of an existing mining lease. Mine planning has ensured that it maximises the extraction of coal resources. It will not impact on surrounding mines, or their ability to extract target resources.
(i) the existing uses and approved uses of land in the vicinity of the development, and	
(ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and	
(iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and	
(b) evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and	
(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	
14 Natural resource management and environmental management	
1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:	The results of the surface water and groundwater studies indicate that impacts are likely to be minor and manageable through licensing arrangements. The greenhouse gas assessment has estimated that the change in annual average greenhouse gas emissions over the remaining project life are negligible, representing approximately 0.13 per cent and 0.50 per cent of Australia's and NSW's emissions, respectively. Details on potential impacts on groundwater and surface water resources are provided in Chapters 10 and 11, respectively. Details on greenhouse gas emissions are provided in Section 8.5.
(a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,	
(b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,	
(c) that greenhouse gas emissions are minimised to the greatest extent practicable.	
(2) Without limiting subclause (1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.	

Table 4.2 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Addressed in this EA
(3) Without limiting subclause (1), in determining a development application for development for the purposes of mining, the consent authority must consider any certification by the Chief Executive of the Office of Environment and Heritage or the Director-General of the Department of Primary Industries that measures to mitigate or offset the biodiversity impact of the proposed development will be adequate.	
15 Resource recovery	
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.	Mining has occurred at the now HVO since 1949. The geology, mining methods and mining equipment required to maximise both the quantum and efficiency of the extraction of the available resources are well understood. Mine plans have been prepared which continue existing mining methods to progress Cheshunt Pit through the mined areas of Riverview Pit to extract seams down to the base of the Bayswater seam. This progression is able to be achieved within the existing disturbance footprint.
(2) Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.	
(3) The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.	
16 Transport	
(1) Before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any one or more of the following: (a) require that some or all of the transport of materials in connection with the development is not to be by public road, (b) limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools, and (c) require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.	There will be no change to transport of materials under the proposed modification.
(2) If the consent authority considers that the development involves the transport of materials on a public road, the consent authority must, within 7 days after receiving the development application, provide a copy of the application to: (a) each roads authority for the road, and (b) the Roads and Traffic Authority (if it is not a roads authority for the road).	

Table 4.2 Consideration of relevant Mining SEPP, Part 3 matters

Matter	Addressed in this EA
(3) The consent authority: (a) must not determine the application until it has taken into consideration any submissions that it receives in response from any roads authority or the Roads and Traffic Authority within 21 days after they were provided with a copy of the application, and (b) must provide them with a copy of the determination.	
(4) In circumstances where the consent authority is a roads authority for a public road to which subclause (2) applies, the references in subclauses (2) and (3) to a roads authority for that road do not include the consent authority.	
17 Rehabilitation	
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development.	The primary objective of final rehabilitation at HVO South is to create a stable, free draining landform able to maintain viable land uses where the post-mining rehabilitated areas are integrated with the surrounding landscape.
(2) In particular, the consent authority must consider whether conditions of the consent should:	Land capability will support both agriculture and native habitat.
(a) require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or	Rehabilitation will continue to be progressively undertaken across the mined area under the proposed modification. The overburden emplacement strategy requires an increase in emplacement height to accommodate the additional volume of overburden material which provides the opportunity to incorporate micro-relief into the design of the final landform. This is shown in Figures 13.1 and 13.2.
(b) require waste generated by the development or the rehabilitation to be dealt with appropriately, or	
(c) require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the Contaminated Land Management Act 1997), or	
(d) require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.	

Part 4AA of the Mining SEPP applies to 'mining or petroleum development' on strategic agricultural land. The definition of 'mining or petroleum development' for the purposes of Part 4AA includes development specified in clause 5 (Mining) of Schedule 1 to the S&RD SEPP but only if a new mining lease under the Mining Act is required to be issued to enable the development to be carried out.

The proposed modification is development specified in clause 5 of the S&RD SEPP but does not require a new mining lease under the Mining Act to be issued as it is development proposed to be carried out within the mining area of an existing mining lease. Therefore, Part 4AA of the Mining SEPP does not apply to the proposed modification.

iii State Environmental Planning Policy No 33 –Hazardous and Offensive Development

State Environmental Planning Policy No 33 – Hazardous and Offensive Development (SEPP 33) requires the consent authority to consider whether development is a potentially hazardous or offensive industry. The existing operations at HVO South are not classed as hazardous or offensive development under SEPP 33.

The proposed modification proposes only minor changes to current operations and does not propose changes to the types or quantities of dangerous goods stored, handled or transported to the site. The proposed modification will not pose a significant risk in relation to the locality to human health, life or property, or the biophysical environment. Therefore, the proposed modification is not considered to be a potentially hazardous industry.

Potential polluting discharges from the proposed modification (ie noise emissions, air pollutants, and water pollutants) have been assessed in Appendices E to H to this EA. These discharges will not have a significant adverse impact in the locality or on the existing or likely future development on other land. Therefore, the proposed modification is not considered to be a potentially offensive industry.

iv Singleton Local Environmental Plan 2013

The site is zoned RU1 Primary Production under the *Singleton Local Environmental Plan 2013*. Notwithstanding clause 7(1)(b) of the Mining SEPP, open cut mining is permissible with development consent within this zone. The proposed modification is consistent with the RU1 zone objectives which are:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base;
- to encourage diversity in primary industry enterprises and systems appropriate for the area;
- to minimise the fragmentation and alienation of resource lands; and
- to minimise conflict between land uses within this zone and land uses within adjoining zones.

4.3.4 Other plans and policies

i Strategic Regional Land Use Policy

The NSW Government's *Strategic Regional Land Use Policy* (DP&I 2012) aims to protect strategic agricultural land (SAL) and valuable water resources in areas of regional NSW where mining and coal seam gas resources are prevalent. Seven regions in NSW have been identified as applying under this policy with each region having a Strategic Regional Land Use Plan (SRLUP). Parts of the project approval boundary area to the north and east are mapped as biophysical strategic agricultural land (BSAL) under the Upper Hunter SRLUP.

As previously mentioned, the proposed modification does not require a new mining lease, or an extension to its existing mining lease and, therefore, Part 4AA of the Mining SEPP does not apply to the proposed modification. Under the SRLUP, all SSD coal and coal seam gas projects that may impact agricultural resources, whether or not they are on land mapped as SAL under the Upper Hunter SRLUP, require an Agricultural Impact Statement (AIS) to accompany a project application. HVO South is a transitional Part 3A project and is, therefore, not SSD and an AIS is not required. Given that there are no additional areas of disturbance, the proposed modification will not impact agricultural resources.

ii Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation including the Water Act and WM Act. The AIP considers and defines minimal harm criteria for productive and less productive aquifers. The AIP is associated with the SRLUP, discussed above. Consideration of the proposed modification against the requirements of the AIP is given in Chapter 10.

iii Voluntary Land Acquisition and Mitigation Policy

The VLAMP applies to SSD applications for mining, petroleum and extractive industry development. HVO South is a transitional Part 3A project and, therefore, is not SSD by virtue of Clause 2(8) of Schedule 6A to the EP&A Act. However, the VLAMP has been considered in the assessment of noise and air impacts (see Appendices E and F) and the outcomes are summarised below.

- Noise:
  - The proposed modification is predicted to have significant impact on one property (remaining residence in Warkworth village, ie location 77) with noise levels greater than 5dB above PSNL. This residence is currently entitled to mitigation within the project approval (PA 06_0261) and entitled to voluntary acquisition due to impacts from other neighbouring mining operations (ie Wambo Mine and Warkworth Mine).
  - The proposed modification is predicted to have moderate impacts on twelve additional properties with noise levels 3-5dB above PSNL (contributing more than 1dB to the total industrial noise level). Eight of these properties are west of the proposed modification on Jerrys Plains Road and the remaining four are east in Maison Dieu. According to VLAMP these properties would be entitled to treatment measures such as upgraded façade elements like windows, door, roof insulation to further increase the ability of the building facade to reduce noise levels. It should be noted that due to the United Wambo Project, should it be approved, six of the eight additional properties on Jerrys Plains Road would be afforded acquisition rights and the remaining two would be afforded mitigation rights (refer to Section 3.2.5).
  - The proposed modification is predicted to have negligible impacts on four additional properties with noise levels 0-2dB above PSNL. Three of these properties are west of the proposed modification and one to the east. Noise exceedances would not be discernible by the average listener and, therefore, would not warrant receiver based treatments or controls.
  - No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

    The parcel of vacant land already afforded voluntary acquisition rights upon request within the project approval (PA 06_0261) (refer to Section 7.2.1) does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments.

- Air quality:

  - No additional private dwellings are impacted that are not already afforded acquisition rights from neighbouring mine operations.

    It should be noted that the proposed modification is predicted to exceed the VLAMP air quality criteria at four properties, three within Warkworth village and one south-west of Camberwell village. Two of these three Warkworth properties are non-residences (102 - Warkworth Hall and 264 - St Phillip's Church) and the third Warkworth property (77) is entitled to acquisition upon request from Wambo Mine and Warkworth Mine as noted in Appendix 3 of the project approval (PA 06_0261). The property south-west of Camberwell village (471) is entitled to acquisition upon request from Ashton Coal's South East Open Cut project.

    Assessment locations 102 and 264 are non-residences and occupied infrequently and voluntary acquisition rights do not apply in accordance with the VLAMP. The relevant section of the VLAMP is reproduced below:

    > A consent authority should only apply voluntary acquisition rights where, even with the implementation of best practice management, the development is predicted to contribute to exceedances of the acquisition criteria in Table 3:
    >
    > - at any residence on privately owned land; or
    > - at any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace, including consideration of the following factors:
    >   - the nature of the workplace;
    >   - the potential for exposure of workers to elevated levels of particulate matter;
    >   - the likely period of exposure; and
    >   - the health and safety measures already employed in that workplace.
    > - on more than 25 per cent of any privately owned land where there is an existing dwelling or
    > - where a dwelling could be built under existing planning controls.

  - No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

    Similar to the noise and vibration study, the assessment was also applied to the parcel of vacant land already afforded voluntary acquisition upon request rights within the project approval (PA 06_0261). The assessment predicted to experience dust impacts above VLAMP 25 per cent criteria. However, this property also does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments and government policy.

4.4 Commonwealth approvals

4.4.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect matters of national environmental significance (MNES), namely:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- actions of development for coal seam gas or large coal mining on water resources.

If an action will, or is likely to, have a significant impact on any matters of MNES (know as a controlled action), then the action must be referred and approved by the Commonwealth Environment Minister or the Minister's delegate before that action is taken. To determine whether a proposed action would or is likely to be a Controlled Action, an action may be referred to the Department of the Environment and Energy (DoEE).

The proposed modification was referred to DoEE for potential impacts to water resources in February 2016 (EPBC 2016/7461). The referral considered the *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources* (DoE 2013). A second referral was submitted to DoE for State-approved disturbance areas within Riverview and Cheshunt Pits that contained vegetation communities that were listed in May 2015 subsequent to PA 06_0261 being granted in 2009 by the NSW Minister for Planning. This referral (EPBC 2016/7640) also comprised State-approved disturbance areas within HVO North.

4.4.2 Native Title Act 1993

The Commonwealth *Native Title Act 1993* establishes that some Aboriginal and Torres Strait Islander people have rights and interests to their land that comes from their traditional laws and customs. The National Native Title Tribunal is responsible for maintaining a register of native title claimants and bodies to whom native title rights have been granted. Proposed activities or development that may affect native title are called 'future acts'.

Claimants whose native title claims have been registered have the right to negotiate about some future acts, including mining and the granting of a mining lease, over the land subject of their native title claim. All native title claim applications are subjected to a registration test and claims would only be registered if claimants satisfy a number of conditions. Where a native title claim is not registered a development can proceed through the mediation and determination processes, though claimants would not be able to participate in future act negotiations.

There are no native title claims or indigenous land use agreements relating to HVO South. There is currently an unregistered claimant application (NC2013/006, NSD 1680/2013) which encompasses the entire Hunter Valley including HVO South. As the proposed modification does not require disturbance of land outside the existing disturbance footprint and does not require the granting of a new mining lease, the future act and right to negotiate processes under the *Native Title Act 1993* are not triggered.

5 Stakeholder engagement

5.1 Introduction

The proponent is committed to extensive engagement within the communities in which it operates and has assisted in the contribution to their long-term sustainability.

An ongoing stakeholder engagement strategy is in place for HVO. The key goals of the strategy are to ensure timely provision of relevant and clear information on its operations, including development changes, and to create a process that provides opportunities for stakeholders to express their views and allows timely feedback on any matters raised.

Engagement tools implemented by the proponent on an ongoing basis include:

- a freecall information line (1800 727 745) to provide the community with the opportunity to provide feedback or gather information relating to Coal & Allied's operations in the Hunter Valley;
- Coal & Allied's website (www.riotinto.com) which contains information on mine operations and management, environmental monitoring results, project applications, community investment and engagement and contact details;
- advertorials in the Singleton Argus and Hunter Valley News which provide information on Coal & Allied's mining operations, including the upcoming projects;
- HVO's Community Consultative Committee (HVOCCC) which is used to discuss mining operations and environmental performance, and comprises representatives of the community, Singleton Council and Coal & Allied;
- regular letters to residents in the areas surrounding HVO which include updates from the General Manager on HVO's operations, environmental results and community programmes; and
- regular formal and informal updates to HVO employees from the General Manager and site leaders.

As outlined in the subsequent sections, consultation has been, and will continue to be supplemented by activities that relate specifically to the proposed modification. The nature and extent of these stakeholder consultation activities reflect the nature and scale of the proposed modification and its potential impacts.

5.2 Consultation with government

The proponent has engaged with the DP&E regarding the proposed modification and the scope of the assessment to be undertaken. Meetings were held in March and September 2015 and April 2016. Items discussed during the consultation process included a project briefing, planning pathway and matters requiring consideration.

The DoEE was also consulted through the preparation of the EA, specifically regarding the water trigger under the EPBC Act. Meetings with DoEE were held in December 2015 and January 2016.

5.3 Consultation with community and special interest groups

5.3.1 Overview

As noted above, community consultation for HVO South is ongoing. This EA is available on Rio Tinto Coal Australia's website (riotintocoalaustralia.com.au). Presentations related to the proposed modification were made to the HVOCCC in July and November 2015 and March and July 2016.

During the engagement programme, the HVOCCC requested further information regarding the mine design planning principles (ie avoid and mitigate impacts as described in Section 3.3.1) and the proposed modification's potential interactions with residences in Maison Dieu. This is discussed further in Section 5.3.2 and the presentation is provided in Appendix D.

The engagement programme implemented by the proponent included the following:

- HVOCCC presentations, as noted above;
- one-on-one consultations – consultation was carried out with 25 affected near neighbours during the preparation of the EA and following completion of the technical studies to present the outcomes;
- HVO BBQ – an open-invitation BBQ was held in December 2015 and November 2016 for the local community at HVO where information on the proposed modification was available. This is a regular event held by Coal & Allied which was used to enable the local community to provide feedback on the proposed modification.

Matters raised during the engagement programme and where they have been considered in this EA are provided in the table below.

Table 5.1 Matters raised during engagement programme

Matter	Where addressed
Visual amenity and final landform	
Effects on surrounding receptors, particularly Maison Dieu, from increased height of overburden emplacement areas, including any effects on sunlight at these receptors	9.3.2
Increased overburden emplacement heights and consistency with other surrounding mines	1, 2.3, 3.2.1, 9.3.1, 9.5, 11.2.3, 11.3.1 and 13.3.1
Effects on surrounding receptors from lighting plant operating on overburden emplacement areas	9.2.2 and 9.4
Noise	
Effects on surrounding receptors, particularly Maison Dieu and Jerrys Plains Road, from noise generated by the proposed modification	7.3
Air quality	
Effects on surrounding receptors, particularly Maison Dieu, from dust generated by the proposed modification	8.3.2
Groundwater	
Effects on Hunter River due to connectivity with coal seams	10.2.3, 10.3.3 and 10.3.5
Effects on existing water tables due to mining deeper seams	10.3.2, 10.3.3, 10.3.4 and 10.3.5

Table 5.1 Matters raised during engagement programme

Matter	Where addressed
Additional baseline investigations to inform groundwater study	10.2
Flooding	
Requirements for new levees due to the proposed modification	11.1
Water management	
Operational management of water storages and their integrity	11.2.3 and 11.3.1
Infrastructure	
New infrastructure requirements due to the proposed modification	3.2
Rehabilitation	
Effects of mining through rehabilitated areas	3.2.2 and 13.3.1
Consultation	
One-on-one consultations regarding potential impacts on directly affected properties	5.3

The community will also be notified of the proposed modification through an advertisement placed in a local newspaper following lodgement, and through the public exhibition process where community members will be invited to comment and be invited to a number of community information and feedback sessions.

5.3.2 Community engagement regarding potential impacts

The proponent delivered a presentation to the HVOCCC in November 2016 which provided a summary of the proposed modification impact assessment outcomes of the technical studies.

The presentation also provided tailored information in response to a request for further information regarding potential noise, air quality and visual amenity impacts on private dwellings in Maison Dieu due to the proposed modification. The presentation is provided in Appendix D and comprised information related to mine plan design principles (ie avoid and mitigate) and features and their resultant changes to noise and dust generation and the implementation of operational management and control measures to manage these impacts through the duration of the proposed modification.

The proponent delivered a presentation to Singleton Council and the community through both a closed session and public Council meeting on 19 December 2016. This presentation summarised the proposed modification and provided an overview of the findings of the technical studies and proposed management and mitigation measures.

Consultation has also been undertaken with 25 near neighbours in Maison Dieu, Long Point and Jerrys Plains Road. One on one meetings were held to communicate the outcomes of the technical studies and seek feedback. HVO will continue to engage with near neighbours on issues they have raised regarding the proposed modification as well as ongoing operations at the HVO complex.

Further information regarding the above noise, air quality and visual amenity matters is provided in Chapters 7, 8 and 9, respectively.

6 Prioritisation of environmental matters

6.1 Method

As detailed in Section 3.3.1, an opportunities and constraints analysis of conceptual mine plans for HVO South was undertaken by technical specialists as part of the mine plan optimisation process. The main objective of the analysis was to enable the proponent to make informed decisions in relation to the proposed modification of the project approval and/or the scope of mining activities to be addressed by that modification and for recommendations to be further considered in the mine planning process. It included a series of workshops and iterations involving mine planners and technical specialists. The extensive analysis resulted in improvements in the mine plan design and provided a platform for the detailed assessment of key issues.

Environmental risks were determined using standard safeguards, design or management measures applied at all Coal & Allied operations. Three levels of risk rating were established: low, medium and high. Each of the risk sources were then allocated an issue prioritisation category based on their considered likelihood and consequence of occurrence. These were used to determine environmental study priorities for this EA.

6.2 Environmental assessment prioritisation

Based on the outcomes of the workshop, the following broad qualitative risk prioritisation categories were assigned to each environmental attribute:

- High – noise, air quality and groundwater;
- Medium – surface water, vibration, greenhouse gases, visual, final landform and rehabilitation; and
- Low – Aboriginal cultural heritage, historic heritage and ecology.

Assessments for each of the attributes listed above have been undertaken as part of this EA, commensurate with risk. The risk assessment process only considered potentially adverse incremental environmental impacts; however, the proposed modification will have a number of substantial benefits, including economic and social benefits which are further detailed in the respective chapters.

7 Noise

7.1 Introduction

This chapter provides a summary of the noise and vibration study prepared by EMM, which is presented in full in Appendix E.

The chapter describes the existing acoustic environment, predicted emissions, potential impacts at assessment locations, and management and monitoring measures. The noise and vibration study was completed with reference to:

- the *Industrial Noise Policy* (NSW EPA 2000) (INP);
- the *Rail Infrastructure Noise Guideline* (NSW EPA 2013) (RING); and
- the *Voluntary Land Acquisition and Mitigation Policy* (DP&E 2014) (VLAMP).

Acoustic engineers worked closely with the proponent during the mine plan development phase. This enabled important noise mitigation/management to be incorporated into the design and the development of comprehensive operational noise management regime.

7.2 Existing environment

7.2.1 Existing acquisition rights within the project approval

As stated in Section 3.1.7, the only remaining properties entitled to acquisition upon request under Condition 1 Schedule 3 of the project approval (PA 06_0261) are two vacant lots owned by Keys (Lot 2 DP 7709905 and Lot 84 DP 753792). Since approval was granted in 2009, the landowner has consolidated these two lots into a single parcel of land, referenced as Lot 84 DP 1124139. This consolidation does not affect the existing voluntary acquisition rights. Additional context is provided in Section 7.2.2 regarding current NSW Government policy for land acquisition entitlements documented within the VLAMP and adopted for the assessment of the proposed modification.

7.2.2 Noise and blasting criteria

The INP provides a framework and process for deriving noise criteria for project approvals and licences that enables the NSW EPA to regulate premises that are scheduled under the POEO Act. The INP provides two criteria to assess industrial noise sources; namely, the intrusiveness criteria and the amenity criteria. Project specific noise level (PSNL) criteria for a development's operation are equal to the lower of the derived intrusiveness and amenity criteria. Existing noise and blasting criteria for the approved HVO South activities are outlined in Schedule 3 of the project approval and have been used to develop Tables 7.1 to 7.5. These criteria were derived by adopting INP principles and based on PSNLs. Since the project approval, the VLAMP was released (DP&E 2014) and hence is used to contemporise the criteria as appropriate.

It is also important to note that voluntary acquisition and mitigation rights are afforded by the VLAMP (DP&E 2014) to landholders predicted to be affected by exceedances of prescribed noise criteria or PSNLs from proposed mining developments. The VLAMP seeks to balance acquisition and mitigation obligations for mining operators that provide appropriate protection for landholders. These obligations and their relationship to residual noise exceedance of PSNL are:

- 0-2dB - impacts are considered to be negligible;
- 3-5dB but contribution of less than 1dB to total industrial noise - impacts are considered to be marginal with voluntary mitigation rights afforded;
- 3-5dB and contribution of more than 1dB to total industrial noise - impacts are considered to be moderate with voluntary mitigation rights afforded; and
- greater than 5dB - impacts are considered to be significant with voluntary acquisition rights afforded.

Furthermore, the VLAMP provides noise acquisition criteria for privately owned land parcels. The policy assigns acquisition rights if the noise generated by a development contributes to an exceedance of the recommended maximum noise levels in Table 2.1 of the INP on more than 25 per cent of any privately owned land, where a dwelling could be built on the land under existing planning controls.

The VLAMP defines land as '...the whole of a lot, including contiguous lots owned by the same landowner'.

For the proposed modification, this results in acquisition criteria of 55 dB, 50 dB and 45 dB ($L_{Aeq,period}$) for the day, evening and night periods, respectively, on more than 25 per cent of privately owned land where a dwelling could be built under existing planning controls.

As described in Section 3.1.7, since the project approval (PA 06_0261) was granted in 2009, Coal & Allied has consolidated its dataset for sensitive receptors surrounding its operations in the Hunter Valley (ie HVO and MTW). Therefore, the receptors presented in Tables 7.1 to 7.3 show both the new identifier (New ID) as well as the identifier within the project approval (PA 06_0261).

Table 7.1 Noise impact assessment criteria

Locality	PA reference	New ID	PA ID	Noise limits, dB			
				Day/Evening/Night $L_{Aeq,15minutes}$			Night $L_{A1,1minute}$
				Day	Evening	Night	
-	Hunter Valley Gliding Club (when in use) [2,3]	-	-	55 (when in use)			-
Warkworth							
	Kelly	77[1, 4]	45	43	43	43	45
All other privately-owned residence in Warkworth village	-	-	-	43	43	43	45
Warkworth Hall[4]	-	102	-	65 (when in use)			-
St Phillips Church[4]	-	264	-	40 (internal, when in use)			-

Table 7.1 Noise impact assessment criteria

Locality	PA reference	New ID	PA ID	Noise limits, dB			
				Day/Evening/Night $L_{Aeq,15minutes}$			Night $L_{A1,1minute}$
				Day	Evening	Night	
Maison Dieu	Shearers Lane	160[1], 161, 162, 163, 256, 258, 260, 261	5, 61, n/a, n/a, 47, n/a, n/a, n/a	41	41	41	45
Maison Dieu	-	121[1], 123	34, 50	40	40	40	45
	Within 250m of 24	120, 122, 124[1]	n/a, 56, 24	39	39	39	45
Maison Dieu	Within 1km of Shearers lane, not otherwise listed in this table	244, 245, 246, 247	n/a	37	37	37	45
Jerrys Plains Road	Smith	309	36	36	36	36	45
	Other Jerrys Plains Road	-	-	35	35	35	45
Jerrys Plains	Jerrys Plains village residences	-	-	35	35	35	45
All other privately owned residences				35	35	35	45

Notes: *1. PA 06_0261 nominates at Table 4 land subject to additional mitigation upon request and includes location 77, 121, 124 and 160.*

2. Noise impacts at HVGC are to be assessed in the immediate vicinity of its residential facilities and/or clubhouse. Noise impact assessment limits are only applicable during times of use that have been notified by Hunter Valley Gliding Club (HVGC) to the proponent.

3. As required by Conditions 47 to 49 of Schedule 3 of the project approval (PA 06_0261), Coal & Allied has an agreement in place with the HVGC and prepared an Amenity Management Plan in consultation with the HVGC.

4. Noise criteria were not specifically included in the PA and hence are derived as per the INP amenity criteria (ie $L_{Aeq,period}$) for a commercial receiver and place of worship for the hall and St Phillip's Church, respectively. In reality, the resulting noise level will be the lowest criteria achievable by the proposal in this locality (eg if the 40 dB internal criteria for the church is achieved, this will be the noise level exposure of the hall also, given their proximity to one another).

Table 7.2 Land acquisition criteria, dB

PA ID/ New ID	Day	Evening	Night
	$L_{Aeq,15minute}$	$L_{Aeq,15minute}$	$L_{Aeq,15minute}$
36/309 - Smith	43	41	41
All Maison Dieu residences	43	41	41
All Jerrys Plains Road residences other than Smith (36/309)	43	40	40
All other privately owned residences	40	40	40

Table 7.3 Additional noise mitigation criteria, dB

PA ID/ New ID	Day	Evening	Night
	$L_{Aeq,15minute}$	$L_{Aeq,15minute}$	$L_{Aeq,15minute}$
Maison Dieu residences	39	39	39
36/309 - Smith	39	39	39
Jerrys Plains Road residences except Smith (36/309)	38	38	38
All other privately owned residences	38	38	38

Table 7.4 Airblast overpressure impact assessment criteria

Airblast overpressure level, dB(Lin peak)	Allowable exceedance
115	5% of the total number of blasts over a period of 12 months
120	0%

Table 7.5 Ground vibration impact assessment criteria

Peak particle velocity, mm/s	Allowable exceedance
5	5% of the total number of blasts over a period of 12 months
10	0%

Notes: Schedule 3, Condition 9 requires a ground vibration limit of 5mm/s peak particle velocity at the St Philip's Church and the outbuildings at Archerfield.

7.2.3 Acoustic environment

The noise criteria outlined in Schedule 3 (Tables 2 to 5) of the project approval (PA 06_0261) (reproduced in Tables 7.1 to 7.3 above) were derived from measured background noise levels as shown in the ERM (2008) EA. Ambient noise levels are influenced by varying degrees by the HVO pits, Wambo and Warkworth mines, road traffic, animals, insects and weather conditions. Mining operations have existed in the area for decades, including the now HVO, which commenced operations in 1949.

Records of wind speed, wind direction and sigma-theta used in the noise modelling were acquired from the Coal & Allied Cheshunt automatic weather station (AWS) for the 2014 calendar year. A comparison of data from other neighbouring weather stations was undertaken and it is considered that these data are representative for the site and surrounds (see Appendix E). The stability class frequency for the area, as determined from the hourly weather data, indicates that atmospheric stability class F and G (which represent moderate to strong temperature inversions) occurs for only 7.5 per cent of the winter nights in the area. This is well below the INP's 30 per cent threshold where temperature inversions are considered to be a 'feature' of an area and therefore does not need to be included in a noise impact assessment. Nonetheless, inversion effects on noise were included in modelling.

7.2.4 Assessment locations

The assessment considered impacts at 163 (predominantly privately owned) assessment locations (shown in Figure 3.2) which is a substantial increase on the 2008 noise study (ERM 2008) which considered 22 representative locations. Two of these 163 assessment locations are the Warkworth Hall and St Phillip's Church in Warkworth village. The assessment locations for the proposed modification include properties in Maison Dieu to the east, Warkworth to the south, Jerrys Plains Road to the south-west, Jerrys Plains to the west and others further afield (eg Gouldsville and Long Point Road to the south-east).

7.2.5 Current noise management

HVO South and HVO North have integrated their management of noise and operate an integrated noise management system. The noise management plan incorporates all relevant conditions of the project approval (PA 06_0261), together with relevant legislation and relevant standards and guidelines and includes noise control considerations, operational management options and monitoring requirements. It was prepared in consultation with relevant government agencies and was approved by DP&E in August 2015.

The key expectation of the INP is that all feasible and reasonable mitigation is applied taking into account economic, social and environmental considerations of the modified project. In accordance with Section 7 of the INP, the proponent adopts three main mitigation strategies for noise control which are described below.

i Mitigation at the source

Examples of mitigation at source are given below.

- Mine plan development: mine plans that form the basis of the current operations were optimised over many iterations of noise modelling for different operating scenarios (as occurred for the proposed modification). In arriving at the mine plans, noise minimisation/management techniques were identified and applied.

- Operational management: during adverse weather conditions, a relatively small number of fleet/equipment are either relocated to in-pit areas or shut down to ensure the operations satisfy the noise criteria. This method is common practice for current operations at the site and is commonly used elsewhere in the mining industry. This measure also results in an annual cost to the business associated with the lost production due to less equipment operating during these conditions.

- Haul truck fleet attenuation: HVO has attenuated a portion of the haul truck fleet and is continuing to attenuate trucks. Any new or contractor haul trucks are required to be attenuated.

ii Mitigation at the receiver

A number of residences have been afforded architectural treatment to mitigate noise intrusion in accordance with the requirements and mechanisms within the project approval (PA 06_0261) which were based on the outcomes of previous studies. These include the dwellings of Maison Dieu at Shearers Lane and Knodlers Lane, as identified in Table 1 and Table 4 of project approval (PA 06_0261). Controlling noise at the receiver has been further considered and properties have been identified where treatment to existing dwellings will be made available in addition to those already treated.

iii Noise mitigation through mine design

Noise mitigation was also considered during the mine design process and improvements were identified to reduce noise for the residents in Maison Dieu. The mine design process (as described in Section 3.3) comprised key features enabling reduction of potential noise generation to private dwellings in Maison Dieu. This was afforded through the emplacement of material further north in the Cheshunt emplacement areas away from Maison Dieu. The design of this emplacement also includes a hauling and dumping strategy behind a noise bund. The noise bund is constructed on the outer face of the emplacement during non adverse noise generating conditions (ie when the wind is blowing away from receptors or during the day). Dumping behind the protection of the noise bund would occur during adverse conditions. An existing east west haul route in a valley between the Cheshunt emplacement and the rehabilitated Lemington overburden emplacement was also identified as a noise transmission pathway to Maison Dieu. This noise transmission pathway is designed to be blocked with the strategic emplacement of overburden to fill in the valley. These design principles to avoid and mitigate environmental and amenity impacts were communicated to HVOCCC in November 2016 (refer to Section 5.3.2 and 7.3.6).

iv Monitoring

The proponent conducts both routine attended monthly and real time noise monitoring at representative residences. The real time monitoring network is linked to the HVO Mine Monitoring and Control Team, providing alerts on an 'as required' basis when noise levels exceed internally derived triggers. Following receipt of an alarm, an investigation is undertaken, with actions implemented to ensure noise levels are managed below regulatory criteria.

HVO operates a network of five blast monitors located at nearby privately owned residences which function as regulatory compliance monitors. HVO also implements a number of blast management practices including drill and blast design to minimise airblast overpressure and ground vibration on neighbours.

v Compliance history

Compliance monitoring for HVO South has been undertaken via a routine compliance assessment (Global Acoustics) from 2009 to present. In more recent years, monitoring has included low frequency noise assessment.

An assessment of monitoring data (publically available via the Rio Tinto Coal Australia website www.riotintocoalaustralia.com.au) demonstrates that operations have predominantly been compliant with noise criteria in the period since the granting of the project approval (PA 06_0261).

Non-compliant noise measurements account for a small percentage of the monitoring dataset at 1.16 per cent ($L_{Aeq,15min}$, seven non-compliances measured from 601 individual assessments undertaken) and 2.86 per cent ($L_{A1,1min}$, 16 non-compliances measured from 560 individual assessments undertaken). These are shown in Table 7.6 and Table 7.7. These tables also demonstrate that there are no sustained exceedances.

Table 7.6 Summary of noise measurements for HVO South (2009 to 2015)

Total measurements (2009-2015, $L_{Aeq, 15min}$)	601
Total measurements (2009-2015, $L_{A1,1min}$)	560
Total number of exceedances (2009-2015, $L_{Aeq, 15min}$)	7
Total number of exceedances (2009-2015, $L_{A1,1min}$)	2
Total number of non-compliances (2009-2015, $L_{Aeq\ 15min}$)	7
Total number of non-compliances (2009-2015, $L_{A1,\ 1min}$)	16
Percentage of non-compliant measurements (2009-2015, $L_{Aeq, 15min}$)	1.16%
Percentage of non-compliant measurements (2009-2015, $L_{A1,\ 1min}$)	2.86%

Note: 1. Exceedance refers to a measured result greater than the relevant consent limit, but within the 2dB allowable tolerance listed in Chapter 11 of the INP.

Table 7.7 Yearly breakdown of noise measurements for HVO South

	2009	2010	2011	2012	2013	2014	2015
Total number of measurements ($L_{Aeq, 15min}$)	71	114	90	75	85	75	91
Total number of measurements ($L_{A1,1min}$))	43	114	90	74	85	74	80
Total number of exceedances[1] ($L_{Aeq, 15min}$)	1	3	0	1	1	1	0
Total number of exceedances[1] ($L_{A1,1min}$))	1	0	0	1	0	0	0
Total number of non-compliances ($L_{Aeq, 15min}$)	1	2	3	0	0	0	1
Total number of non-compliances ($L_{A1,1min}$))	0	8	4	0	2	0	2
Non-compliant measurements (%,$L_{Aeq, 15min}$)	1.41	1.75	3.33	0	0	0	1.10
Non-compliant measurements (%,$L_{A1,1min}$)	0	7.02	4.44	0	2.35	0	2.5

Note: 1. Exceedance refers to a measured result greater than the relevant consent limit, but within the 2 dB allowable tolerance listed in Chapter 11 of the INP.

7.3 Impact assessment

7.3.1 Operational noise assessment

i Assessment approach

To assess the potential for noise impacts on residences, a total of four indicative mine scenarios (refer to Section 3.2.2) were assessed over the remaining life of the project approval (PA 06_0261) until 2030. These indicative mine plans reflect the worst case operating scenarios in respect of the potential impacts on surrounding residences. These indicative mine plans are described in Section 3.2.2. The construction of the LCPP and associated infrastructure represents a significant investment of capital. This capital is unlikely to be available in current market conditions. The construction of the LCPP, associated infrastructure and the mining of South Lemington Pit 1 are not currently scheduled in the near to mid-term but are included in the mine plans to retain flexibility and enable a worst case assessment to be modelled.

The prediction of noise from the proposed modification was undertaken using the Predictor software by Bruel & Kjaer. The software predicts total noise levels at residences from the concurrent operation of multiple noise sources. The model included consideration of factors such as the lateral and vertical location of plant, source-to-receiver distances, ground effects, atmospheric absorption, topography of the mine and surrounding area and meteorological conditions. The model also incorporated reasonable and feasible management of noise emissions, such as operational management scenarios which will be implemented during forecast adverse weather conditions (refer to Section 6.5 of the noise and vibration study in Appendix E).

Noise modelling was based on three-dimensional digitised ground contours for the surrounding land, mine pits and overburden emplacement areas for four stages of the proposed modification. The indicative mine plans represent plausible worst case snapshots and equipment was placed at various locations and heights, representing realistic managed operating conditions in each of these indicative stages of the mine. The results presented assume all plant and equipment to be operating simultaneously and at full power with the exception of adverse weather condition scenarios where plant shut downs would occur. In practice, such an operating scenario would occur very infrequently.

Operational noise levels were predicted during calm and 'prevailing' (worst case) meteorological conditions for day, evening and night periods. Temperature inversions are not considered to be a 'feature' of the area. However, the prediction of noise impacts in the assessment included consideration of the effects of a 4ºC/100m temperature inversion consistent with the recommendations of the INP.

Sound power levels for equipment modelled are listed in Table 7.8.

Table 7.8 Equipment sound power levels

Typical item	Model	Representative $L_{Aeq,15minute}$ sound power level, dB
Dozer	CAT D6	114
	CAT D10T	116
	CAT D11R	118
	CAT D11T	118
	RTD CAT 690	120
Water cart	CAT 777	122
	CAT 785	122
Scraper	CAT 637G	107
Cable Reel[1]	CAT992	115
Float[1]	Haul Max 3900 - G	122
Loader	Letourneau L-1850	119
Shovel	P&H XPB	118
	P&H 4100	118
Dragline	BE 1370	113
Excavator	Hitachi 5500	118
	Hitachi 5600	118
Drill	Atlas Copco DML60	116
	Atlas Copco PV275	116
	Reedrill SKSS	116
Grader	CAT 24H	114
	CAT14H	114

Table 7.8 Equipment sound power levels

Typical item	Model	Representative $L_{Aeq,15minute}$ sound power level, dB
Crusher (mobile)[1]		123
Coal truck	KOM830E (attenuated)	117
Haul truck	DRESSER 830E (attenuated)	117
	KOM830E 240T AC (attenuated)	117
CPP[1]		113
Locomotive[1]		106
Conveyor[1]		110
Conveyor driver[1]		100
Infrastructure area (MIA)[1]		117

Notes: 1. The sound power level for these items are based on EMM's database for similar plant.

The typical equipment schedules for the four modelled indicative mining scenarios are presented in Table 7.9. The figures in parenthesis represent the modelled total fleet quantities during worst case prevailing meteorological conditions following implementation of operational management. This was only needed for specific items as shown and for when emissions required management during adverse weather. As shown the fleet changes are relatively modest and only apply during Stages 2 and 3 of the proposed modification.

Table 7.9 Modelled typical mining equipment schedule

Equipment	STG 1	STG 2	STG 3	STG 4
Coal haul truck	18	18(10)	24	24
Waste haul truck	63	76(61)	56(48)	32
Water cart	3	3	3	3
Drill	6	6	4	3
Shovel	2	2	2	1
Dozer	20	22(19)	21(18)	13
Rubber tyre dozer	2	2	2	1
Dragline	1	1	1	1
Grader	3	3	2	2
Loader	2	2	2	1
Excavator	6	9	5	2
Float	1	1(0)	1(0)	1
Scraper	2	2	2	2
Cable reel	1	1	1	1
Road trucks (rail)				6

Table 7.9 Modelled typical mining equipment schedule

Equipment	STG 1	STG 2	STG 3	STG 4
Infrastructure area:				
CPP	N/A	N/A	1	1
Reclaimer	N/A	N/A	1	1
Crusher/Feed bin	1	1	1	
Conveyor				4
Conveyor drivers				4
Rail construction	N/A	2(0)	2(0)	N/A
Locomotives				2

Notes: 1. The numbers in brackets () represent the modelled total operational fleet during worst case prevailing conditions.

ii Noise level predictions

A summary of the predicted noise impacts resulting from the proposed modification during 'prevailing' meteorological conditions is provided below, in accordance with the VLAMP (refer to Section 7.2.2), adopting PSNLs which are consistent with the existing project approval criteria. As described in Section 3.2.2i, the construction of the LCPP, associated infrastructure, and the mining of South Lemington Pit 1 are not currently scheduled in the near to mid-term but are included in the mine plans so that worst case impacts can be modelled and assessed.

- The proposed modification is predicted to have significant impact on one property (remaining residence in Warkworth village, ie location 77) with noise levels greater than 5dB above PSNL. This residence is currently entitled to mitigation within the project approval (PA 06_0261) and entitled to voluntary acquisition due to impacts from other neighbouring mining operations (ie Wambo Mine and Warkworth Mine).

- The proposed modification is predicted to have moderate impacts on twelve additional properties with noise levels 3-5dB above PSNL (contributing more than 1dB to the total industrial noise level). Eight of these properties are west of the proposed modification on Jerrys Plains Road and the remaining four are east in Maison Dieu. According to VLAMP these properties would be entitled to treatment measures such as upgraded façade elements like windows, door, roof insulation to further increase the ability of the building façade to reduce noise levels. It should be noted that due to the United Wambo Project (refer to Section 3.2.5), should it be approved, six of these eight additional properties on Jerrys Plains Road would be afforded acquisition rights and the remaining two would be afforded mitigation rights.

- The proposed modification is predicted to have negligible impacts on four additional properties with noise levels 0-2dB above PSNL. Three of these properties are west of the proposed modification and one to the east. Noise exceedances would not be discernible by the average listener and, therefore, would not warrant receiver based treatments or controls.

- The Mining SEPP (clause 12AB(3)) non-discretionary standard for acceptable night-time (ie amenity) criterion of 40dB $LA_{eq,9hour}$ is met at all but one assessment location. This location (location 77) is in Warkworth village and already entitled to voluntary acquisition due to operations at Wambo Mine (refer to Condition 3 of Schedule 3 of the project approval (PA 06_0261)). HVO South's contribution at this location is predicted to be between one and four per cent of all expected noise levels.

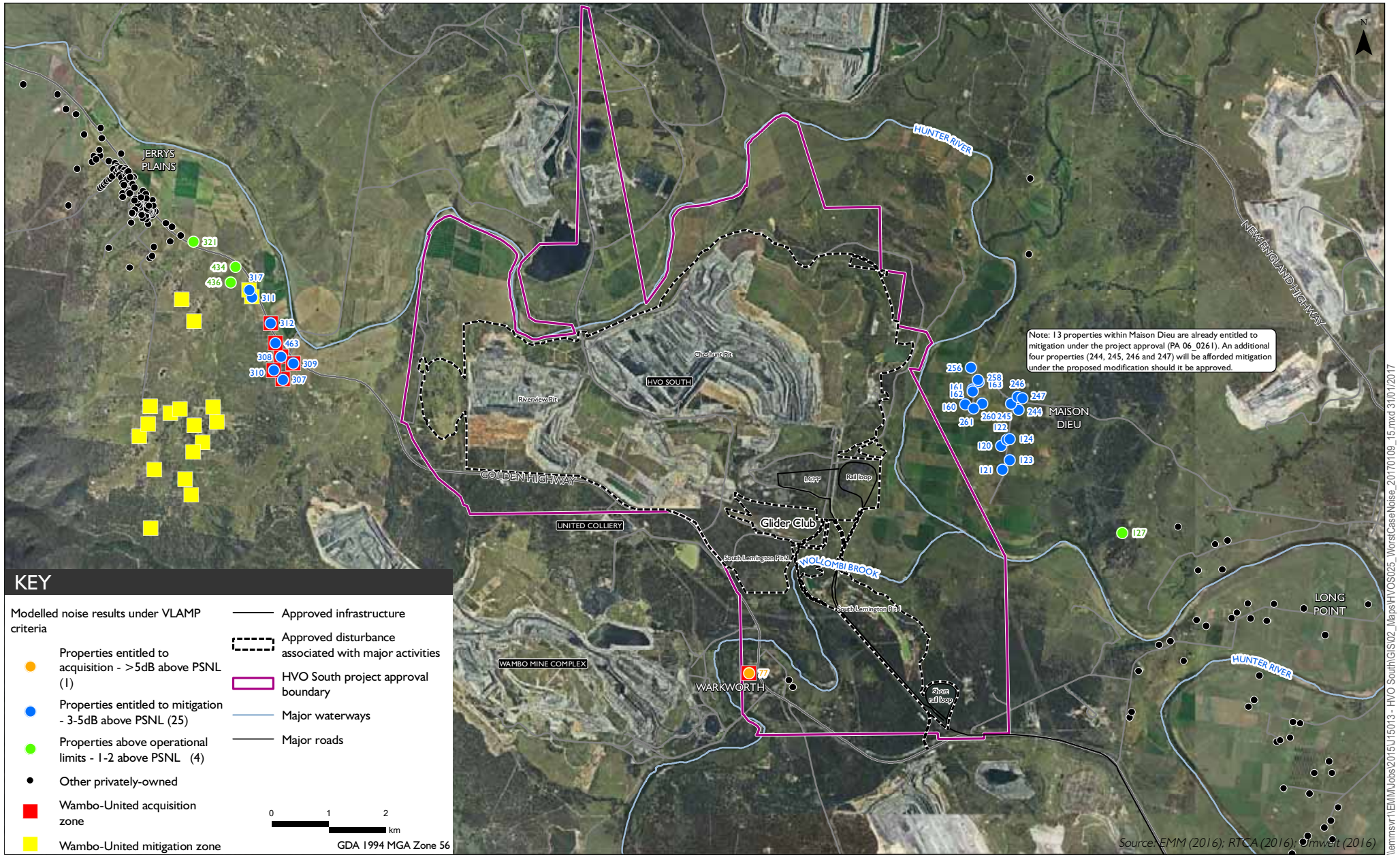
- The Mining SEPP (clauses 12AB(5) and (6)) non-discretionary standards for acceptable air-blast overpressure and ground vibration, respectively, are predicted to be satisfied at all privately owned residences.

It should be noted that the parcel of vacant land already afforded voluntary acquisition rights upon request within the project approval (PA 06_0261) (refer to Section 7.2.1) does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments and government policy. No other vacant land is predicted to be subject to voluntary acquisition rights under the VLAMP 25 per cent criteria (refer to Section 7.3.3).

It should be noted that the eight Jerrys Plains Road residences are impacted by the existing Wambo Mine (up to 40dB during adverse winds), all of which are predicted to be impacted by the United Wambo Project. In addition, 17 properties in Maison Dieu are entitled to mitigation, of which 13 are currently entitled to mitigation in accordance with the project approval (PA 06_0261). The proposed modification would result in an additional four properties in Maison Dieu being entitled to mitigation under the VLAMP.

Figure 7.1 shows the characterisation of noise impacts in accordance with VLAMP (refer to Section 7.2.2) for all stages worst case day, evening and night time operational noise levels for assessed privately owned locations.

Operational noise levels were predicted to comply with the project approval conditions for all assessment locations during calm meteorology for day, evening and night periods.



All stages worst case day, evening and night time operational noise results – INP weather

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Figure 7.1

iii Comparison with existing noise levels

A comparison was undertaken between the noise levels for the existing operations, the proposed modification and measured 2015 data. The comparison found that measured data was generally consistent with predicted noise levels in the previous ERM (2008) EA for locations to the east and lower for locations to the west (see Table 7.10).

Table 7.10 Comparison of existing operations and future noise levels, dB $L_{Aeq,15minute}$

Property		Existing operations noise levels		Proposed modification	PA Criteria
ID (PA ID)	**Location**	**Predicted (ERM 2008)[1]**	**Measured data (2015)**	**Stage 1, 2, 3, 4**	**D/E/N**
256 (47)	Maison Dieu	41	41[2]	40, 40, 39, 37	41
308 (31)[3]	Jerrys Plains Road	35	32	38, 37, 39, 38	35

Notes: 1. Predictions from the 2008 study shown are for the highest stage and option modelled.

2. Measured maximum values are the result of implementation of operational mitigation measures by HVO and on rare occasion has marginally exceeded it during adverse weather.

3. PSNL criteria are provided in Table 7.1 for 'All other privately owned residences'.

The above demonstrates that Maison Dieu residences will be afforded lower noise contributions from the proposed modification, which reduces further as mining progresses from indicative Stages 1 to 4 (ie westward and away from these properties). Conversely, noise to the western assessment locations (ie Jerrys Plains Road) is predicted to increase, however levels are not significantly different to current approved operations and will be mitigated through implementation of operational management during adverse weather.

The noise model adopted applies the same algorithm used for the HVO South Coal Project (ERM 2008), which included a comprehensive onsite validation process for adverse weather conditions. This is documented in the ERM (2008) noise technical report at Annex H (Appendix F).

In addition, predictions for adverse weather conditions from previous noise models developed for HVO South are generally consistent with measured levels (eg within 1 to 2 dB). This has been achieved frequently for compliance monitoring event samples by modelling GPS data provided for all plant at a given 15 minutes in time and the weather conditions during the sampling event.

iv Sleep disturbance

Sleep within residences may be disturbed by intermittent noises such as shovel gates banging, bulldozer track plates and heavy vehicle reversing alarms. The criteria used to assess sleep disturbance are based on the criteria within the project approval (PA 06_0261), which are consistent with the NSW EPA's requirement for the maximum L_{max} level of 'background noise level plus 15dB'.

Predicted noise levels under prevailing weather conditions are within the project approval (PA 06_0261) sleep disturbance criterion at all representative assessment locations. It is expected that maximum noise levels at other assessment locations will be similar to or less than those presented, and will also satisfy sleep disturbance criteria (refer to Section 6.8 of the noise and vibration study in Appendix E). These predicted noise levels are shown in the table below.

Table 7.11 Predicted maximum noise levels from site under prevailing meteorology

New ID	Location	External L_{Amax} noise level from on-site plant, dB				L_{Amax} criterion, dB
		Stage 1	Stage 2	Stage 3	Stage 4	
307	Jerrys Plains Rd	39	37	39	38	45
321	Jerrys Plains	35	35	35	36	45
160	Maison Dieu	41	41	40	38	45
261	Maison Dieu	41	41	40	38	45
77	Warkworth	40	44	41	44	45

Notes: 1. The L_{eq} operational noise level prediction from Appendix C in the noise and vibration study has been adopted where it is higher than the predicted L_{max} noise level. This is because it is theoretically impossible to measure an L_{eq} greater than the L_{max}. This was the case in most instances. However, the prediction method adopts the maximum noise level from a single source which can result in an L_{max} prediction less than the overall L_{eq} result, which includes all noise sources.

v Construction noise

Construction activities planned for the proposed modification include the LCPP, rail loop and rail spur. These activities will be undertaken concurrently and noise emissions generated will be less than that from mining operations. Therefore, they will not contribute to the total overall received noise at surrounding residences. As described in Section 3.2.2, construction activity was modelled together with indicative Stage 2 and Stage 3 mining to represent a worst case noise scenario during these stages.

vi Rail traffic noise

The proposed modification will not result in any net increase in rail traffic above currently approved rail activities servicing HVO. While noise from rail movements on the rail loop and loading of the wagons has been included and assessed with the industrial noise from the site, noise emissions from the proposed rail spur options were considered separately as required by the RING.

The proposed modification includes up to two trains (four movements) on the approved Lemington rail spur in any 24 hour period, and predictions have assumed a worst case of four movements in any night period. The calculations of $L_{Aeq,night}$ at the closest most exposed residences of Maison Dieu and Warkworth range between 1dB to 10dB under adverse weather. This is well below and satisfies the RING acceptable recommended noise level of 40dB $L_{Aeq,night}$ further details relating to rail traffic noise are detailed in Section 6.9.2 of the noise study in Appendix E.

Other off-site transportation will remain consistent with current operations (eg road traffic).

7.3.2 Cumulative noise assessment

The ambient noise at assessment locations in the vicinity of the proposed modification is also influenced by nearby industrial premises. To assess cumulative impacts, the L_{Aeq} noise levels predicted by this assessment were combined with the L_{Aeq} noise levels from relevant publically available documents.

Clause 12AB(3) of the Mining SEPP provides non-discretionary development standards relating to cumulative noise. It states:

> The development does not result in a cumulative amenity noise greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings.

The Mining SEPP references the acceptable noise level from the INP Table 2.1. Satisfying the acceptable noise level implies the noise amenity of the area is not compromised and that the area is habitable commensurate with rural and other respective categories.

The results of the cumulative assessment show that the INP's (and the Mining SEPP non-discretionary standard) acceptable night time 40dB $L_{Aeq,9hour}$ criterion is satisfied at all but one location.

The exception is assessment location 77 (located in Warkworth village), where current approved mining at Wambo Mine dominates expected noise levels, with relatively insignificant contributions from the proposed modification (1 to 4 per cent).

7.3.3 Vacant land assessment

The VLAMP provides noise acquisition criteria for privately owned land parcels. For the proposed modification, acquisition criteria of 55dB, 50dB and 45dB ($L_{Aeq,\ period}$) for the day, evening and night periods, respectively, on more than 25 per cent of any privately owned apply according to the VLAMP. This applies to noise from all industrial sources cumulatively and contribution to exceedance of these criteria from the proposed modification needs to be quantified.

The lateral distribution of mine noise levels was assessed over vacant and occupied privately owned land parcels. The assessment considered predicted noise levels from the proposed modification along with potential cumulative noise levels from other mine operations, as described in Section 7.3.2, as required by the VLAMP.

A conservative screening method approach was adopted; with worst case noise levels initially determined using single point noise predictions and the potential percentage noise level contribution from surrounding mining operations. A high resolution noise prediction grid was used where noise levels could not be reasonably inferred using nearby single point predictions or potential cumulative noise levels approached VLAMP criteria.

The assessment concluded that predicted $L_{Aeq,period}$ noise levels satisfy the VLAMP 25 per cent exceedance criteria on all vacant and occupied privately owned land parcels for day, evening and night periods during calm and worst case prevailing meteorological conditions. The parcel of vacant land already afforded voluntary acquisition rights upon request within the project approval (PA 06_0261) (refer to Section 7.2.1) does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments and government policy.

7.3.4 Blasting noise and vibration assessment

Off-site noise and vibration from blasting will not be materially different to the approved operations under the proposed modification. Nonetheless, potential blasting impacts were considered for the extremities of approved disturbance areas as detailed in Section 8 of the noise study in Appendix E.

HVO's existing blast management procedures include the active management of blast design and use of appropriate charge masses to minimise airblast overpressure and ground vibration. The charge masses (or maximum instantaneous charge (MIC)) needed to achieve human annoyance based criteria have been calculated using the formulae in the Blastronics Pty Limited publication (Blastronics 1994) and are presented in Table 8.1 of the noise and vibration study (Appendix E). This provides a guide to assist blast designers with their assessment of potential impacts at the specified distances from assessment locations. Table 8.1 demonstrates that ground vibration limits will be achieved during all types of blasts for separation distances of over 3km. Within 3km, blasts will be designed to achieve the appropriate limits and in all cases will be monitored. Appropriate management of blasts will be needed to ensure blast noise overpressure limits are satisfied.

For potentially sensitive structures, such as St Phillip's Church in Warkworth village and outbuildings at Archerfield, a conservative limit of 10mm/s peak particle component vibration velocity has been adopted. Blasting will be at its closest to St Phillip's Church during the indicative Stage 2 mine plan at South Lemington Pit 1 with an estimated separation distance of at least 1,600m. To achieve the limit at the church from blasting located 1,600m away, Blastronics formulae suggest a MIC of up to 2,200kg can be used. This should be used as a guide to blast designers, and be confirmed through monitoring. Therefore, it is anticipated that ground vibration at St Phillip's Church will achieve criteria.

Very little evidence is available in literature on the direct impacts that blast noise has on livestock or animals in general. Blast noise is not a new or newly introduce source for the area and, therefore, it is expected that livestock and other animals are accustomed to such sources of noise. For the proposed modification, the current level of noise from blasting will not increase significantly at locations where livestock or animals inhabit such as surrounding grazing land. Impacts on animals are, therefore, expected to be minimal.

Therefore, additional blasting impacts under the proposed modification are considered highly unlikely and current blasting management practices will continue to be implemented. Further, the Mining SEPP (clauses 12AB(5) and (6)) non-discretionary standards for acceptable air-blast overpressure and ground vibration, respectively, are satisfied at all privately owned residences under the continued implementation of blasting management practices.

7.3.5 Residual level of impact

The INP, in Section 8.2.1, lists the matters to be considered if predicted noise levels exceed the PSNLs after reasonable and feasible mitigation has been applied. Table 7.12 provides an assessment of residual impacts from the proposed modification.

Table 7.12 Residual level of impact

INP factors for consideration	Justification of the proposed modification
1. Characteristics of the area and receivers likely to be affected	The majority of the local area surrounding the proposed modification is characterised by mining and associated infrastructure and agricultural land, mainly pasture, with moderate sized stands of native woodland retained along the steeper hillsides and ridgelines and in patches along creek lines. The proponent owns a substantial area of land surrounding HVO South. The now HVO has been in operation since 1969 and the originally approved mine has been modified several times. Immediately to the south is Warkworth Mine, commissioned in 1981 which has been operating as an integrated complex with Mount Thorley Mine since 2004. The Bulga Coal Complex, which is adjacent to the south of MTW, was commissioned in the 1980s. Wambo Mine, also to the south, commenced in 1969. The noise and vibration study predicted noise levels at 163 privately owned assessment locations surrounding the mine. The predicted noise levels are during worst case INP prevailing meteorological conditions and for the majority of the time actual noise levels are likely to be less than those predicted. Of the 163 assessment locations, a total of 30 assessment locations are predicted with noise levels above PSNLs over the life of the mine. Of the 30 assessment locations, four are predicted with negligible noise level exceedances (0-2 dB above PSNL), 25 are predicted with moderate noise level exceedances (3-5 dB above PSNL) and one (location 77) is predicted with significant noise level exceedances (greater than 5 dB above PSNL). Thirteen of the 17 properties in Maison Dieu with predicted moderate noise level exceedances are currently entitled to mitigation in the project approval (PA 06_0261), with an additional four properties to be afforded mitigation due to the proposed modification. Further, location 77 predicted with a significant noise level exceedance has previously been identified in an acquisition zone of a neighbouring mine. This leaves a remaining eight residential assessment locations on Jerrys Plains Road with moderate noise level exceedances due to the proposed modification which accounts for less than 7 per cent of all assessment locations considered. It should be noted that six of these eight additional properties would be afforded acquisition rights and the remaining two would be afforded mitigation rights due to the United Wambo Project (refer to Section 3.2.5), should it be approved. The noise from the proposed modification is predicted to be similar to approved operations for assessment locations to the east (eg Maison Dieu) and marginally higher as the project progresses for western assessment locations. The proposed noise suppression and fleet management will mean the advancement westward will not result in a material increase to noise levels. A cumulative noise assessment in accordance with the INP and Mining SEPP demonstrates criteria will be satisfied for all assessment locations with the exception of location 77 (Warkworth), where current approved mining at Wambo dominates expected noise levels. There is a very large range of human reaction to noise, including those who are very sensitive to noise. This noise-sensitive sector of the population will react to intruding noises that are barely audible within the overall noise environment, or will have an expectation of very low environmental noise levels. On the other hand, there are those within the community who find living in noisy environments, such as near major industry, on main roads or under aircraft flight paths, an acceptable situation. The bulk of the population lies within these two spectrums, being unaffected by low levels of noise and being prepared to accept levels of noise commensurate with their surroundings.

Table 7.12 Residual level of impact

INP factors for consideration	Justification of the proposed modification
2. Characteristics of the proposal and its noise or vibrations	The site is an existing and well established mine in the Hunter Valley. The application to modify PA 06_0261 is to allow: • the progression of mining to the base of the deeper Bayswater seam from Cheshunt Pit into Riverview Pit and mining to the base of the Vaux seam below the Bowfield seam in South Lemington Pit 2; • a modification to the currently approved overburden emplacement strategy to enable an increase in height in some areas up to 240mAHD and incorporation of micro-relief to provide a more natural final landform; • an increased rate of extraction from 16Mtpa to 20Mtpa ROM coal at peak production and an increased processing rate of coal extracted from HVO South from 16Mtpa to 20Mtpa of ROM coal across HVO CPPs; and • the update of the Statement of Commitments within PA 06_0261 with removal of commitments that are redundant or inconsistent with measures prescribed in approved management plans. This includes the transition from prescriptive blasting conditions and replacement with contemporary outcome based conditions. HVO South currently invests significantly in the noise management on the mine and will continue to do so under the proposed modification. For example, continued progression of attenuation of haul trucks at HVO, any new or contractor haul trucks are required to be attenuated and operational noise measures continued to be used to control noise as outlined in the NMP. This may include noise suppression of fleet as determined by operational requirements. The assessment has identified that noise levels predicted above PSNLs will occur during worst case prevailing metrological conditions. It has been demonstrated that with continued management of the mine, such as limiting some plant and equipment operation during adverse meteorological conditions, and implementing equipment fleet with good practice noise suppression, that INP PSNLs can be met for the majority of assessment locations. The noise modelling adopts area specific validation and therefore provides added confidence in the accuracy of predictions. Extensive monitoring to measure compliance would be continued under the proposed modification. The existing socio-economic benefits of HVO South will continue under the proposed modification including: • ongoing direct and indirect employment; • continued community engagement and investment through the HVOCCC and programmes such as the Coal & Allied Community Development Fund, sponsorships and donations, with current community contributions commitments being approximately $4 million for the period between January 2015 and December 2017; and • additional direct economic benefits and flow-on economic effects of HVO South with 21 per cent of revenue to be paid in the form of $160 million taxes and $243 million royalties. In addition, as described in Section 15.3.3, a Near Neighbour Amenity Resource fund will be established and fund works and services to improve amenity for near neighbours. The scope of the programme will be developed in consultation with local stakeholders and will be in addition to the technical mitigation and management measures outlined elsewhere in this EA.

Table 7.12 Residual level of impact

INP factors for consideration	Justification of the proposed modification
3. The feasibility of additional mitigation or management measures: - Alternative sites or routes for the development - The technical and economic feasibility of alternative noise controls or management procedures	HVO South is an existing and well established mine in the Hunter Valley and relocation is not reasonable or feasible. The proponent has considered a range of noise management and mitigation measures for the proposed modification. Those that are considered reasonable and feasible have been included in this assessment. This includes continued investment in noise suppression for equipment fleet (see details in Section 6.3.1 of the noise and vibration study) and limiting plant and equipment operation during worst case meteorological conditions.
4. Equity issues in relation to: - The costs borne by a few for the benefit of others - The long-term cumulative increase in noise levels - The opportunity to compensate effectively those affected	The proponent will be investing significantly in noise management and mitigation over the life of the proposed modification which will be of benefit to the surrounding communities. The cumulative noise assessment demonstrates that with reasonable and feasible mitigation and management in place that the INP recommended acceptable amenity noise limits can be achieved for the life of the mine, with the exception of location 77 (located in Warkworth), where current approved operations at a neighbouring mine operation leads to an exceedance of acquisition limits. The proponent will appropriately compensate all assessment locations identified with moderate or significant noise level exceedance as negotiated with DP&E and the community.

7.3.6 Community engagement

As described in Section 5.3.2, the proponent presented information to the November 2016 HVOCCC meeting in response to a request for further information regarding the mine design principles (ie avoid and mitigate) and potential noise impacts from the proposed modification to private dwellings in Maison Dieu.

Information presented to the HVOCCC, provided in Appendix D, showed that the mine design of the proposed modification incorporates key features that have avoided some noise generating activities with potential to impact private dwellings in Maison Dieu. For example:

- Material will be emplaced further north in the Cheshunt emplacement areas which provide protection from noise generation for sensitive receivers to the east.
- Strategic emplacement of overburden within areas along the previously internal haul route alignments, as mining progresses westward, creating a landform consistent with the existing rehabilitated areas which would provide further protection from noise impacts to the east.

The presentation provided to the HVOCCC in November 2016 is in Appendix D.

7.4 Management and monitoring

The existing noise management system described in Section 7.2.5 will continue under the proposed modification.

The proposed modification will continue to implement the current best practice management and monitoring practices described in the existing BMP to protect safety of people, property, public infrastructure and livestock.

7.5 Conclusions

Noise mitigation and management measures were incorporated into the conceptual mine design through discussions between noise specialists and mine planning engineers.

The noise study assessed noise and vibration emissions under the proposed modification against the conditions of the project approval (PA 06_0261), INP requirements and VLAMP. The assessment concluded that operational noise will comply with the project approval (PA 06_0261), for all assessment locations during 'calm' weather conditions for day, evening and night periods.

A conservative assessment of managed operational noise levels during adverse weather predicts that one assessment location in Warkworth village (the remaining residence at location 77, which is currently within the voluntary acquisition zone for a neighbouring mine) will be entitled to voluntary acquisition rights and twelve additional assessment locations (eight on Jerrys Plains Road and four in Maison Dieu) will be entitled to voluntary mitigation rights. It should be noted that the Jerrys Plains Road residences are impacted by the existing Wambo Mine operations and six of these eight additional properties would be afforded acquisition rights and the remaining two would be afforded mitigation rights due to the United Wambo Project (refer to Section 3.2.5), should it be approved.

The noise from the proposed modification is predicted to be similar to approved operations for assessment locations to the east (Maison Dieu) and marginally higher for western assessment locations (Jerrys Plains Road).

The results of the cumulative assessment show that the proposed modification satisfies the INP's (and the Mining SEPP non-discretionary standard) acceptable night time 40dB $L_{Aeq,9hour}$ criterion at all but one location (ie location 77) which was previously identified as impacted from a surrounding mine.

An assessment of residual impacts undertaken in accordance with Section 8.2.1 of the INP concluded that reasonable and feasible mitigation has been applied to the proposed modification.

The study also concluded that impacts are within appropriate criteria (including Mining SEPP (clause 12AB(5) and (6)) non-discretionary standards for acceptable air-blast overpressure and ground vibration) for operational blasting activities and rail operations on the proposed spur with the continued implementation of blast management practices.

8 Air quality and greenhouse gas

8.1 Introduction

This chapter provides a summary of the air quality and greenhouse gas study prepared by Todoroski Air Sciences Pty Ltd (TAS), which is presented in full in Appendix F.

The chapter describes the existing air quality environment, predicted emissions, potential impacts at assessment locations, and management and monitoring measures.

The air quality and greenhouse gas study was completed with reference to:

- the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the EPA Approved Methods, DEC 2005); and
- the *Voluntary Land Acquisition and Mitigation Policy* (DP&E 2014) (VLAMP).

Air quality scientists and modellers worked closely with the proponent during the mine plan development phase. This enabled important air quality mitigation to be incorporated into the design and consideration of the operational dust management regime.

8.2 Existing environment

8.2.1 Topography and climate

The surrounding landform and local climate has a bearing on how air in the locality moves and disperses air emissions, thus it is important to understand and to accurately consider these factors when conducting an air quality and greenhouse gas study.

The terrain features of the surrounding area which form the Hunter Valley region (see Section 2.2) effect the local wind distribution patterns and flows.

Long-term climate data was used to characterise the local climatic conditions. The data was collected at the Bureau of Meteorology's (BoM) station at Jerrys Plains Post Office (Station Number 061086), approximately 10km west-northwest of HVO South. A summary of the climatic data is provided below:

- January is the hottest month with a mean maximum temperature of 31.7°C and July is the coldest month with a mean minimum temperature of 3.8°C.
- Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity levels range from 59 per cent in October to 80 per cent in June. Mean 3pm relative humidity levels vary from 42 per cent in October to December to 54 per cent in June.
- Rainfall peaks during the summer months and declines during winter. The data show January is the wettest month with an average rainfall of 77.7mm over 6.4 days and August is the driest month with an average rainfall of 36.1mm over 5.2 days.
- Wind speeds during the warmer months have a greater spread between 9am and 3pm compared to the colder months. The mean 9am wind speeds range from 8.6km/h in April to 11.7km/h in September. The mean 3pm wind speeds vary from 11km/h in May to 14.7km/h in September.

The Cheshunt and HVO meteorological stations (see Figure 8.1) are operated at HVO to assist with environmental management of operations. Annual and seasonal windroses were prepared from available data collected in 2014. Analysis of the windroses shows that, on an annual basis, the general wind flows at the Cheshunt station are along the north-west to south-east axis which is typical of the Hunter Valley conditions. Very few winds originate from the north-east and south-west quadrants.

The annual wind flow at the HVO station is skewed in an anticlockwise direction with winds along a west to east-southeast axis. This station may be influenced by local terrain features which at this location would skew the winds. Dominant seasonal winds are south-east and east-southeast at both stations in summer, north-west and west-northwest followed by the south-southeast at the Cheshunt station and from the west and east-southeast at the HVO station in autumn, west-northwest and west at both stations in winter and north-west, south-east and south-southeast at the Cheshunt station and from the west and east-southeast at the HVO station in spring.

8.2.2 Current air quality management

HVO South and HVO North have integrated their management of air quality and operate an integrated air quality and greenhouse gas management plan. The plan incorporates all relevant conditions of the project approval (PA 06_0261), together with relevant legislation, EPL conditions and relevant standards and guidelines. It was prepared in consultation with relevant government agencies.

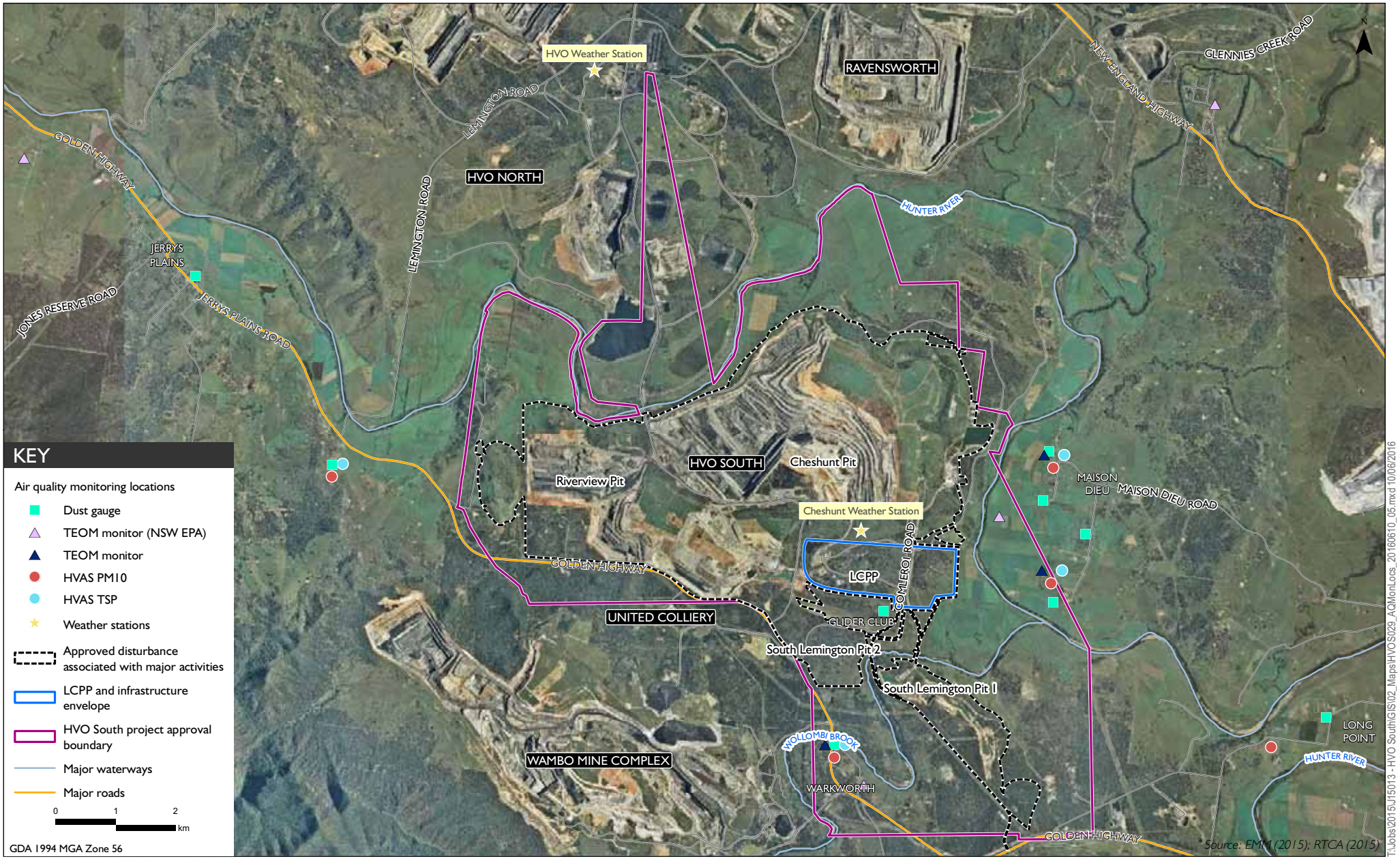
Measures include implementation of best practice management techniques to reduce dust, and staff guidance for the visual identification and hence control of dust. Other measures include alarms based on monitoring to manage potentially rising dust levels and to help prevent or reduce potential impacts. Operational measures such as enforcing a cessation of particular operations during periods of high dust provide additional assistance in reducing the potential dust impacts.

HVO South utilises meteorological forecast data to guide the day to day planning of mining operations. These systems identify potentially adverse conditions that may arise over the coming day, giving HVO South time to prepare in advance means to mitigate dust appropriately.

The NSW EPA has placed a Pollution Reduction Programme (PRP) on coal mines as part of the Dust Stop programme, a recommendation of the Katestone (2011) report reviewing operational practices and measures to minimise dust generation. A series of PRPs are attached to each coal mine's EPL, including HVO's, which requires identification and assessment of the practicality of implementing further best practice measures.

A comprehensive air quality monitoring network supports the management of dust from HVO South and is shown in Figure 8.1. Monitors are positioned in areas representative of the surrounding assessment locations. This network is augmented by ambient air quality monitoring stations operated by the NSW EPA and, therefore, provides an extensive network of stations from which to measure ambient air quality.

Air quality monitoring at HVO South is supplemented with portable real-time PM_{10} monitoring and visual surveillance to support the reactive air quality management system. The monitors are portable to enable relocation as mining and seasonal conditions change. Whilst not a significant component of the air quality monitoring system and network at HVO, depending upon conditions, these monitors can be used for trigger action response plans in response to increasing concentrations of particulate matter approaching levels to protection human health and amenity. Visual surveillance monitoring is also used in the network to assist with identification of problem dust sources, informing a management response and verifying the effectiveness of controls implemented.



Note: some monitoring locations offset for clarity

COAL & ALLIED

Air quality monitoring network

HVO South Modification 5
Environmental Assessment

Figure 8.1

As described in Section 3.1.5, Coal & Allied has a negotiated written air quality agreement with the nearby HVGC that it will manage HVO South mining operations to meet the relevant dust criteria when the facility is in use.

These current air quality management controls were a key component of the mine design process (as described in Section 3.3) which enabled key features to be developed in order to avoid and mitigate potential air quality (ie dust generation) impacts on private dwellings in Maison Dieu. This was afforded through the emplacement of material further north in the Cheshunt emplacement areas. Design principles to avoid and mitigate environmental and amenity impacts were communicated to HVOCCC in November 2016 (refer to Section 5.3.2 and 8.3.3).

8.2.3 Ambient air quality

i Types and sources of particulates

The main sources of particulate matter in the wider area include active mining, agricultural activities, emissions from local anthropogenic activities such as motor vehicle exhaust and domestic wood heaters, urban activity and various other commercial and industrial activities. Particulate matter consists of dust particles of varying size and composition, which are referred to as deposited dust, total suspended particulate matter (TSP), and TSP particles which have a diameter of 10 micrometres (µm) or less (PM_{10}) or 2.5µm or less ($PM_{2.5}$).

Other air pollutant emissions which can potentially arise from mining operations such as the diesel powered equipment include carbon monoxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) used on-site. Emissions associated with diesel powered equipment are generally considered too low to generate any significant off-site concentrations and were not assessed in detail in the assessment. The potential NO_2 and other oxides of nitrogen (NO_X) emissions associated with blasting activity were assessed qualitatively.

ii Air quality goals and criteria

Air quality goals are benchmarks set to protect the general health and amenity of the community in relation to air quality. The air quality goals relevant to the study are outlined in the EPA Approved Methods and summarised in Table 8.1. The NSW EPA currently does not have impact assessment criteria for $PM_{2.5}$ concentrations; however, the National Environment Protection Council (NEPC) has released a variation to the *National Environment Protection Measure* (NEPC 2003) to include advisory reporting standards for $PM_{2.5}$, which is included in Table 8.1.

The Mining SEPP non-discretionary standard with respect to cumulative air quality at private dwellings of PM_{10} annual average criterion of 30µg/m^3 is equivalent to the NSW EPA annual average PM_{10} criterion.

Table 8.1 Impact assessment air quality goals

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90µg/m^3
PM_{10}	Annual	Total	30µg/m^3
	24 hour	Total	50µg/m^3
Deposited dust	Annual	Incremental	2g/m^2/month
		Total	4g/m^2/month
$PM_{2.5}$*	24 hours	-	25µg/m^3
	Annual	-	8µg/m^3
Carbon monoxide (CO)	15 minute	-	100mg/m^2
Nitrogen dioxide (NO_2)	1 hour	-	246µg/m^3
	Annual	-	62µg/m^3

Source: Approved Methods (DEC 2005).

The VLAMP requires proponents to assess impacts in accordance with the EPA Approved Methods. Voluntary mitigation or acquisition rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 8.2 at any residence or workplace. Voluntary acquisition rights may also apply where there are exceedances of the criteria on more than 25 per cent of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls (vacant land).

Table 8.2 Particulate matter acquisition and mitigation criteria

Pollutant	Averaging period	Impact	Criterion
PM_{10}	Annual	Total	30µg/m^3*
	24 hour	Total	50µg/m$^{3\#}$
TSP	Annual	Total	90µg/m^3*
Deposited dust	Annual	Incremental	2g/m^2/month$^\#$
		Total	4g/m^2/month*

Source: DP&E (2014).

*Notes: *Cumulative impact (ie increase in concentration due to the development plus background concentration due to all other sources).*

 # Incremental impact (ie increase in concentration due to the development alone), with five allowable exceedances of the criteria over the life of the development.

iii Regional and local air quality monitoring

To quantify ambient air quality, data was collected from a number of air quality monitors in the vicinity of HVO South including eight Tapered Element Oscillating Microbalances (TEOMs), 10 High Volume Air Samplers (HVAS) measuring either TSP or PM_{10}, nine dust deposition gauges, two Beta attenuation monitors (BAM) measuring $PM_{2.5}$, and three NO_2 monitors (see Figure 8.1). A summary of the available and reviewed ambient monitoring data relevant to the proposed modification is provided below.

- Annual average PM_{10} concentrations for each of the monitoring stations were below the relevant criterion of 30µg/m³.

- Maximum 24-hour average PM_{10} concentrations were on occasion above the relevant criterion of 50µg/m³ and this can generally be attributed to events such as bushfires, dust storms, localised sources and dust emissions as a result of mining activity. The annual trends seen in the TEOM and HVAS monitoring data indicate that PM_{10} concentrations are generally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the occurrence of windblown dust, bushfires and pollen levels.

- Annual average TSP concentrations are below the relevant criterion of 90µg/m³.

- Annual average dust deposition concentrations are below the relevant criterion of 4g/m^2/month.

- Maximum 24-hour $PM_{2.5}$ concentrations were on occasion above the relevant criterion of 25µg/m^3. Ambient $PM_{2.5}$ levels are likely to be governed by many non-mining background sources such as wood heaters and motor vehicles with peaks observed during winter. It is unlikely that the trends in the $PM_{2.5}$ levels observed in the data are due to mining activity as mining produces a relatively steady level of $PM_{2.5}$ particulate emissions over the entire year.

- Maximum daily 1-hour average NO_2 concentrations are well below the relevant criterion of 246µg/m³.

8.3 Impact assessment

8.3.1 Method

The assessment investigated the potential for adverse air quality impacts to occur at surrounding assessment locations as a result of the proposed modification through the use of air dispersion modelling. Assessment locations used were as per the noise and vibration study shown in Figure 3.2. Estimated maximum dust emissions from the proposed modification, and all nearby mines were added to existing air quality levels to determine the total impacts that may arise. The calculated dust concentrations at the assessment locations were then compared with the air quality criteria presented in Tables 8.1 and 8.2 to determine whether compliance was achieved. This is discussed in detail in Section 5 of Appendix F.

i Dispersion modelling

The modelling approach used was a combination of the CALPUFF Modelling System for dispersion modelling and The Air Pollution Model (TAPM). The CALPUFF model is an advanced 'puff' model that deals with the effects of complex local terrain on dispersion meteorology. It allows for spatial variation of meteorology, such as wind patterns, over a three-dimensional modelling domain in an hourly varying time step. The CALPUFF approach is accepted by the NSW EPA as an appropriate modelling system for open cut coal mines in NSW. The potential impacts of the proposed modification were modelled using local topographical and meteorological data.

The assessment considered two indicative mine plan years (scenarios) which were chosen to represent potential worst case impacts of the proposed modification. The two scenarios nominally represent the generally highest levels of proposed activity for the modification in future years, with Stage 2 being closest to the south-eastern and eastern residences and Stage 3 being closest to the north-western and western residences.

For each of the chosen modelling scenarios, dust emission estimates were calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from both locally developed and US EPA developed documentation. As stated in Section 5.4 of Appendix F, the estimated dust emissions are commensurate with a mining operation utilising reasonable and feasible best practice dust mitigation applied where applicable.

ii Cumulative assessment

In addition to the estimated dust emissions from the proposed modification, emissions from all nearby approved mining operations were also modelled, in accordance with their current consent (or current proposed project), to assess potential cumulative dust effects. The modelling also included preliminary emission estimates from the proposed United Wambo Project. Emissions estimates from these sources were derived from information provided in the air quality assessments available in the public domain at the time of modelling. These estimates are likely to be conservative, as in many cases, mines do not continually operate at the maximum extraction rates assessed in their respective environmental assessments. Further, it is noted that consents for some mining operations will expire at some stage during the proposed modification. However, to assess potential worst case cumulative dust effects, it has been assumed that these operations will continue until the end of the proposed modification. This adds considerable conservatism to the model predictions.

Emissions from nearby mining operations will contribute to the background level of dust in the area surrounding the proposed modification, and these emissions were explicitly included in the modelling assessment. Additionally, there will be numerous smaller or very distant sources that contribute to the total background dust level. Modelling these sources explicitly is impractical; however, the residual level of dust due to all other such non-modelled sources has been included in the cumulative results.

Maximum background levels of 24-hour average $PM_{2.5}$ and PM_{10} have, in the past, reached levels near the relevant criterion (depending on the monitoring location and time). As a result, the approach of adding maximum background levels to maximum predicted proposed modification only levels (referred to as the Level 1 EPA approach) would show levels above the criterion. In such situations, more detailed assessment is required. The Level 2 EPA approach sets out a more thorough assessment whereby the measured background level on a given day is added contemporaneously with the corresponding predicted project-only level using the same day's weather data. This method factors into the assessment the spatial and temporal variation in background levels affected by the weather and existing sources of dust in the area on a given day.

The 2014 calendar year was selected as the period for modelling the proposed modification. This was done based on a review of the long-term meteorological and ambient air quality conditions that found this period contains meteorological data representative of the prevailing conditions. Accordingly, ambient (background) dust concentration data for January 2014 to December 2014 from the TEOM and BAM stations were applied in the Level 2 contemporaneous 24-hour average $PM_{2.5}$ PM_{10} assessment and represent the prevailing measured background levels in the vicinity of HVO South and surrounding assessment locations. As the existing mine was operational during 2014, it will have contributed to the measured levels of dust in the area on some occasions. Due to this it is important to account for these existing activities in the cumulative assessment. Modelling of the actual mining scenario for the 2014 period (in which the weather and background dust data were collected) was conducted to determine the existing contribution to the measured levels of dust. The results were applied in the cumulative assessment to minimise potential double counting of existing mine emissions (as they will occur in both the measured data and in the predicted levels), and thus to make a more reliable prediction of the likely cumulative total dust level.

a. Interaction with the United Wambo Project

The cumulative assessment of the proposed modification included estimates of the potential dust emissions from the United Wambo Project and were based on the indicative production rates available at the time of modelling.

Since this time, the air quality study for the United Wambo Project (Jacobs 2016) has become publically available. The data in the Jacobs (2016) study were compared with emission estimates included in the cumulative assessment for the proposed modification to determine any potential underestimation in this assessment. It was determined that the air quality study for the proposed modification assumes significantly higher TSP emissions for the United Wambo Project (approximately 70 to 80 per cent higher). Accordingly, the results presented in the study and this EA are considered to be highly conservative.

iii Coal dust emissions from train wagons

As product coal produced at HVO South will continue to be transported off-site via rail to the Port of Newcastle for export to customers, there is potential to generate coal dust emissions from train wagons during transportation. The proposed modification does not seek any increase in product coal transported or any change to the approved rail movements and it is not anticipated that there will be any change to air quality levels due to this activity. However, consistent with the noise assessment, potential impacts associated with coal dust emissions from train wagons were assessed to ensure there is no significant impact due to the already approved levels of rail activity for HVO South.

The scale of the potential emissions depends on various factors including the material properties of the product coal, meteorological factors and train/wagon specific factors. To determine the potential for dust lift-off during transportation, dust emissions were estimated from measurements conducted in other studies (Connell Hatch 2008; Ferreira et al 2003).

8.3.2 Predicted impacts

i Dispersion modelling

The dispersion model predictions for the modelled mine plan stages are presented in this section. The assessment locations where impacts are predicted to exceed relevant assessment criteria are summarised in Table 8.3 showing the year(s) of impact and the level of impact.

Figure 8.2 shows the incremental 24 hour PM_{10} (50µg/m^3) concentrations for indicative mine plans stages 2 and 3 under the proposed modification and a comparison with the worst case predictions of the approved mine plan shown in the ERM (2008) EA.

Figure 8.3 shows the annual average PM_{10} (30µg/m^3) for indicative mine plans stages 2 and 3 under the proposed modification a comparison with the worst case predictions of the approved mine plan shown in the ERM (2008) EA. Figure 8.3 also shows the worst case cumulative annual average PM_{10} (30µg/m^3) which represents the Mining SEPP non discretionary standard (clause 12AB(4. Additional isopleth diagrams for dust emissions are displayed in Appendix F of the air quality and greenhouse gas study.

In summary:

- the proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from neighbouring mine operations; and

- under the VLAMP, no additional private dwellings are impacted that are not already afforded acquisition rights from neighbouring mine operations as the VLAMP significant impact criteria correspond with the Mining SEPP (clause 12AB(4)) non-discretionary standard with respect to cumulative air quality at private dwellings.

It should be noted that the proposed modification is predicted to exceed the VLAMP and Mining SEPP PM_{10}, annual average cumulative criteria of 30ug/m^3 at four properties, with three properties within Warkworth village and one south-west of Camberwell village. Two of these three Warkworth properties are non-residences (102 - Warkworth Hall and 264 - St Phillip's Church) and the third property (77) is entitled to acquisition upon request from Wambo Mine and Warkworth Mine as noted in Appendix 3 of the project approval (PA 06_0261). The ERM (2008) EA assessed representative receptors in this locality to have exceeded the PM_{10} annual average criteria and found that HVO South contributed a small proportion compared to the contributions from other mines. The property south-west of Camberwell village (assessment location 471) is entitled to acquisition upon request from Ashton Coal's South East Open Cut project.

As noted above, assessment locations 102 and 264 are Warkworth Hall and St Phillip's Church, respectively. These properties are uninhabited and used infrequently. The VLAMP provides guidance of when acquisition rights apply, as follows:

> A consent authority should only apply voluntary acquisition rights where, even with the implementation of best practice management, the development is predicted to contribute to exceedances of the acquisition criteria in Table 3:
>
> - at any residence on privately owned land; or
>
> - at any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace, including consideration of the following factors:
>
> - the nature of the workplace;
>
> - the potential for exposure of workers to elevated levels of particulate matter;
>
> - the likely period of exposure; and
>
> - the health and safety measures already employed in that workplace.
>
> - on more than 25 per cent of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Assessment locations 102 and 264 do not fall within the above criteria as, unlike a residence, they will only be subject to brief periods of potential exposure (less than the minimum period applicable for dust criteria) when infrequently occupied. Therefore, voluntary acquisition rights do not apply to assessment locations 102 and 264.

Table 8.3 Summary of modelled predictions where impacts exceed assessment criteria

Assessment location ID[#]	$PM_{2.5}$	PM_{10}			TSP	Deposited dust	
	Total annual average	Project 24-hour average		Total annual average	Total annual average	Project annual average	Total annual average
	Advisory 8µg/m³	Criterion 50µg/m³		Criterion 30µg/m³	Criterion 90µg/m³	Criterion 2g/m²/month	Criterion 4g/m²/month
	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	No. of days >50µg/m³	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - g/m²/month)	
77	Stage 3 (9)	Stage 2 (64) Stage 3 (56)	1 1	Stage 2 (35) Stage 3 (39)	Stage 3 (93)	-	-
78	Stage 3 (9)	-	-	Stage 3 (39)	Stage 3 (94)	-	-
79*	Stage 2 (9) Stage 3 (9)	Stage 2 (73) Stage 3 (62)	1 1	Stage 2 (38) Stage 3 (41)	Stage 2 (92) Stage 3 (97)	-	-
83*	Stage 2 (9) Stage 3 (10)	Stage 2 (88) Stage 3 (73)	2 1	Stage 2 (44) Stage 3 (46)	Stage 2 (103) Stage 3 (105)	-	-
90	Stage 2 (10) Stage 3 (10)	Stage 2 (95) Stage 3 (79)	3 2	Stage 2 (46) Stage 3 (47)	Stage 2 (106) Stage 3 (108)	-	-
91*	Stage 2 (9) Stage 3 (9)	Stage 2 (83) Stage 3 (72)	1 1	Stage 2 (42) Stage 3 (44)	Stage 2 (98) Stage 3 (101)	-	-
93	Stage 3 (9)	Stage 2 (68) Stage 3 (64)	1 1	Stage 2 (36) Stage 3 (40)	Stage 3 (93)	-	-
94*	Stage 2 (10) Stage 3 (10)	Stage 2 (92) Stage 3 (79)	3 4	Stage 2 (44) Stage 3 (46)	Stage 2 (104) Stage 3 (105)	-	-
96*	Stage 2 (9) Stage 3 (9)	Stage 2 (77) Stage 3 (72)	1 2	Stage 2 (39) Stage 3 (41)	Stage 2 (94) Stage 3 (97)	-	-
99*	Stage 3 (9)	Stage 2 (66) Stage 3 (69)	1 1	Stage 2 (36) Stage 3 (38)	Stage 3 (91)	-	-
102	Stage 3 (9)	Stage 2 (67) Stage 3 (73)	1 2	Stage 2 (36) Stage 3 (38)	-	-	-

Table 8.3 Summary of modelled predictions where impacts exceed assessment criteria

Assessment location ID[#]	$PM_{2.5}$	PM_{10}			TSP	Deposited dust	
	Total annual average	Project 24-hour average		Total annual average	Total annual average	Project annual average	Total annual average
	Advisory 8µg/m³	Criterion 50µg/m³		Criterion 30µg/m³	Criterion 90µg/m³	Criterion 2g/m²/month	Criterion 4g/m²/month
	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	No. of days >50µg/m³	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - g/m²/month)	
105	Stage 2 (11) Stage 3 (11)	Stage 2 (123) Stage 3 (124)	20 44	Stage 2 (53) Stage 3 (53)	Stage 2 (119) Stage 3 (119)	-	-
109*	Stage 2 (9)	Stage 3 (63)	1	Stage 2 (43) Stage 3 (35)	Stage 2 (103)	-	-
114	Stage 2 (11) Stage 3 (11)	Stage 2 (149) Stage 3 (160)	126 126	Stage 2 (55) Stage 3 (54)	Stage 2 (123) Stage 3 (123)	Stage 2 (2.8) Stage 3 (2.5)	Stage 2 (4.6) Stage 3 (4.3)
116	-	Stage 2 (77) Stage 3 (80)	28 20	Stage 2 (34) Stage 3 (31)	-	-	-
117	-	Stage 2 (58) Stage 3 (58)	7 9	-	-	-	-
118	-	Stage 2 (60) Stage 3 (68)	7 9	-	-	-	-
119	-	Stage 2 (64) Stage 3 (67)	7 7	-	-	-	-
121	-	Stage 3 (53)	1	-	-	-	-
125	-	Stage 3 (51)	0	-	-	-	-
158	-	Stage 2 (66) Stage 3 (77)	18 18	Stage 2 (32) Stage 3 (31)	-	-	-
165	-	Stage 2 (71) Stage 3 (76)	19 16	Stage 2 (32)	-	-	-
259	-	Stage 2 (58) Stage 3 (69)	6 8	-	-	-	-

Table 8.3 Summary of modelled predictions where impacts exceed assessment criteria

Assessment location ID[#]	$PM_{2.5}$	PM_{10}			TSP	Deposited dust	
	Total annual average	Project 24-hour average		Total annual average	Total annual average	Project annual average	Total annual average
	Advisory 8µg/m³	Criterion 50µg/m³		Criterion 30µg/m³	Criterion 90µg/m³	Criterion 2g/m²/month	Criterion 4g/m²/month
	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	No. of days >50µg/m³	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - g/m²/month)	
264	-	Stage 2 (63) Stage 3 (73)	1 1	Stage 2 (35) Stage 3 (36)	-	-	-
265	-	Stage 2 (57) Stage 3 (58)	7 9	-	-	-	-
302*	Stage 2 (9)	Stage 2 (56)	4	Stage 2 (43) Stage 3 (33)	Stage 2 (110)	-	-
303*	Stage 2 (9)	Stage 2 (52)	2	Stage 2 (44) Stage 3 (33)	Stage 2 (112)	-	-
304*	Stage 2 (10)	-	-	Stage 2 (51) Stage 3 (36)	Stage 2 (127) Stage 3 (94)	-	Stage 2 (4.3)
305*	Stage 2 (9)	-	-	Stage 2 (41)	Stage 2 (104)	-	-
306*	Stage 2 (9)	-	-	Stage 2 (42) Stage 3 (31)	Stage 2 (107)	-	-
313*	-	Stage 2 (56)	3	Stage 2 (32)	-	-	-
314	-	Stage 3 (78)	6	-	-	-	-
315	-	Stage 3 (66)	7	-	-	-	-
316	-	Stage 3 (83)	5	Stage 3 (31)	-	-	-
319	Stage 2 (9) Stage 3 (14)	Stage 2 (100) Stage 3 (257)	54 195	Stage 2 (42) Stage 3 (85)	Stage 2 (105) Stage 3 (201)	Stage 3 (4.8)	Stage 3 (6.6)
320	Stage 3 (9)	Stage 2 (51) Stage 3 (113)	1 38	Stage 2 (32) Stage 3 (39)	Stage 3 (98)	-	-
442*	-	-	-	Stage 2 (32)	-	-	-

Table 8.3 Summary of modelled predictions where impacts exceed assessment criteria

Assessment location ID[#]	$PM_{2.5}$	PM_{10}			TSP	Deposited dust	
	Total annual average	Project 24-hour average		Total annual average	Total annual average	Project annual average	Total annual average
	Advisory 8µg/m³	Criterion 50µg/m³		Criterion 30µg/m³	Criterion 90µg/m³	Criterion 2g/m²/month	Criterion 4g/m²/month
	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	No. of days >50µg/m³	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - µg/m³)	Year of impact (level of impact - g/m²/month)	
443*	Stage 2 (9)	Stage 2 (68)	9	Stage 2 (39) Stage 3 (31)	Stage 2 (103)	-	-
444	Stage 3 (9)	Stage 2 (55) Stage 3 (102)	2 62	Stage 2 (33) Stage 3 (42)	Stage 3 (104)	-	-
446*	Stage 2 (9)	-	-	Stage 2 (35) Stage 3 (35)	-	-	-
447	Stage 2 (9) Stage 3 (9)	Stage 2 (108) Stage 3 (105)	41 38	Stage 2 (38) Stage 3 (37)	-	-	-
448		Stage 3 (63)	6	-	-	-	-
449	Stage 2 (9) Stage 3 (15)	Stage 2 (95) Stage 3 (259)	47 194	Stage 2 (41) Stage 3 (88)	Stage 2 (103) Stage 3 (206)	Stage 3 (4.7)	Stage 3 (6.5)
450	Stage 2 (10) Stage 3 (13)	Stage 2 (114) Stage 3 (219)	69 158	Stage 2 (46) Stage 3 (75)	Stage 2 (114) Stage 3 (180)	Stage 3 (4.3)	Stage 3 (6.4)
467	Stage 3 (9)	Stage 2 (51) Stage 3 (100)	1 52	Stage 2 (32) Stage 3 (41)	Stage 3 (101)	-	-
471	Stage 2 (9) Stage 3 (9)	-	-	Stage 2 (42) Stage 3 (40)	Stage 2 (97) Stage 3 (94)	-	-

Notes = # Assessment locations highlighted in grey are identified as mine owned assessment locations, and those highlighted in orange are privately owned assessment locations already in the acquisition zone for other mine operations.

**Other mine owned property.*

ii Vacant land assessment

The VLAMP provides air quality voluntary acquisition criteria for privately owned vacant land parcels (see Section 8.2.3ii). For the proposed modification, the acquisition criteria on more than 25 per cent of any privately owned land, shown in Table 8.2, were applied. The assessment was based on the predicted pollutant dispersion contours. It should be noted that Condition 1 within Schedule 3 of the project approval (PA 06_0261) already affords voluntary acquisition upon request rights to two vacant land parcels (now a single land parcel - refer to Section 3.1.7) near Warkworth village.

The assessment considered privately owned vacant land parcels where a dwelling could be built under existing planning controls under the Singleton LEP. The majority of land relevant to this assessment is zoned RU1 and requires a minimum lot size of 40ha for the construction of a dwelling.

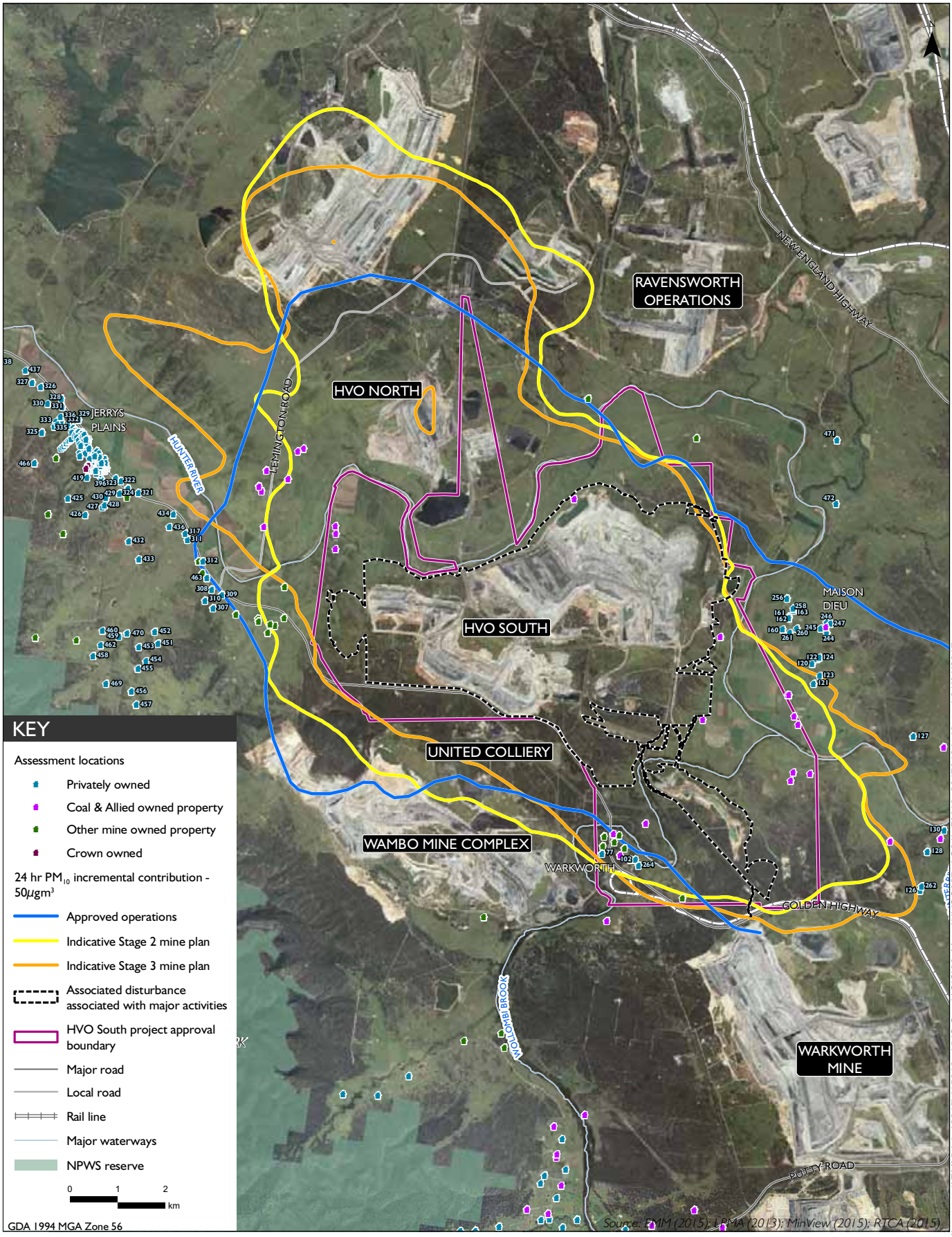
The maximum extent of the 6th highest 24-hour average PM_{10} impact predicted to result from the proposed modification (ie accounting for the five allowable exceedances of the criteria over the life of the development) is the most limiting (most stringent) VLAMP acquisition criterion for the proposed modification and was applied to these vacant land parcels.

The assessment found that the maximum extent of the 6th highest 24-hour average PM_{10} level will not exceed the VLAMP 25 per cent criteria at any additional privately owned land parcels.

Similar to the noise and vibration study, the assessment was also applied to the parcel of vacant land already afforded voluntary acquisition upon request rights within the project approval (PA 06_0261). The assessment predicted to experience dust impacts above VLAMP 25 per cent criteria. However, this property also does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments and government policy.

iii Comparison of modelling predictions

To show the effect of the proposed modification relative to the approved operations, the key results (maximum 24-hour average and annual average PM_{10}) were overlayed with results for the maximum year (Scenario B1) from the most recent modelling assessment for HVO South (Holmes Air Sciences 2008) as illustrated in Figures 8.2 and 8.3. Overall, the comparison indicated that the predicted dust levels associated with the proposed modification will be of a generally similar extent to the approved operations and, therefore, the proposed modification will not result in any significant change.

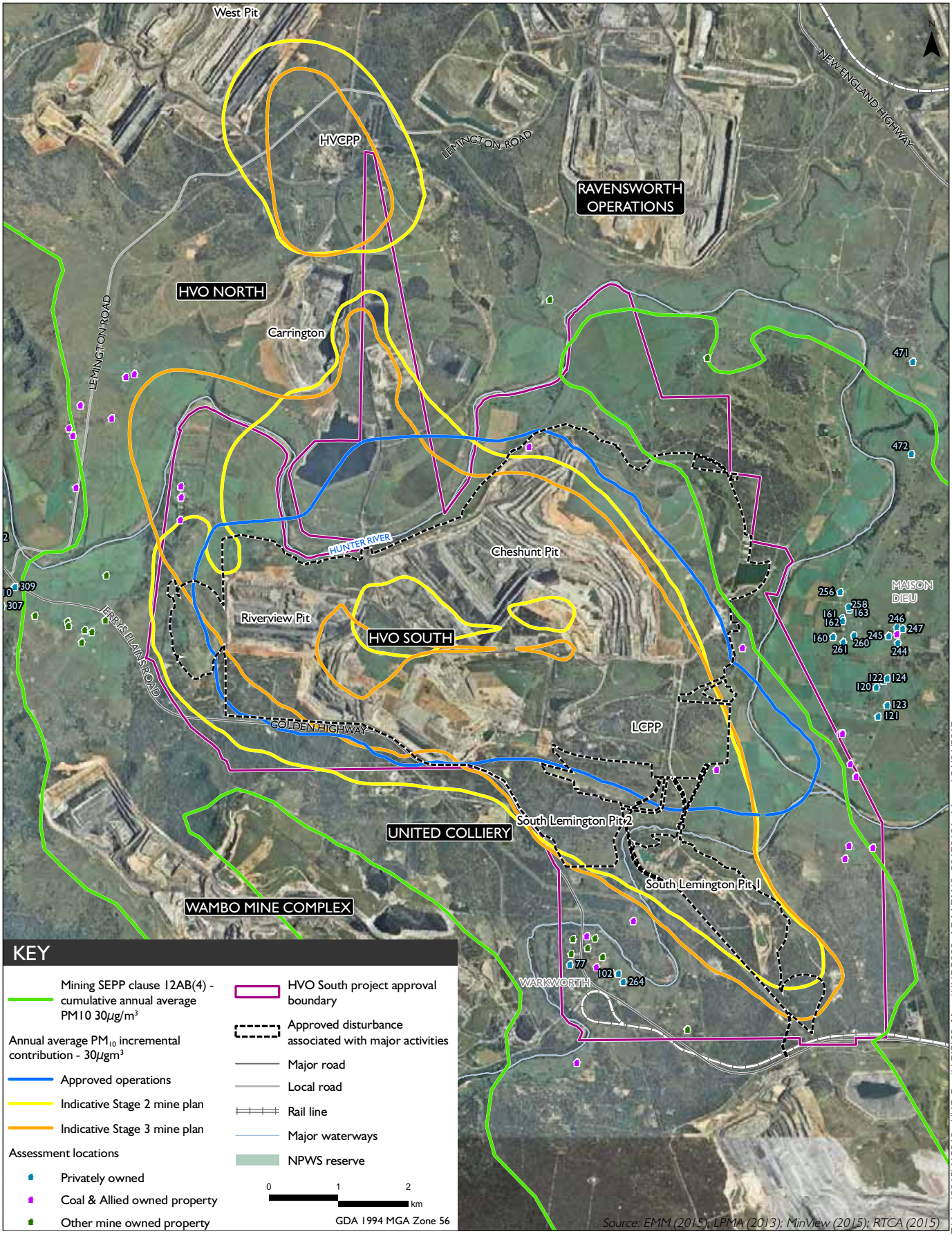


Note: Approved operations contour reproduced from ERM (2008) EA

COAL & ALLIED

Comparison of approved and proposed incremental 24 hr PM_{10} concentrations

HVO South Modification 5
Environmental Assessment
Figure 8.2



COAL & ALLIED

Comparison of approved and proposed incremental annual average PM_{10} concentrations

HVO South Modification 5
Environmental Assessment
Figure 8.3

iv Maximum 24-hour average $PM_{2.5}$ and PM_{10} contemporaneous assessment

The NSW EPA contemporaneous assessment method was applied to examine the potential maximum total (cumulative) 24-hour average $PM_{2.5}$ and PM_{10} impacts for HVO South should the proposed modification be approved. The results of the contemporaneous assessment are shown in Table 8.4.

Table 8.4 NSW EPA contemporaneous assessment – maximum number of additional days per year above the 24-hour average criterion

Assessment location	$PM_{2.5}$ analysis		PM_{10} analysis	
	Stage 2	Stage 3	Stage 2	Stage 3
77*	0	0	**9**	**9**
102*	0	0	**8**	**13**
121	0	0	0	0
126	0	0	2	4
160	0	0	0	1
261	0	0	0	0
262	0	0	2	3
264*	0	0	**7**	**13**
309	0	0	4	1

Notes: **Privately owned assessment locations already in the acquisition zone for other mine operations.*

Bold *indicates potential for a significant impact (ie more than five additional days above the 24-hour average criterion).*

The results of the contemporaneous assessment indicate that there is no likely potential for any significant new cumulative 24-hour average $PM_{2.5}$ impacts to occur due to the proposed modification (noting that the impacted locations are already impacted due to various existing activities). Potential cumulative PM_{10} impacts are likely to be significant in the area near Warkworth village (assessment locations 77 and non-residence locations, 102 – Warkworth Hall and 264 – St Phillip's Church) where it is predicted that there may be 7 to 13 additional days per year above the criteria. It is noted that assessment location 77 is already afforded acquisition rights from other neighbouring mining operations (ie Wambo Mine and Warkworth Mine).

Further analysis of the predicted cumulative $PM_{2.5}$ and PM_{10} impacts at the likely most impacted of these locations (126, 160 and 309) was undertaken by examining time series plots of the predicted 24-hour average $PM_{2.5}$ and PM_{10} concentrations. The results indicate that $PM_{2.5}$ levels will remain relatively similar as a result of the proposed modification. Due to the prevailing winds, there is some potential increase to PM_{10} levels, generally in areas to the south-east of HVO South during winter and to the north-west during summer.

v Coal dust emissions from train wagons

Dispersion modelling of potential train wagon emissions was calculated using the transportation model CAL3QHCR, developed by the US EPA. To consider the range of varying land use between HVO South and the Port of Newcastle, and the varying orientation of the rail line relative to the prevailing winds, the dispersion model has been set up to assess theoretical sections of the rail line over a distance of 3km with two varying alignments (north/south and east/west) and two different land use categories. Dust level calculation points were applied at 10m spacing, perpendicular from the centre of the rail line source alignment out to a distance to 200m either side of the rail line.

The modelling predictions indicate that at distances of 50m and beyond from the rail track centreline, the maximum 24-hour average TSP concentration for the assessed scenarios will be approximately 2.95µg/m³ through Newdell, and approximately 1.01µg/m^3 through Lemington. For urban areas, the predicted maximum 24-hour average TSP level at 50m from the rail line centre will be approximately 1.71µg/m^3 through Newdell, and approximately 0.58µg/m^3 through Lemington. By assuming that 40 per cent of the TSP is PM_{10} (NSW Minerals Council 2000), the predicted maximum 24-hour average PM_{10} concentration at 50m from the rail line centre will be approximately 1.18µg/m³ through Newdell and 0.40µg/m^3 through Lemington. For urban areas the predicted maximum 24-hour average PM_{10} level at 50m from the rail line centre will be approximately 0.68µg/m^3 through Newdell and 0.23µg/m^3 through Lemington.

This assessment is consistent with the findings of previous studies (Connell Hatch 2008; Ryan and Wand 2014; Malecki and Ryan 2015) in indicating that the potential for any adverse air quality impacts associated with coal dust generated during rail transport will be low and not make any appreciable difference to air quality (refer to Section 7.3 of Appendix F). Further, as the proposed modification is not seeking any increase in product coal transported from HVO South or changes to rail movements, there will not be any changes to the level in air quality as a result of this activity.

vi Blast fume emissions

Blasting activities at HVO South are managed through well understood and established operational procedures and protocols. HVO South operates an approved Blast Management Plan (BMP), which aims to ensure that blasting operations comply with all relevant requirements particularly noise, overpressure, vibration, blast fume and dust effects.

The BMP applies a blasting permissions procedure to guide operators on the suitability of various factors including the weather conditions for blasting. The BMP takes into consideration meteorological factors such as wind speed and direction which can affect the scale of potential blast impacts at assessment locations. A predictive blast system is also used to schedule blast events to the least-risk time of the day where feasible. This approach minimises the risk of any off-site impact occurring, and is based on hourly forecast weather conditions that may affect the dispersion of blast emissions.

To ensure that HVO South is implementing best practice, the proposed modification will remove the current commitments related to blasting and replace them with the following:

The HVO BMP will be updated to include the following blast scheduling procedures:

- 4 – 7 days in advance of blasting – scheduling undertaken in consideration of forecast meteorological conditions (use of publically available forecast information);

- 1 – 3 days in advance of blasting – site-specific blast plume predictions and updated weather forecast information is used to refine the blast schedule, taking account of a range of factors such as shot size and location, requirement for closure of public roads, and risk-assessed likelihood of dust / fume associated with the blast;

- morning of the planned blast – site-specific blast plume predictions are used to determine the optimum time for firing; and

- approaching blast detonation – review of the blasting permissions page for the appropriate pit area which considers wind speed and wind direction relative to sensitive receptors and public roads.

Step 1 aims to ensure that it is likely that there would be favourable air dispersion conditions prevailing after the four to seven days that it may take to load the shot with explosive. Step 2 aims to define the likely blast window, and to begin planning for the blast to occur within that window. Step 3 is the final stage of the blast planning and aims to schedule the optimal blast time on the blast day. Step 4 is the last check immediately before the blast is initiated and is done to ensure that the conditions are as expected, are likely to prevail after the event, are low risk air dispersion conditions (but with that risk being commensurate with the nature of the expected blast), and that the blast may (or may not) proceed.

vii Particulate matter health effects

The air quality and greenhouse gas study (see Appendix F) included a detailed review of the available studies that relate to health effects associated with exposure to particulates. Finer particles (smaller than 10µm, termed 'respirable') tend to be of more concern when considering health risks related to air quality as these particles can penetrate into the lungs whereas larger particles would, if inhaled, be trapped in the upper respiratory system and not reach the lungs (WHO 2003).

Health effects related to air quality vary depending on the length of exposure and whether those exposed are within a susceptible group (eg the elderly, infants, and persons with chronic cardiopulmonary disease, pneumonia, influenza or asthma).

The majority of health studies that identify the potential health risks of human exposure to particulate matter generally relate to large cities, where a larger portion of the particulates are in the fine fraction that would penetrate into the lung, and also where a greater portion of the particulate matter is from combustion sources, which carries with it other individually toxic substances that are damaging to human health. Rural populations are too small for conclusive epidemiological studies to be conducted in those areas, and insufficient alternative data is available for rural areas to identify specific issues that health experts can agree on. Therefore, as a matter of precaution, the findings for urban areas are extrapolated to cover rural areas in order to have a basis for managing exposure to particulate matter for rural populations.

It is important to note that the majority of particulate emissions from mining are dust which originates from the soil. Due to the extreme forces required at the micro level to break down a particle of dust into smaller particles in the fine fraction, mining techniques used at coal mines generally cannot breakdown rock, coal or soil material into these very fine fractions. As a result emissions from mines are predominantly in the coarse size fraction which would not penetrate as deeply into the lung, or carry additional toxic combustion substances.

On average it has been measured that approximately 5 per cent of the total dust (TSP) from mining is in the $PM_{2.5}$ size fraction, and approximately 12 per cent of PM_{10} from mining is in the $PM_{2.5}$ fraction (SPCC 1986). In contrast, in the urban areas in which the majority of the health studies have been conducted, approximately 50 per cent of the PM_{10} is comprised of particles in the $PM_{2.5}$ size range, and most of these are from combustion.

In many rural areas domestic wood smoke is a key issue of health impact. Wood smoke can be a significant, highly localised source of toxic pollution in the winter period for rural communities and individuals. Wood heaters are also inside living rooms and their chimneys closer to residents than coal mines, which means the air that the population breathes will usually be affected by wood heater emissions to a much greater degree than more distant particle sources such as coal mines. Recent studies by the CSIRO (CSIRO 2013) into the composition of particulate matter in the Hunter Valley found that a key source of fine particulate is wood smoke. An initiative to target particulates in the Hunter Valley has recently been launched by the NSW EPA, and a key action relates to management of wood smoke in the urban areas (EPA 2013).

8.3.3 Community engagement

As described in Section 5.3.2, the proponent presented information to the November 2016 HVOCCC meeting in response to a request for further information regarding the mine design principles (ie avoid and mitigate), potential air quality impacts on private dwellings in Maison Dieu and operational controls to be implemented due to the proposed modification. For example:

- Material will be emplaced further north in the Cheshunt emplacement areas which provide protection from dust generation for sensitive receivers to the east.
- Lower or more protected overburden emplacement areas would be utilised during adverse conditions reducing offsite impacts at Maison Dieu.
- Continued use of meteorological forecasting information would guide the implementation of these practices for the duration of the proposed modification.

The presentation provided to the HVOCCC in November 2016 is in Appendix D.

8.4 Management and monitoring

8.4.1 Dust

The existing air quality management system described in Section 8.2.2 will continue under the proposed modification. The existing Amenity Management Plan for the HVGC will be updated in accordance with the HVGC to accommodate the proposed modification. No additional management measures are required as a result of the proposed modification.

8.4.2 Blast fume

The BMP will be updated to incorporate contemporary blast scheduling procedures and be implemented under the proposed modification.

As referenced in Section 3.2.4, the proposed modification seeks to contemporise the Statement of Commitments, including the commitments relating to blasting activities. These proposed changes are presented in Section 16.2.

8.5 Greenhouse gas emissions

The GHG emissions were predicted in accordance with the National Greenhouse Accounts (NGA) Factors document published by the DoEE (Department of the Environment 2015b). The NGA Factors document defines three scopes (Scopes 1, 2 and 3) for different emission categories based on whether the emissions generated are from 'direct' or 'indirect' sources. Scope 1 emissions encompass the direct sources from an activity and Scope 2 and 3 emissions occur due to indirect sources.

Calculations of greenhouse gas emissions for the proposed modification are provided in Table 8.5.

Table 8.5 Summary of CO_2-e emissions per scope (t CO_2-e)

Period	Scope 1	Scope 2	Scope 3
Annual	570,807	137,231	41,318,571
Total	6,941,902	1,668,942	502,498,142

The estimated annual greenhouse emissions for Australia for the period February 2014 to March 2015 was 545.1Mt CO_2-e (Department of the Environment 2015a). At a state level, the estimated greenhouse emissions for NSW in the 2013 period was 141.8Mt CO_2-e (Department of the Environment 2015b). In comparison, the conservative estimated annual average greenhouse emission for the proposed modification is 0.71Mt CO_2-e (Scope 1 and 2). Therefore, the annual contribution of greenhouse emissions from the proposed modification results in a small increase of approximately 0.13 per cent and 0.50 per cent of the Australian and NSW annual greenhouse emissions, respectively.

The annual greenhouse emission (Scope 1 and 2) for the approved HVO South activities is approximately 0.53Mt CO2-e, which is approximately 0.1 per cent of the estimated annual greenhouse emissions for Australia. Therefore, the proposed modification will result in an increase in greenhouse emissions of approximately 0.03 per cent greater than the currently approved HVO South emissions.

HVO South will continue to utilise various mitigation measures to minimise the overall generation of greenhouse gas emissions, including:

- integration of the objectives of Rio Tinto Coal Australia's climate change programme into existing business processes;
- funding for research programmes, such as the COAL21 Fund, the Australian Coal Association Research Programme (ACARP) and the Cooperative Research Centre for Greenhouse Gas Technologies (CO_2CRC), to support and develop the research of low emissions coal technologies;
- monitoring and monthly reporting on the bulk consumption of diesel and total site electricity consumption;
- energy efficiency performance metrics for fuel and electricity consumption which are tracked monthly against internal targets have been developed and implemented at HVO South; and
- management of waste across the site in accordance with an appropriate waste management procedure.

8.6 Conclusions

Dust mitigation measures were incorporated into the conceptual mine design principles (ie avoid and mitigate) through discussions between air quality experts and mine planning engineers. These features of the proposed modification's mine plan were presented to the HVOCCC in November 2016.

An assessment of air quality impacts indicates that the proposed modification will lead to dust levels generally similar to the approved operations. The proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from surrounding mine operation. Three properties, of which two are non-residences, in Warkworth village, and a fourth south-west of Camberwell village are predicted to exceed the VLAMP and Mining SEPP PM_{10}, annual average cumulative criteria of 30ug/m^3. The Warkworth residence (77) is entitled to acquisition upon request from Wambo Mine and Warkworth Mine as noted in Appendix 3 of the project approval (PA 06_0261). The property south-west of Camberwell village (471) is entitled to acquisition upon request from Ashton Coal's South East Open Cut project. No additional privately owned parcels of land are predicted to exceed criteria in accordance with the VLAMP.

The proposed modification is not predicted to significantly change air quality impacts associated with coal train dust and blasting or significantly increase greenhouse gas emissions.

A comprehensive air quality management system, including an extensive monitoring network, is currently in place at HVO which incorporates best practices for the control of dust emissions from coal mines. Predicted air quality impacts resulting from the proposed modification will be managed and mitigated under the current management system.

9 Visual amenity

9.1 Introduction

As described in Chapter 3, mining of the deeper seams has been designed to occur within the existing State-approved disturbance footprint. The additional volume of overburden material to access the deeper seams requires a revision to HVO South's overburden emplacement strategy. The overburden emplacement strategy requires an increase in landform height in some areas and the proponent plans to develop a more natural landscape into the post mining landform design using micro-relief design techniques.

This chapter describes the existing visual landscape and potential impacts on visual amenity from the proposed modification compared with the existing approval.

9.2 Existing environment

HVO South is bound by the Hunter River to the north, with Wollombi Brook passing through the south-eastern section and the Golden Highway to the south. The surrounding land is undulating, with elevations ranging between 70m and 165m AHD. Mining is a key feature of the local environment, with HVO South and neighbouring mines visible from a number of vantage points. The mine's local context and surrounding land uses are described in Section 2.2 and shown in Figure 2.3.

Mining commenced at the now HVO in 1949, making the operation a well established feature of the landscape. Approved operations are described in Section 3.1. The visual catchment of the area is generally limited by distance and topography and is defined as follows:

- to the north-west by a ridgeline;
- to the east by a ridgeline and the higher elevations of the South Lemington Pit 1 and extending to the north and north-east to Ravensworth Operations north of the Hunter River;
- to the south-west by a ridgeline behind Warkworth village; and
- to the west by a ridgeline south from HVO North (Carrington Pit) which generally screens properties west of the operations.

Current and historical components of mining operations at HVO South, principally overburden emplacement areas (both active and completed), are visible from surrounding locations, including both public viewpoints and privately owned land and residences as is described in the visual assessment in ERM (2008) EA. The previous visual assessment conducted as part of the ERM (2008) EA concluded that the LCPP and associated infrastructure will not be overly visible from residences in Maison Dieu (nor from other sensitive receptors) and could be screened with appropriate tree plantings if required.

The ERM (2008) EA focussed on three individual residences (Cheshunt, Oaklands and Wandewoi - all of which are now owned by the proponent or other mining companies), along with a number of public viewpoints in Maison Dieu, Warkworth and Jerrys Plains, which were considered to be representative of surrounding residences. The assessment concluded that some residences would experience increased visibility of certain parts of the operation due to the proposal. Management measures to alleviate impacts included the use of vegetation screening, retention of original vegetation and landscape features, and progressive rehabilitation (ERM 2008). Existing visual and lighting management implemented at HVO South is discussed further in Section 9.2.2.

9.2.1 Final landform – 2008 assessment

The 2008 assessed final landform was developed with consideration of the pre-mining landform features and based on mining within the disturbance footprint to the Bayswater seam in Cheshunt Pit (referred to as Deep Cheshunt) and Bowfield seam in Riverview Pit and the South Lemington Pits. The landform incorporates the existing rehabilitated landforms to promote consistency with the surrounding landscape features. The ERM (2008) EA stated:

> The final landform will be undulating, with slopes of generally 10 degrees for overburden emplacements and up to 18 degrees for internally draining ... low walls and ramps as approved in previous MOPs. This will be achieved by creating gradients for the Cheshunt and Riverview overburden emplacement areas similar to the adjoining natural slopes and [existing] rehabilitation.

The landforms will be established to support a variety of activities, which include both agriculture and native ecosystems. The ERM (2008) EA stated:

> The intent is to increase the flat terrain available and reduce the void dimensions to promote the best use of overburden material and optimise topography. This may result in areas of steeper but stable slopes, but would ultimately increase areas suitable for agricultural purposes.

These objectives will be delivered through the implementation of the Landscape Management Plan (refer to Condition 35 of the existing project approval (PA 06_0261)), which comprises the Rehabilitation and Biodiversity Management Plan (refer to Condition 36 of the existing project approval (PA 06_0261)). These plans have since been replaced by the HVO South Rehabilitation and Landscape Management Plan as reference in Chapter 13.

9.2.2 Visual and lighting management

HVO South currently operates 24 hours per day and implements a number of visual and lighting management procedures in accordance with the existing project approval (PA 06_0261), the approved Rio Tinto Coal Australia's accredited ISO 14001 EMS which forms part of the HSEQ Management System, the relevant plans, procedures and monitoring programmes, which include:

- awareness through environmental inductions to ensure that relevant employees consider the potential impacts of lighting equipment and its operation on sensitive locations;
- ensuring lighting is directed away from residences through the use of directional lighting equipment and shielding but in accordance with safety regulations;

- the use of colours to complement the surrounding environment. Muted greens or beige are preferred over bright colours unless necessary for safety;
- overburden emplacement areas are designed to provide visual shielding to active mining operations;
- minimising the area of disturbance;
- maintenance of existing vegetation where possible or construction of physical bunds where practicable to visually screen the extraction areas;
- progressive rehabilitation; and
- ongoing annual visual survey.

In addition to the mitigation measures undertaken at HVO for management of visual amenity, the existing project approval (PA 06_0261) requires a review of the approved extension areas (as contemplated in the ERM (2008) EA) that adjoin Jerrys Plains Road and the approved rail spur and loop easement be undertaken prior to construction of the rail spur and loop, to determine if additional screening is required.

9.3 Impact assessment

9.3.1 Method

The following sections describe the method of assessment of the effects of the landform changes to surrounding receptors (eg residences) as a result of the proposed modification.

i Final landform

Rehabilitation will occur progressively, through the four stages of mining described in Section 3.3.2, to create a stable, free draining landform consistent with surrounding natural landscape features. The final landform will be developed with consideration of the pre-mining landform features.

Native vegetation areas of the proposed modification extend through the central part of Riverview Pit, into a ring around the Cheshunt Pit and into the LCPP and infrastructure envelope and South Lemington Pit 2 (refer to Figure 13.1). As outlined in the MOP, native vegetation will cover approximately 30 to 40 per cent of the approved disturbance area and will link with remnant vegetation beyond the approved disturbance boundary. Land suitable for grazing will occupy approximately 60 to 70 per cent of the approved disturbance area.

Condition 36(b) of the existing project approval (PA 06_0261) requires the rehabilitated landform to be integrated with the rehabilitation and offset strategies of MTW, Wambo, United, HVO North, Ravensworth Operations and Ashton mines to ensure there is a comprehensive strategic framework for the restoration and enhancement of the landscape over time.

As per the existing rehabilitation commitments for HVO South, treed areas would generally be on slopes with a gradient of greater than 10 degrees, consistent with viewpoint intervening vegetation and areas of natural vegetation west of the operations. However, in some areas, treed vegetation would generally form the outer slopes of the overburden emplacement areas, which were designated as grassed under the 2008 assessed final landform. Notwithstanding this, it is considered that the proposed final landform maintains the linkages to surrounding (future) rehabilitated landforms of MTW, Wambo, United, HVO North, Ravensworth Operations and Ashton mines, enabling the establishment of the strategic framework for the post-mining landscape's restoration and enhancement over time.

ii Visual effect and sensitivity

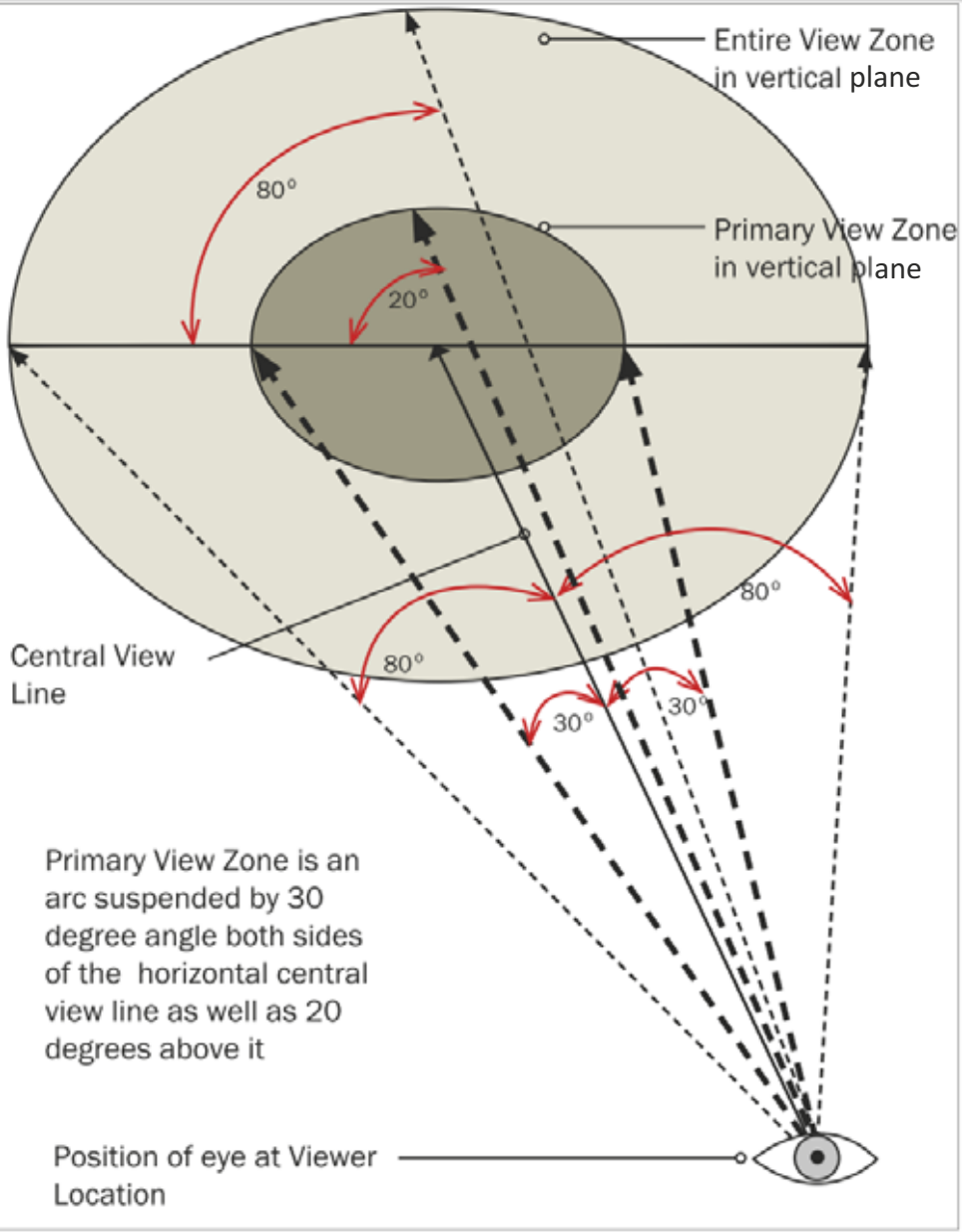
The potential visual impacts of the proposed modification were determined by considering the visual effect and visual sensitivity within the existing environment.

Visual effect is determined by comparing the level of contrast between a development and its surrounding environment. The magnitude of a development's visual effect is determined by considering the level of contrast or integration with its surroundings and the proportion of the view that includes the proposed development for the given level of contrast or integration (Integral 2010).

The proportion of the view is determined by measuring the occupied percentage of the Primary View Zone (PVZ), the area occupied by an arc created by sight lines radiating vertically and horizontally at angles of 30 degrees around the centre view line from the eye. Figure 9.1 displays the PVZ relative to the entire view zone, while Table 9.1 shows the factors that determine visual effect (Integral 2010).

In order to assess visual effect, GIS modelling software was used to run a viewshed analysis to determine the visibility of the proposed modification from within the visual catchment. Inputs into the GIS model included topographical contours, the height of the surrounding vegetation and the proposed conceptual final landform.

Distance from Project Site	Area of Primary View Zone
1 km	0.60 km²
2 km	2.4 km²
3 km	5.43 km²
4 km	9.66 km²
5 km	15.09 km²
6 km	21.73 km²
7 km	29.57 km²
8 km	38.62 km²
9 km	48.88 km²
10 km	60.35 km²
11 km	73.02 km²
12 km	86.9 km²
13 km	101.99 km²
14 km	118.29 km²
15 km	135.79 km²



Source: JVP (2015)

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Primary view zone

HVO South Modification 5
Environmental Assessment

Figure 9.1

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed by people from different land use areas in the vicinity of a development (EMM 2014). Levels of visual sensitivity are shown in Table 9.2. There are no privately owned residences within 2.5km of HVO South with the closest residences some 2.7km east in Maison Dieu.

Table 9.1 Visual effect

Visual properties			Visual effect		
Contrast levels with elements in primary view zone	**Visual integration with elements in primary view zone**		**High visual effect**	**Moderate visual effect**	**Low visual effect**
High Project elements do not borrow, form, shape, line, colour or scale from existing features of the visual setting and contrast levels are high with existing landscape. For example, a landform that with hard engineered shapes in contrast to the surrounding natural undulating landscape would represent high contrast levels.	**Low** The project lacks integration with visual setting because of scale totally dominating the ability of site or surrounding features, vegetation and or topographic features to integrate the development.	**Category 1**	Visible element occupies more than 2.5% of the primary view shed.	Visible element occupies between 1 - 2.5% of the primary view shed.	Visible element occupies less than 1% of the primary view shed.
Moderate Project elements borrow from some features of the visual setting in terms of form, shape, line, pattern and/or colour and scale, reducing visual contrast with existing setting.	**Moderate** The project has some degree of visual integration with setting from other features, vegetation, and/or topography, achieving some level of integration.	**Category 2**	Visible element occupies more than 20% of the primary viewshed, generally when in a foreground location.	Visible element occupies between 10 - 20% of the primary viewshed.	Visible element occupies less than 10% of the primary viewshed.
Low Project elements borrow extensively from features in visual setting in terms of form, shape, line, pattern, colour and scale, minimizing contrast with the existing setting.	**High** Visual integration is high due to other features, vegetation and/or topography, achieving dominance and screening or filtering.	**Category 3**	Visible element occupies more than 40% of the primary viewshed.	Visible element occupies between 30 - 40% of the primary viewshed.	Visible element occupies less than 30% of the primary viewshed.

Source: JVP (2015).

Table 9.2 Levels of visual sensitivity

Visual sensitivity	Distance from development (km)
High	<2.5
High to Moderate	2.5 – 7.5
Moderate	7.5 – 12.5
Low	>12.5

Visual impacts are determined through the consideration of visual effect in conjunction with visual sensitivity, as shown in Table 9.3 (EMM 2014).

Table 9.3 Visual impact

Visual effect	Visual sensitivity		
	High	**Moderate**	**Low**
High	High visual impact	High/moderate visual impact	Moderate/low visual impact
Moderate	High/moderate visual impact	Moderate visual impact	Moderate/low visual impact
Low	Moderate/low visual impact	Moderate/low visual impact	Low visual impact

iii Viewpoints

The viewpoints listed in the previous visual assessment conducted as part of the ERM (2008) EA were considered not representative to the visual changes resulting from the proposed modification. Therefore, identification of new viewpoints was required. The new viewpoints were selected based on the following criteria:

- current landownership status of residences surrounding the operations;
- feedback regarding visual amenity as a result of ongoing stakeholder consultation activities;
- a review of the proposed conceptual final landform, with a 3D viewshed analysis undertaken to confirm areas where the proposed modification was visible; and
- site inspection, which confirmed the outputs of the viewshed analysis.

Five viewpoints were selected for the visual assessment of the proposed modification. These viewpoints, their respective distances from the active emplacement areas (ie the element of visual change due to the proposed modification), the existing view and the approved final landform view from each location are detailed in Table 9.4.

Table 9.4 Existing views

Viewpoint	Description	Distance to HVO South[1]	Existing view[2] of HVO South	2008 assessed final landform view
VP1 - Shearers Lane	Shearers Lane, public road, close to private residences	2.7km (high to moderate sensitivity)	Direct views of continued establishment of Cheshunt overburden emplacement area with limited exposed areas awaiting completion of rehabilitation activities. No visibility of active mining areas.	Direct view of grassed Cheshunt overburden emplacement area. Limited, intermittent views of the LCPP and associated infrastructure however existing intervening vegetation provides some screening.
VP2 - Knodlers Lane	Knodlers Lane, public road, close to private residences	3.6km (high to moderate sensitivity)	Direct views of continued establishment of Cheshunt overburden emplacement area with limited exposed areas awaiting completion of rehabilitation activities. No visibility of active mining areas, however a waste haul road is visible.	Direct view of grassed Cheshunt overburden emplacement area. Limited, intermittent views of the LCPP and associated infrastructure however existing intervening vegetation provides some screening.
VP3 - Long Point	Long Point, public road, close to private residences	7km (high to moderate sensitivity)	Views of Cheshunt and Riverview overburden emplacement areas on the horizon. No visibility of active mining areas.	Views of grassed Cheshunt overburden emplacement area and treed Riverview emplacement area on the horizon with constructed micro-relief. Limited, intermittent views of the rail loop however existing intervening vegetation provides some screening.
VP4 - Jerrys Plains Road, east of the Village	Jerrys Plains Road, public road	10km (moderate sensitivity)	Nil. Intervening ridgeline obstructs views of HVO South operations. No visibility of active mining areas.	Nil. Intervening ridgeline obstructs views of HVO South operations.
VP5 - Camberwell village	Within village on Dyrring Street	5.8km (high to moderate sensitivity)	Views of Cheshunt overburden emplacement areas with National Park views on the horizon. No visibility of active mining areas.	Views of grassed Cheshunt overburden emplacement area with constructed micro-relief. National Park views remain on the horizon.

Notes: *1. Nearest disturbance within the project approval boundary.*

2. As of January 2017.

iv Visibility of the proposed modification

The proposed modification will introduce an increase in the elevation of parts of the currently approved final landforms. In the short-term, this would also result in an increase in the exposure time in some areas to establish the increased elevations. Rehabilitation would continue to be progressive with disturbed land rehabilitated as soon as it is practical. Rehabilitation progression is described in Section 3.2.2.

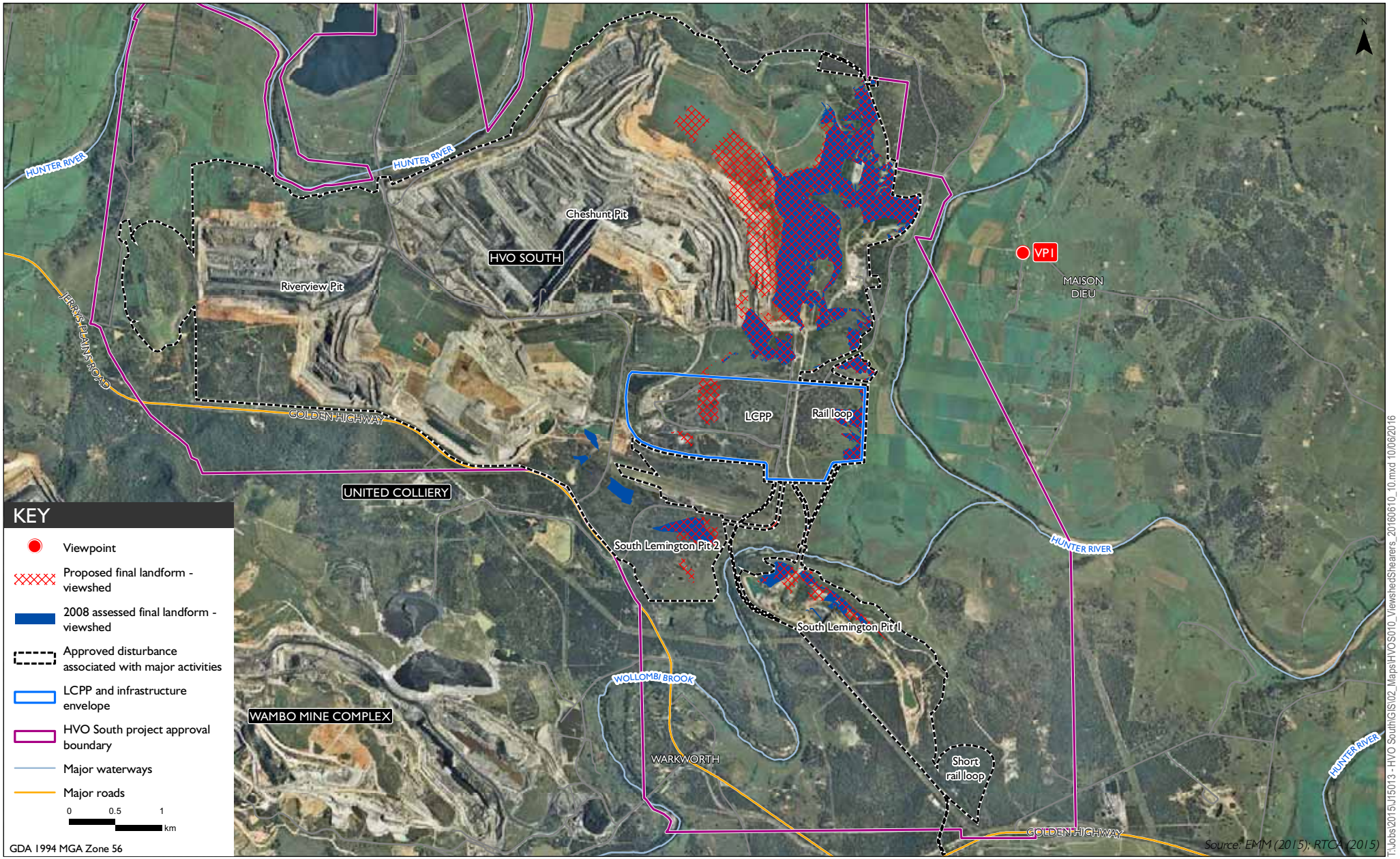
A viewshed analysis was undertaken for the identified viewpoints to determine the visibility of the proposed modification when compared to the approved final landform. In addition, photomontages were also prepared for each viewpoint. These photomontages display the existing view, the view of the currently approved final landform, and the view of the proposed conceptual final landform. Viewshed analyses and photomontages for each viewpoint are shown in Figures 9.2 to 9.11.

As described in Section 3.3.1, the mine planning process for the proposed modification considered avoidance and minimisation of environmental and amenity impacts on surrounding sensitive receptors as its guiding design principles. Some of these key mine design principles of the proposed modification were presented to the HVOCCC in November 2016 with the presentation provided in Appendix D.

Design of the proposed modification within the constraints of the existing State-approved disturbance footprint necessitates an increase in height in some areas of the overburden emplacement up to 240mAHD to accommodate the additional volume of overburden material. The proposed modification has provided an opportunity to redesign the overburden emplacement strategy to incorporate micro-relief design techniques. Although the overburden emplacement will be higher in places, the final landform has been designed to look more consistent with natural landforms in the area.

The overall benefits of this strategy include:

- emplacement of the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the nearby Wollemi National Park for sensitive receivers to the east of HVO South;
- retention of the existing rehabilitated faces (eg eastern Cheshunt Pit overburden emplacement area) for incorporation into the final improved landform design;
- maintaining the current 2.6km setback distance of rehabilitated areas to Maison Dieu;
- the construction of a more natural looking final landform that complements the existing environment, including progressive rehabilitation such as seeding of emplacement areas with a temporary vegetative cover during their construction;
- construction methods for overburden emplacement would comprise an initial lift on the outer edges, which would be seeded to create a temporary vegetative cover, enabling emplacement of overburden behind the initial lift which would reduce the visibility of these emplacement activities;
- increased distance between the Hunter River and the proposed evaporative basin within the final void;
- minimisation of surface water catchment area draining to the final void; and
- reduction in the low-wall slope to enable greater land use optionality within the final void.



VP1 - Shearers Lane - viewshed analysis of approved and proposed final landform

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Environmental Assessment
Figure 9.2

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Existing landform as at November 2015

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VP1 - Shearers Lane - photomontage

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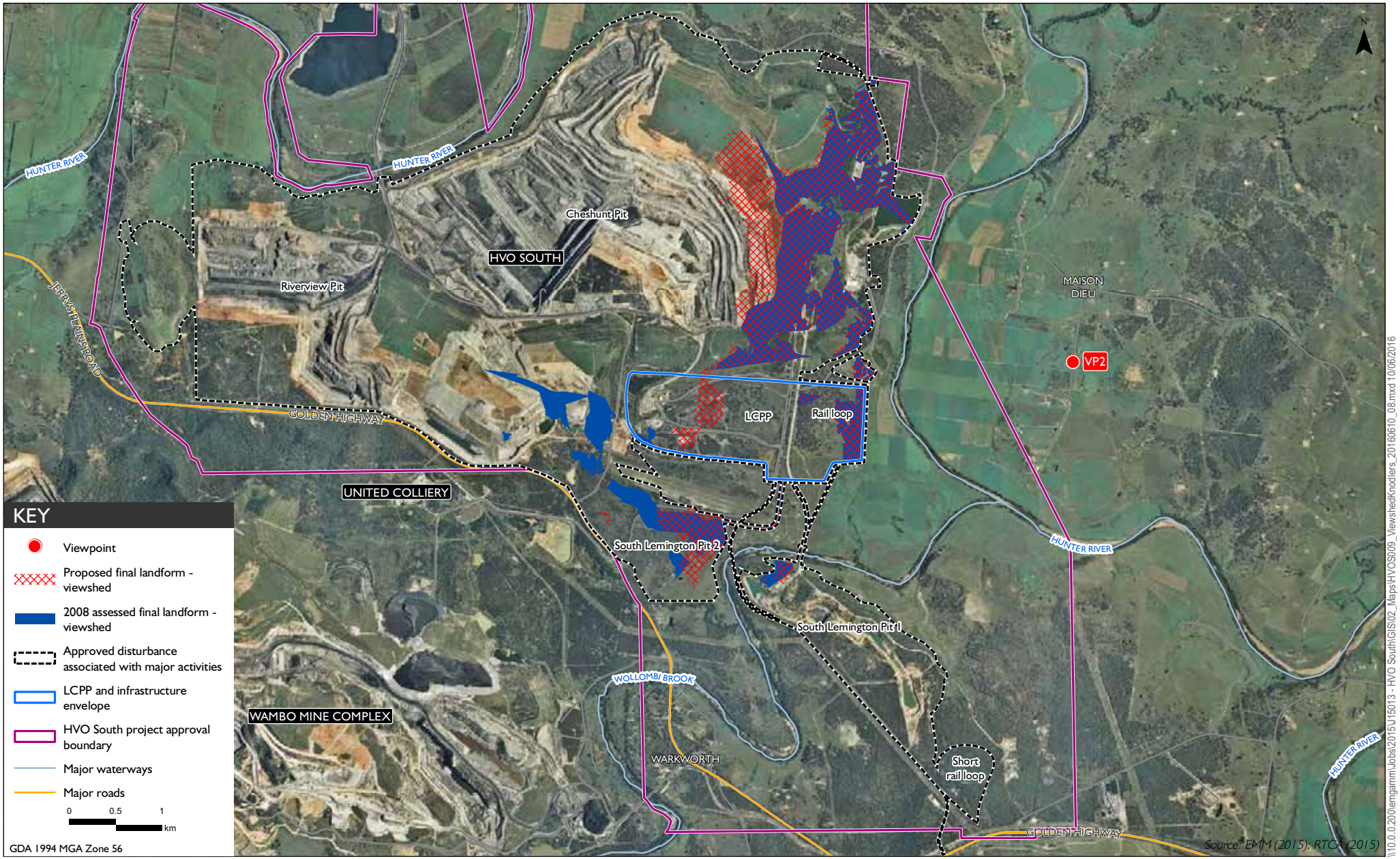
Environmental Assessment
Figure 9.3



VP2 - Knodlers Lane - viewshed analysis of approved and proposed final landform

HVO South Modification 5
Environmental Assessment
Figure 9.4

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Existing landform as at November 2015

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VP2 - Knodlers Lane - photomontage

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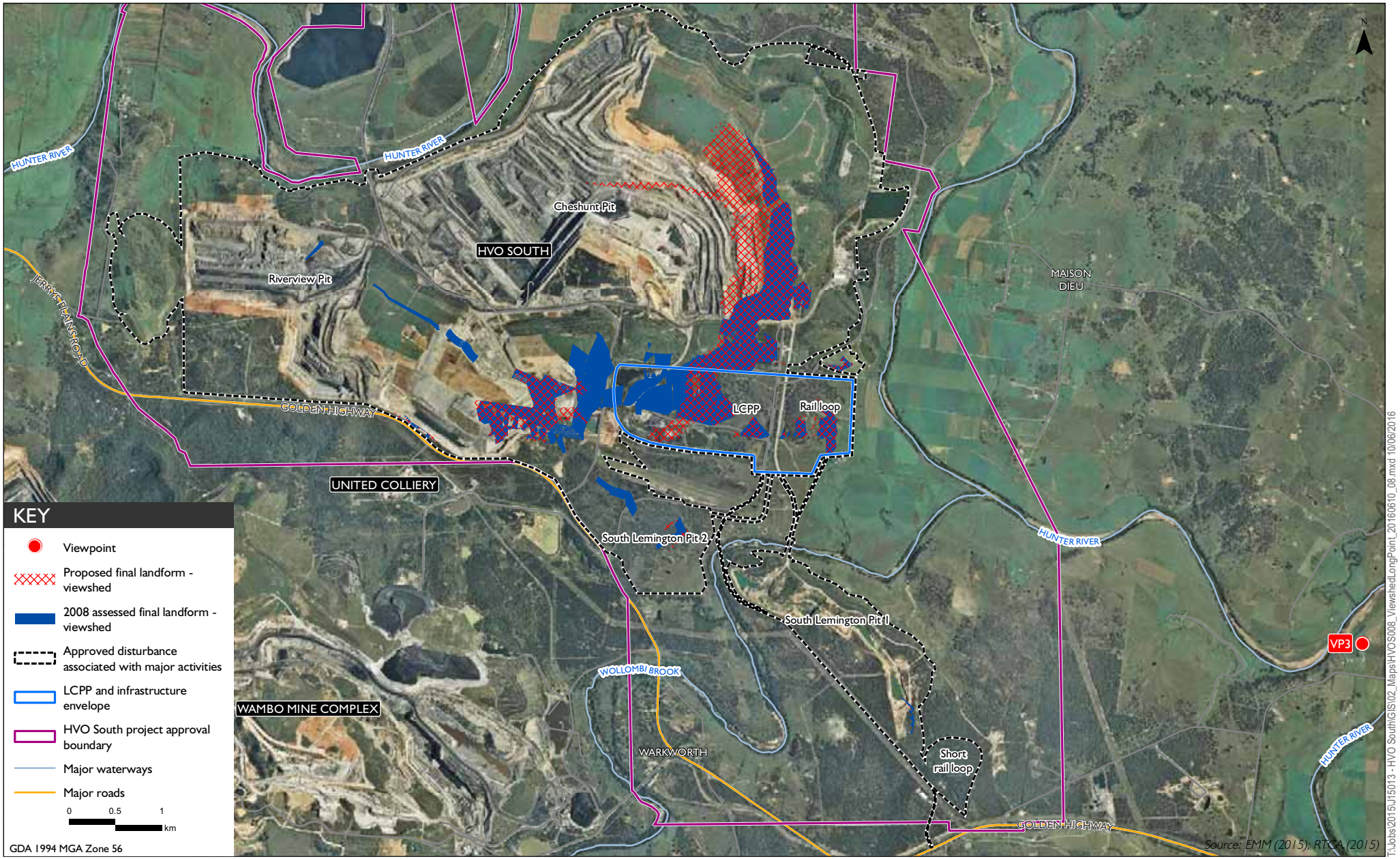
Environmental Assessment
Figure 9.5



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VP3 - Long Point - viewshed analysis of approved and proposed final landform

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Environmental Assessment
Figure 9.6

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Existing landform as at November 2015

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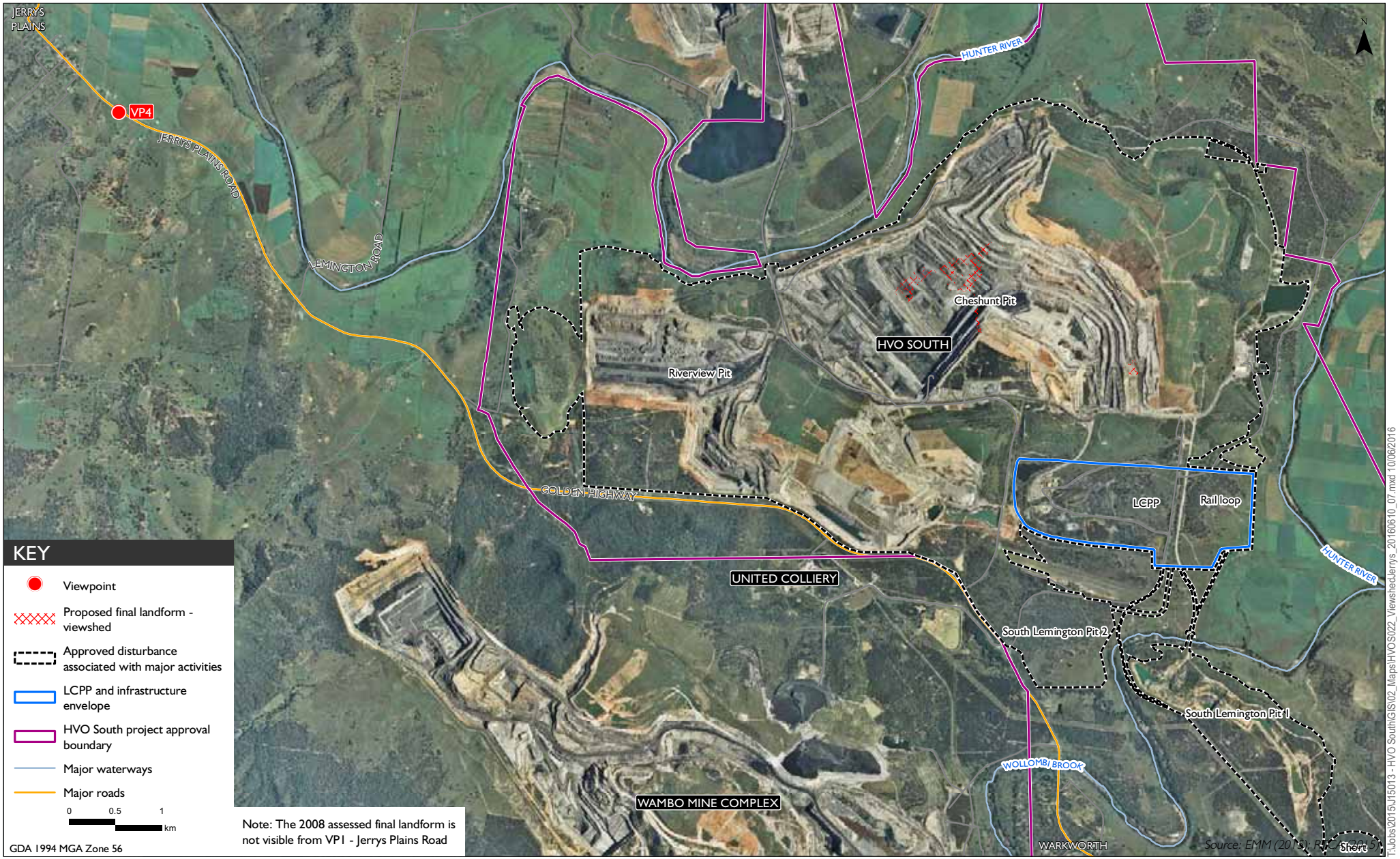
VP3 - Long Point - photomontage

HVO South Modification 5
Environmental Assessment
Figure 9.7



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VP4 - Jerrys Plains Road - viewshed analysis of approved and proposed final landform

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Environmental Assessment
Figure 9.8

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Existing landform as at November 2015

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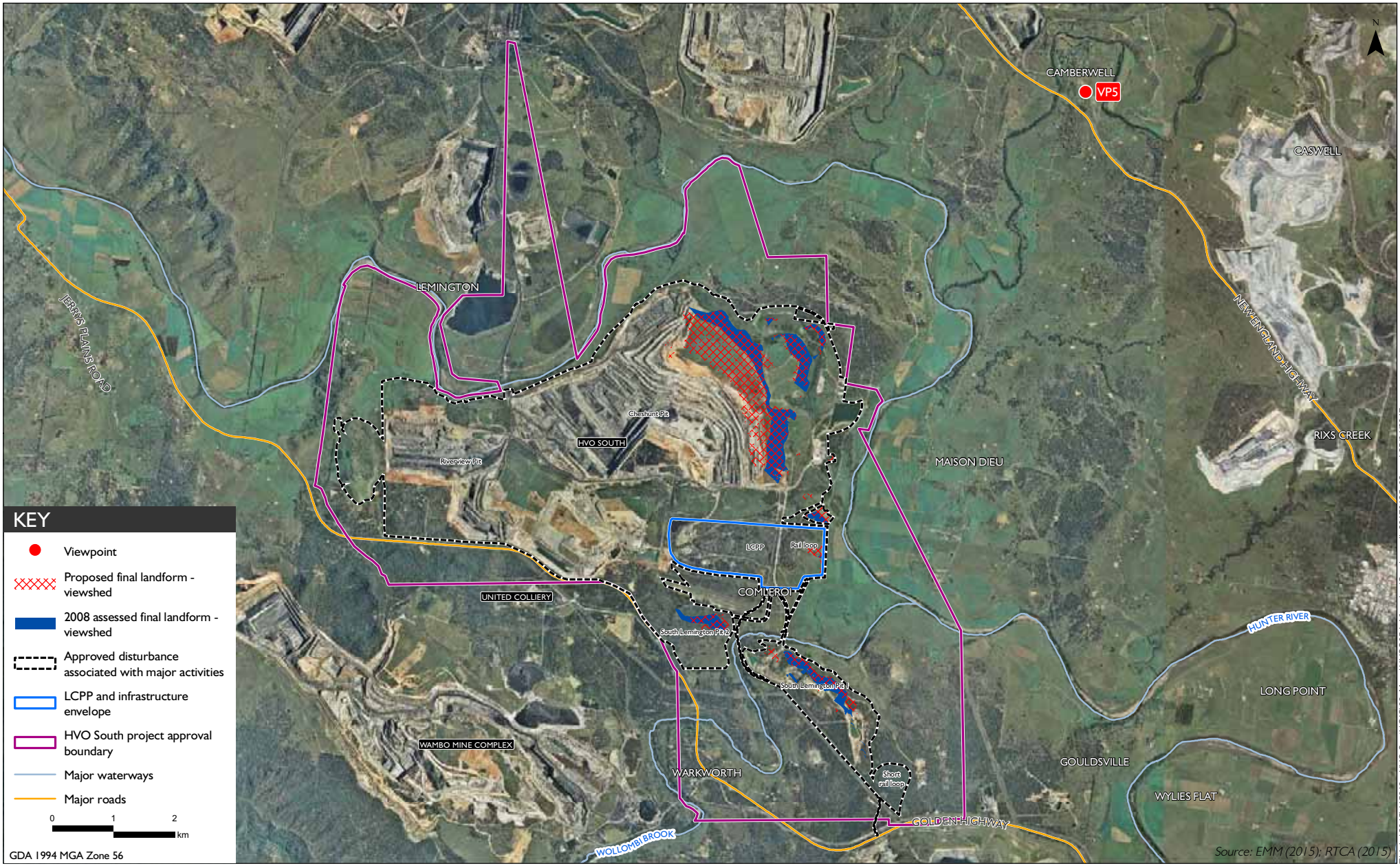
VP4 - Jerrys Plains Road - photomontage

HVO South Modification 5
Environmental Assessment
Figure 9.9



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VP5 - Camberwell - viewshed analysis of approved and proposed final landform

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Environmental Assessment

Figure 9.10

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Existing landform as at January 2017

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VP5 - Camberwell Village - photomontage

HVO South Modification 5
Environmental Assessment
Figure 9.11

The proposed modification does not include an increase to the disturbance footprint of the current operations or the approved infrastructure (eg LCPP and associated infrastructure). As described in the ERM (2008) EA, final landforms influence visual amenity both during operations and following closure. Notwithstanding, rehabilitation will continue to be progressive where practical to do so, providing for the development of a more natural landscape that includes large areas of connected native vegetation and grassland to support land suitable for agriculture and native fauna movement. Another element relevant to the visual assessment is the LCPP and its associated infrastructure which are approved but yet to be constructed.

Figure 2.2 shows the location of the approved envelope for the construction of the LCPP and its associated infrastructure including the rail loop and spur. It is important to recognise that this infrastructure is already approved and its final construction location does not represent a change as a result of the proposed modification. It is also noted (as described in Section 3.2.2i) that the construction of the LCPP, associated infrastructure, and the mining of South Lemington Pit 1 are not currently scheduled in the near to mid-term but are included in the mine plans so that worst case impacts can be modelled and assessed.

For the purposes of assessment, it is anticipated that the LCPP and its associated infrastructure will be constructed on the western side of the overburden emplacement area within the envelope in Stage 3 of the indicative mine plans.

9.3.2 Potential visual impacts

Figure 9.12 demonstrates the application of the method to define the PVZ from a representative viewpoint VP1 (Shearers Lane) to enable assessment of the visual effect of the proposed modification. Calculations were undertaken on both the horizontal and vertical planes to define the PVZ for assessment. This is shown below.

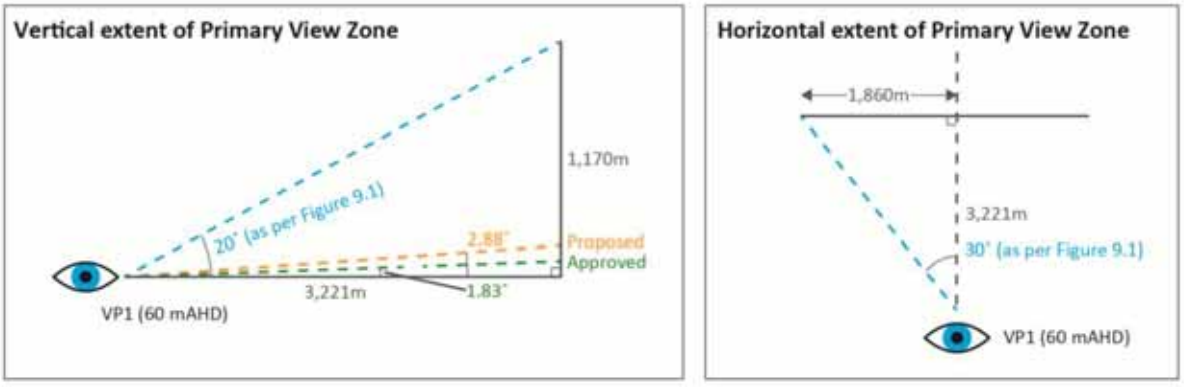
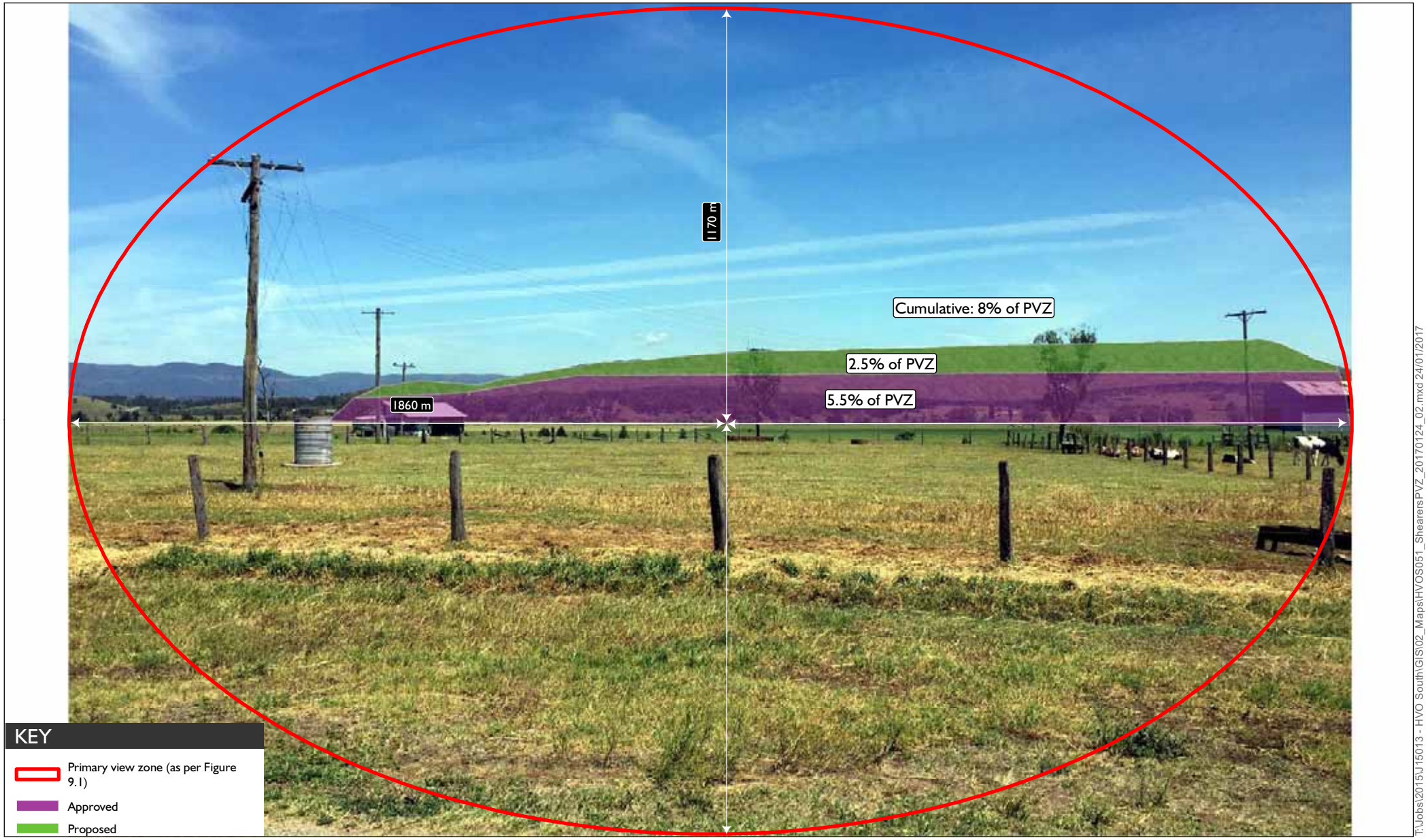


Figure 9.12 Method for primary view zone extent



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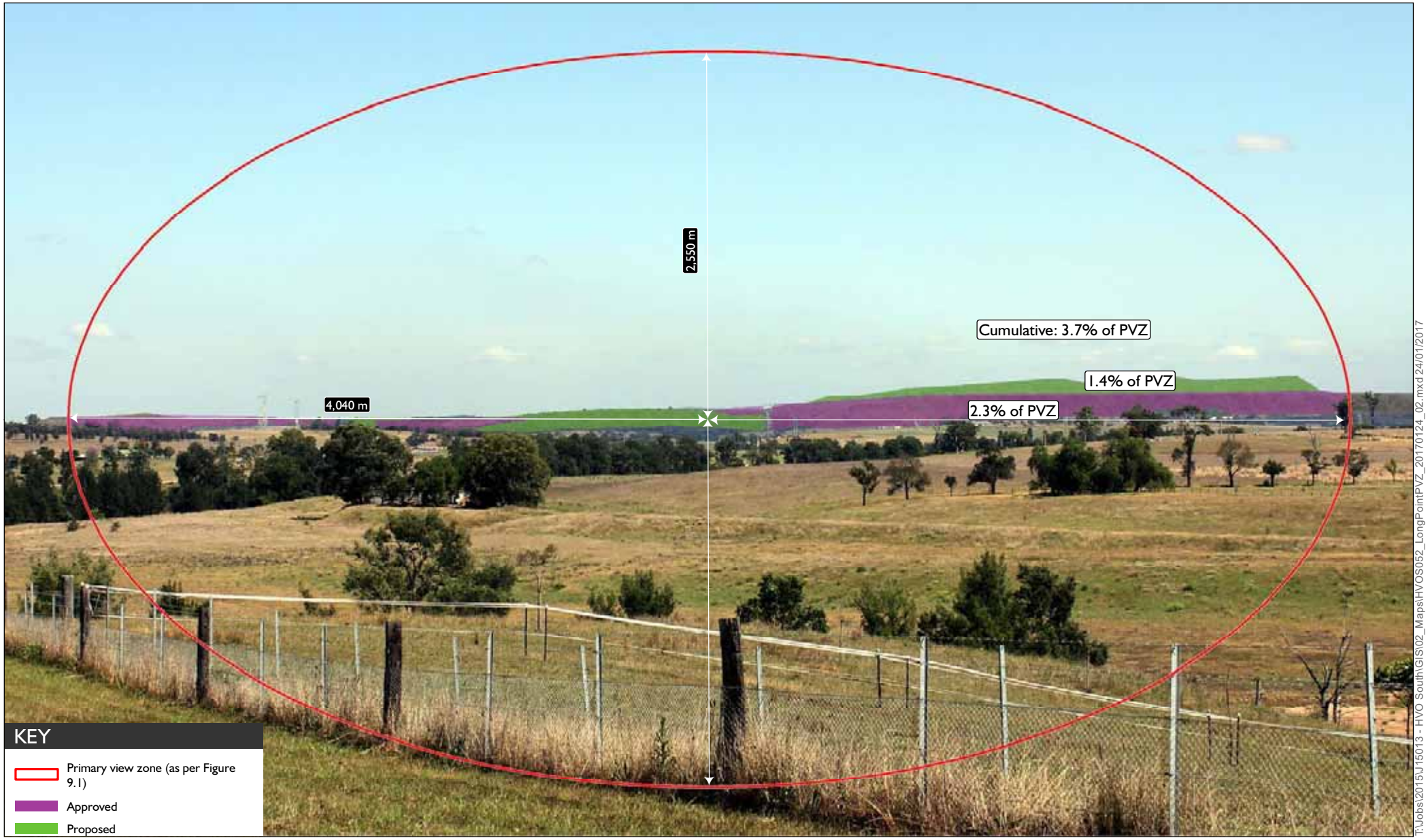
Primary view zone - VP1 - Shearers Lane

HVO South Modification 5
Environmental Assessment

Figure 9.13



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Primary view zone - VP3 - Long Point

HVO South Modification 5
Environmental Assessment

Figure 9.14

Figures 9.13 and 9.14 present the analysis undertaken for VP1 (Shearers Lane) and VP3 (Long Point), respectively. VP2 (Knodlers Lane) is further away from the proposed modification than VP1 (Shearers Lane), and VP4 (Jerrys Plains Road) and VP5 (Camberwell village) have minimal views of the proposed modification. The same analysis was performed on these viewpoints but is not presented in the document as it is considered VP1 and VP3 represent worst case PVZs for the selected viewpoints.

Figure 9.13 presents the analysis for VP1 (Shearers Lane), the closest representative viewpoint with direct views of the overburden emplacement areas, which shows the visual element of the 2008 assessed final landform occupying approximately 5.5 per cent of the PVZ with the proposed modification an incremental 2.5 per cent. The cumulative visible elements of the proposed modification from VP1 are approximately 8 per cent of the PVZ.

Figure 9.14 presents the analysis for VP3 (Long Point). As shown, the proposed modification results in an additional landform within the PVZ, however the visual elements of the proposed final landform occupy less than 10 per cent of the PVZ, which is classified as a low visual effect as per Table 9.3. Analysis of each representative viewpoint is described in further detail in the following section.

i VP1 - Shearers Lane

From VP1, there are clear views of the Cheshunt overburden emplacement area, which is mostly grassed. Progressive rehabilitation behind the active mining area is visible. The PVZ also includes views of treed vegetation along the Hunter River in the foreground and distant views of dense vegetation within Wollemi National Park.

The design of the 2008 assessed final landform is long, flat, with engineered edges which contrast with the natural landscape of Wollemi National Park. The landform is planned to remain as grassland upon completion of rehabilitation. This is shown in Figure 9.3.

a. Final landform

The elevation of the proposed conceptual final landform will increase in some areas when compared to the 2008 assessed final landform. These elevated areas of the landform were designed to be setback from the existing face of the Cheshunt emplacement area, retaining its existing rehabilitated eastern face and maintaining the current setback distance to private dwellings in Maison Dieu to reduce the visual impact. This is also demonstrated in the proposed indicative final landform shown in Figure 13.1 where these elevated treed areas gently slope down to the midslope flatter grassed areas to the east (towards Maison Dieu).

As shown in Figure 9.3, the existing views of Wollemi National Park will remain which is the result of visual amenity being considered in the mine plan optimisation process (see Sections 3.3.1, 5.3.2 and 9.3.1). To retain existing views from the east of the western escarpment, the proposed modification will emplace the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the National Park. In addition, the incorporation of microrelief to the surface is able to reduce the visual contrast to the National Park in the background.

As described in Section 9.3.1iv and shown in Figure 3.5, the approved LCPP and its associated infrastructure are included in the indicative Stage 3 mine plan within the approved envelope. It is anticipated that the LCPP will be constructed on the western side of the overburden emplacement area high point and will not be visible to residences to the east in Maison Dieu. The rail infrastructure is planned to be constructed on the eastern side of the overburden emplacement area and will likely be visible from VP1. It is important to recognise that this infrastructure is already approved and its final construction location does not represent a change as a result of the proposed modification.

Notwithstanding, the increased height in the eastern emplacement areas may result in some additional shadow effects during winter solstice (when the sun is lower in the sky). Preliminary analysis has been undertaken to determine the potential shadow effects of the proposed changes in overburden height to the nearest residential property on Shearers Lane, which shows:

- the residential property is at an elevation of 68mAHD;
- the residential property is approximately 2,717m from the nearest high point of the assessed 2008 final landform, which is at an elevation of 155mAHD, creating an angle of 1.83 degrees; and
- the residential property is approximately 3,221m from the nearest high point of the proposed final landform, which is at an elevation of 230mAHD, creating an angle of 2.88 degrees.

The change in angle between the residential property and the proposed final landform is 1.05 degrees. Due to the assumption that the sun moves through the sky approximately 15 degrees every hour, this may result in a potential change in shadow at the residential property of up to four minutes during winter solstice.

To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP1, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'moderate' (refer to Table 9.1 - Category 2) as the visual elements have some degree of integration with the existing landforms and micro-relief design borrow some features of the existing visual setting (inclusive of the current emplacement area);
- the visual effect is considered to be 'low' as the visible elements are less than 10 per cent of the PVZ (refer to Table 9.1 - Category 2 - and Figure 9.11);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP1 is 2.7km; and
- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

This potential visual impact is generally consistent with the current views of HVO South and the currently approved conceptual final landform as described in Section 9.2 and Table 9.4.

b. Establishment of final landform

It is important to note that in the short to medium term and consistent with the current approved mine plan, some areas will be exposed through active rehabilitation activities to establish the final landform height. Whilst the design considerations have resulted in these areas set back from the existing visible Cheshunt overburden emplacement area, the height establishment activities in these areas will become visible for a period of time. The majority of these activities within the visible components of Cheshunt overburden emplacement area are planned to be completed by Stage 2 or approximately Year 2022 (refer to Figure 3.4). The rehabilitation areas will mature through the remaining stages of the proposed modification, within the same period as the existing project approval (PA 06_0261), reducing the areas of active emplacement areas visible at a distance of approximately 3km.

Under the proposed modification, the Cheshunt Pit emplacement is likely to be exposed for a period due to the time required to complete the final emplacement height and the landform shaping activities that are necessary to create a more natural looking final landform that complements the existing environment. Notwithstanding, during the establishment of overburden emplacement areas, they will be seeded with a temporary vegetative cover and progressive rehabilitation will continue with slopes planted with ironbark woodland communities to reduce visual impacts (refer to Sections 3.3.1, 5.3.2, 9.3.1 and 9.3.3).

To determine the potential visual impacts of the proposed modification in the short to medium term for sensitive receivers at VP1, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'high (refer to Table 9.1 - Category 2) as the visual elements (additional exposed areas of emplacement during height establishment) will contrast with the existing landforms;
- the visual effect is considered to be 'moderate' as the visible elements are between 1 and 2.5 per cent of the PVZ (refer to Table 9.1 - Category 1 - and Figure 9.11);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP1 is 2.7km; and
- the visual impact is considered to be 'moderate' (refer to Table 9.3).

Once the final landform height is achieved in these setback areas, final rehabilitation will commence and reduce the visual impacts on sensitive receivers at VP1.

c. Summary

Due to the progressive nature of rehabilitation activities and as these areas mature with vegetation, the proposed modification will have a potential moderate/low visual impact on residences in Shearers Lane in Maison Dieu in the longer term (refer to Table 9.3). The proposed conceptual final landform is designed to be undulating which reduces the contrast with the other existing landforms in the PVZ (refer to Figure 9.11). Further, the more natural appearance of the proposed conceptual final landform allows for a greater integration into the existing landscape, particularly the treed vegetation along the Hunter River and the more distant views of dense vegetation within the Wollemi National Park.

It is considered that these design measures reduce the longer term potential visual impact for residences in Shearers Lane in Maison Dieu compared to the initial potential short-term moderate visual impacts when the areas behind the existing Cheshunt overburden emplacement area are visibly being established in Stages 1 and 2 of the proposed modification.

ii VP2 - Knodlers Lane

From VP2, there are clear views of the Cheshunt overburden emplacement area, which is mostly grassed. Progressive rehabilitation behind the active mining area is visible. The PVZ also includes views of treed vegetation along the Hunter River and paddocks used for cropping and grazing in the foreground, with distant views of dense vegetation within Wollemi National Park.

The design of the 2008 assessed final landform is such that it would be identified as a constructed and engineered landform with engineered edges which contrast with the natural landscape of Wollemi National Park. The landform will remain as grassland upon completion of rehabilitation. This is shown in Figure 9.5.

a. Final landform

The elevation of the proposed conceptual final landform will increase in some areas when compared to the 2008 assessed final landform. However, the proposed modification has provided an opportunity to redesign the overburden emplacement strategy to incorporate micro-relief design techniques to look more consistent with natural landforms in the area. These elevated areas of the landform were designed to be setback from the existing face of the Cheshunt emplacement area, retaining its existing rehabilitated eastern face to reduce the visual impact. This is also demonstrated in the proposed indicative final landform contours shown in Figure 13.1 where these elevated treed areas gently slope down to the midslope flatter grassed areas to the east.

As can be seen in Figure 9.4, the existing views of Wollemi National Park will remain which is the result of visual amenity being considered in the mine plan optimisation process (see Section 3.3.1). To retain existing views from the east of the western escarpment, the proposed modification will emplace the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the National Park. In addition, the incorporation of microrelief to the surface is able to reduce the visual contrast to the National Park in the background.

As described in Section 9.3.1iv and shown in Figure 3.5, the approved LCPP and its associated infrastructure are included in the indicative Stage 3 mine plan within the approved envelope. It is anticipated that the LCPP will be constructed on the western side of the overburden emplacement area which will not be visible to residences to the east in Maison Dieu. The rail infrastructure is planned to be constructed on the eastern side of the overburden emplacement area and will be likely visible from VP2. It is important to recognise that this infrastructure is already approved and its final construction location does not represent a change as a result of the proposed modification.

To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP2, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'moderate' (refer to Table 9.1 - Category 2) as the visual elements have some degree of integration with the existing landforms and micro-relief design borrow some features of the existing visual setting (inclusive of the current emplacement area);
- the visual effect is considered to be 'low' as the visible elements are less than 10 per cent of the PVZ (refer to Table 9.1 - Category 2);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP2 is 3.6km; and

- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

This potential visual impact is generally consistent with the current views of HVO South and the currently approved conceptual final landform as described in Section 9.2 and Table 9.4.

b. Establishment of final landform

It is important to note that in the short to medium term and consistent with the current approved mine plan, some areas will be exposed through active rehabilitation activities to establish the final landform height. Whilst the design considerations have resulted in these areas set back from the existing rehabilitated visible Cheshunt overburden emplacement area, the height establishment activities in these areas will become visible for a period of time. The majority of the elevation activities within the visible components of Cheshunt overburden emplacement area are completed by the end of Stage 2 or approximately Year 2022 (refer to Figure 3.4). The rehabilitation areas will mature through the remaining stages of the proposed modification, within the same period as the existing project approval (PA 06_0261), reducing the initial high visual impacts where the active emplacement areas are visible at a distance of approximately 7km.

Under the proposed modification, the Cheshunt Pit emplacement is likely to be exposed for a period due to the time required to complete the final emplacement height and the landform shaping activities required to create a more natural looking final landform that complements the existing environment.

To determine the potential visual impacts of the proposed modification in the short to medium term for sensitive receivers at VP2, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'high' (refer to Table 9.1 - Category 1) as the visual elements (additional exposed areas of emplacement during height establishment) will contrast with the existing landforms;
- the visual effect is considered to be 'moderate' as the visible elements are between 1 and 2.5 per cent of the PVZ (refer to Table 9.1 - Category 1);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP1 is 3.6km; and
- the visual impact is considered to be 'moderate' (refer to Table 9.3).

Once the final landform height is achieved in these setback areas, final rehabilitation will commence and reduce the visual impacts on sensitive receivers at VP2.

c. Summary

Due to the progressive nature of rehabilitation activities and as these areas mature with vegetation the proposed modification will have a potential moderate/low visual impact on some residences in Knodlers Lane in Maison Dieu in the longer term (refer to Table 9.3).The proposed conceptual final landform designed to be undulating which reduces the contrast with the other existing landforms in the PVZ (refer to Figure 9.11). Further, the more natural appearance of the proposed conceptual final landform allows for a greater integration into the existing landscape, particularly the treed vegetation along the Hunter River and the more distant views of dense vegetation within the Wollemi National Park.

It is considered that these design measures reduce the longer term potential visual impact for residences in Knodlers Lane in Maison Dieu compared to the initial potential short-term moderate visual impacts when the areas behind the existing Cheshunt overburden emplacement area are visibly being established in Stages 1 and 2 of the proposed modification.

iii VP3 - Long Point

From VP3, there are relatively distant views (approximately 7km) of the Cheshunt overburden emplacement areas on the horizon. The PVZ also comprises views of electricity transmission lines as well as views of natural vegetation along the Hunter River. Grassed paddocks are dominant views in the foreground.

The design of the 2008 assessed final landform is long, flat, with engineered edges with the area planned to be revegetated using grass species that would result in a uniform appearance that emphasises the low relief on completion of the rehabilitation. This can be seen in Figure 9.7.

a. Final landform

The elevation of the proposed conceptual final landform will increase in some areas when compared to the 2008 assessed final landform. These elevated areas of the landform were designed to be setback from the existing face of the Cheshunt emplacement area, retaining its existing rehabilitated eastern face to reduce the visual impact. This is also demonstrated in the proposed indicative final landform shown in Figure 13.1 where these elevated treed areas gently slope down to the midslope flatter grassed areas to the east (towards Maison Dieu).

To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP1, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'moderate' (refer to Table 9.1 - Category 2) as the visual elements have some degree of integration with the existing landforms and micro-relief design borrow some features of the existing visual setting (inclusive of the current emplacement area);
- the visual effect is considered to be 'low' as the visible elements are less than 10 per cent of the PVZ (refer to Table 9.1 - Category 2 - and Figure 9.12);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP3 is 7km; and
- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

This potential visual impact is generally consistent with the current views of HVO South and the currently approved conceptual final landform as described in Section 9.2 and Table 9.4.

b. Establishment of final landform

It is important to note that in the short to medium term and consistent with the current approved mine plan, some areas will be exposed through active emplacement activities to establish the final landform height. Whilst the design considerations have resulted in these areas set back from the existing visible rehabilitated Cheshunt overburden emplacement area, the height establishment activities in these areas will become visible for a period of time. The majority of the elevation activities within the visible components of Cheshunt overburden emplacement area are planned to be completed by Stage 2 or approximately Year 2022 (refer to Figure 3.4).

Under the proposed modification, these active areas are likely to be exposed for longer periods during the initial lifts due to the change in elevation and the landform shaping activities that are required to create a more natural looking final landform that complements the existing environment. This initial period is likely to result in visual amenity impacts on receptors in the Long Point area, however it should be noted that these activities will be experienced over the same approval period as the existing project approval (PA 06_0261), albeit that the eastern emplacements will have increased in elevation.

To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP3, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'high' (refer to Table 9.1 - Category 1) as the visual elements (additional exposed areas of emplacement during height establishment) will have some contrast with the existing landforms;
- the visual effect is considered to be 'moderate' as the visible elements are between 1 and 2.5 per cent of the PVZ (refer to Table 9.1 - Category 1 - and Figure 9.12);
- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP3 is 7km; and
- the visual impact is considered to be 'moderate' (refer to Table 9.3).

Once the final landform height is achieved in these setback areas, final rehabilitation will commence and reduce the visual impacts on sensitive receivers at VP3.

c. Summary

Due to the progressive nature of rehabilitation activities and as these areas mature with vegetation, the proposed modification will have a potential moderate/low visual impact on some residences in Long Point in the longer term (refer to Table 9.3) which are some 7km from the overburden emplacement areas. The more natural appearance of the proposed conceptual final landform allows for a greater integration into the existing landscape and PVZ (refer to Figure 9.12).

It is considered that these design measures reduce the longer term potential visual impact for residences in Long Point compared to the initial short-term moderate visual impacts when the areas behind the existing Cheshunt overburden emplacement area are being established in Stages 1 and 2 of the proposed modification.

iv VP4 - Jerrys Plains Road

HVO South is not currently visible from VP4, as an existing ridgeline obstructs the view. As outlined in Table 9.2, the distance between the viewpoint and HVO South reflects a moderate visual sensitivity for residences. The PVZ also includes views of grassed hillsides and treed vegetation with some minor infrastructure (roads and electricity distribution lines). Grassed paddocks and agricultural crops are also in the foreground. As shown in Figure 9.9, the approved final landform does not rise above this ridgeline and, therefore, would not be visible once completed.

The proposed conceptual final landform would slightly rise above the existing ridgeline, making it visible during the development of the emplacement areas through to completion of the rehabilitated landform. To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP4, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'low' (refer to Table 9.1 - Category 3) as the visual elements have some degree of integration with the existing landforms and micro-relief design borrow some features of the existing visual setting (inclusive of the current emplacement area);
- the visual effect is considered to be 'low' as the visible elements are less than 30 per cent of the PVZ (refer to Table 9.1 - Category 3);
- the visual sensitivity is considered to be 'moderate' (refer to Table 9.2), given the distance between the proposed modification and VP4 is 10km; and
- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

Although a section of the rehabilitated emplacement area would be visible to some of the residences south of Jerrys Plains village, the proposed conceptual final landform is designed to incorporate microrelief and presents a natural looking landscape that is sympathetic with adjacent ridgelines in the PVZ. This reduces the potential contrast with the existing views and allows for greater landscape integration.

It is important to note that some residences along Jerrys Plains Road (VP4) may experience short to medium impacts during height establishment activities for the final landform. However, given the 10km (or greater) distance between the sensitive receivers on Jerrys Plains Road, it is considered that these activities would represent a moderate/low impact in accordance with the method outlined in Tables 9.1 to 9.3.

Once the final landform height is achieved in these setback areas, final rehabilitation will commence and reduce the visual impacts on sensitive receivers at VP4.

v VP5 - Camberwell village

From VP5, there are relatively distant views (approximately 5.8km) of the Cheshunt overburden emplacement area below the horizon. The PVZ also comprises views of the National Park in the distance on the horizon. Views of natural vegetation and grassed paddocks are dominant views in the foreground and mid-ground.

The design of the 2008 assessed final landform is long, flat, with engineered edges with the area planned to be revegetated using grass species that would result in a uniform appearance that emphasises the low relief on completion of the rehabilitation. This can be seen in Figure 9.11.

It should be noted that the visual amenity and environment for residential receptors within the Camberwell village has been modified with the historical and continued development of mining and associated infrastructure in the vicinity. Existing views comprise:

- views to the north of Ashton Coal Mine approximately 1.2km away and Glendell Mine approximately 4km away;
- views of Ravensworth East-Narama Mine approximately 3.5km north-west of VP5; and
- views of Integra Mine approximately 2.9km east of VP5.

Other infrastructure visible from VP5 and surrounds includes the New England Highway, various electrical transmission lines, Main Northern Railway Line, with Bayswater and Liddell power stations, approximately 15km to the north-west. It should be noted that Ashton Coal's (yet to be constructed) South East Open Cut project would be approximately less than 500m south of VP5 and in the foreground of views toward HVO South, which would represent a future significant change in views toward HVO South.

a. Final landform

The elevation of the proposed conceptual final landform will increase in some areas when compared to the 2008 assessed final landform. These elevated areas of the landform were designed to be setback from the existing face of the Cheshunt emplacement area, retaining its existing rehabilitated eastern face and maintaining the current setback distance to surrounding private dwellings to the north-east in Camberwell village and east in Maison Dieu, minimising the visual impact. This is also demonstrated in the proposed indicative final landform shown in Figure 13.1 where these elevated treed areas gently slope down to the midslope flatter grassed areas to the north-east (towards Camberwell village).

As shown in Figure 9.11, the distant existing views of Wollemi National Park will remain which is the result of visual amenity being considered in the mine plan optimisation process (see Sections 3.3.1, 5.3.2 and 9.3.1). To retain existing views from the north-east of the western escarpment, the proposed modification will incorporate microrelief to the surface to reduce the visual contrast to the National Park in the background.

As described in Section 9.3.1iv and shown in Figure 3.5, the approved LCPP and its associated infrastructure are included in the indicative Stage 3 mine plan within the approved envelope. It is anticipated that the approved LCPP will be constructed on the western side of the overburden emplacement area high point and will not be visible to residences in Camberwell village. The approved rail infrastructure is planned to be constructed on the eastern side of the overburden emplacement area but is not likely to be visible from VP5.

To determine the potential visual impacts of the proposed modification in the long term for sensitive receivers at VP5, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'moderate' (refer to Table 9.1 - Category 2) as the visual elements have some degree of integration with the existing landforms and micro-relief design borrow some features of the existing visual setting (inclusive of the current emplacement area);
- the visual effect is considered to be 'low' as the visible elements are less than 10 per cent of the PVZ (refer to Table 9.1 - Category 2);

- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP5 is 5.8km; and

- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

This potential visual impact is generally consistent with the current views of HVO South and the currently approved conceptual final landform as described in Section 9.2 and Table 9.4.

b. Establishment of final landform

It is important to note that in the short to medium term and consistent with the current approved mine plan, some areas will be exposed through active rehabilitation activities to establish the final landform height. Whilst the design considerations have resulted in these areas set back from the existing visible Cheshunt overburden emplacement area, the height establishment activities in these areas will become visible for a period of time, albeit from a distance of 5.8km. The majority of these activities within the visible components of Cheshunt overburden emplacement area are planned to be completed by Stage 2 or approximately Year 2022 (refer to Figure 3.4). The rehabilitation areas will mature through the remaining stages of the proposed modification, within the same period as the existing project approval (PA 06_0261), reducing the areas of active emplacement areas visible at a distance of approximately 5.8km.

Under the proposed modification, the Cheshunt Pit emplacement is likely to be exposed for a period due to the time required to complete the final emplacement height and the landform shaping activities that are necessary to create a more natural looking final landform that complements the existing environment. Notwithstanding, during the establishment of overburden emplacement areas, they will be seeded with a temporary vegetative cover and progressive rehabilitation will continue with slopes planted with ironbark woodland communities to reduce visual impacts (refer to Sections 3.3.1, 5.3.2, 9.3.1 and 9.3.3).

To determine the potential visual impacts of the proposed modification in the short to medium term for sensitive receivers at VP5, the method outlined in Table 9.1 to 9.3 has been applied as follows:

- the proposed modification's visual properties are considered 'high' (refer to Table 9.1 - Category 2) as the visual elements (additional exposed areas of emplacement during height establishment) will contrast with the existing landforms;

- the visual effect is considered to be 'low' as the visible elements are less than 10 per cent of the PVZ (refer to Table 9.1 - Category 2);

- the visual sensitivity is considered to be 'high to moderate' (refer to Table 9.2), given the distance between the proposed modification and VP5 is 5.8km; and

- the visual impact is considered to be 'moderate/low' (refer to Table 9.3).

Once the final landform height is achieved in these setback areas, final rehabilitation will commence and reduce the visual impacts on sensitive receivers at VP5.

c. Summary

Due to the progressive nature of rehabilitation activities and as these areas mature with vegetation, the proposed modification will have a potential moderate/low visual impact on some residences in Camberwell village in the longer term (refer to Table 9.3) which are some 5.8km from the overburden emplacement areas. The more natural appearance of the proposed conceptual final landform allows for a an improved integration into the existing landscape and PVZ (refer to Figure 9.11).

It is considered that these design measures reduce the longer term potential visual impact for residences in Camberwell village compared to the initial short-term moderate visual impacts when the areas behind the existing Cheshunt overburden emplacement area are being established in Stages 1 and 2 of the proposed modification.

9.3.3 Community engagement

As described in Section 5.3.2, the proponent presented information to the November 2016 HVOCCC meeting in response to a request for further information regarding the mine design principles (ie avoid and mitigate), overburden emplacement area establishment methods and potential visual amenity impacts on private dwellings in Maison Dieu. The information presented included:

- Emplacement of the additional material within the Cheshunt emplacement area (and set back from the existing rehabilitated face) rather than in areas to the south which would have reduced views of the nearby Wollemi National Park for sensitive receivers to the east of HVO South.
- Maintaining the current 2.6km setback distance of rehabilitated areas to Maison Dieu.
- Strategic emplacement of overburden within areas along the previously internal haul route alignments, as mining progresses westward, creating a landform consistent with the existing rehabilitated areas which would provide further protection from dust generation impacts to the east.
- Establishment of a more natural looking final landform that complements the existing environment, including progressive rehabilitation such as seeding of emplacement areas with a temporary vegetative cover during their establishment.
- Construction methods for overburden emplacement would comprise an initial lift on the outer edges, which would be seeded to create a temporary vegetative cover, enabling emplacement of overburden behind the initial lift which would reduce the visibility of these emplacement activities.

The presentation provided to the HVOCCC in November 2016 is in Appendix D.

9.4 Management and monitoring

As described in Section 9.2.2, HVO South implements a number of visual and lighting management procedures in accordance with the existing project approval (PA 06_0261), the approved Coal & Allied Environmental Management System, and relevant plans, procedures and monitoring programmes. These measures, inclusive of progressive rehabilitation as soon as practical to do so, will continue to be implemented under the proposed modification.

The continued implementation of the Hunter Valley Operations Air Quality and Greenhouse Management Plan will ensure that dust generating activities, particularly through the initial lifts in Stage 1 and 2 to complete the proposed elevation changes, will minimise dust generation visible to surrounding receivers.

This continued management will assist in the minimisation of the short-term visual impacts experienced by residences surrounding HVO South, particularly those to the east within Maison Dieu. Some of these operational management controls include the below.

- Progressively reshape, topsoil and rehabilitate completed overburden emplacement areas. Temporary cover crops will be used to stabilise rehabilitation areas if sowing of long-term species is unlikely to occur within four weeks (waiting for more favourable sowing conditions in autumn/spring).

- Temporary stabilisation of unused areas or dump slopes will be undertaken annually by way of aerial seeding or similar. It is preferred that this occur during either autumn or spring to increase the potential for vegetation establishment success. Review of operating areas will be conducted in the weeks leading up to each seeding event. Seed will be applied to any area foreshadowed to be inactive for six months or more.

- Cleared vegetation is mulched and incorporated into topsoil.

9.5 Conclusions

The visual assessment for the proposed modification considered the potential impacts on the visual amenity of representative viewpoints as the result of changes to the approved final landform as well as changes to the viewscape during operations. Potential viewpoints for sensitive receivers are generally limited to the east of the existing operations, such as Maison Dieu (between 2.7 and approximately 4km away) and Long Point (some 7km away) and north-east in Camberwell village (some 5.8km away). Views from the north, south and west are generally constrained due to intervening topography and distance, however a viewpoint along Jerrys Plains Road (10km away) was selected for analysis.

The proposed modification does not include an increase to the State-approved disturbance footprint of the approved operations. Instead, residences, again at distances of greater than 2.7km, will observe higher overburden emplacements of up to approximately 240mAHD in some areas. These will, however, incorporate micro-relief and look more consistent with natural landforms in the area when compared with the assessed 2008 final landform. Important design considerations to be implemented with the proposed modification include emplacement of material setback from the existing rehabilitated eastern face of the Cheshunt emplacement area. The existing rehabilitated face of the emplacement area will be retained. Further, the majority of height establishment activities will be undertaken in the northern areas within the current disturbance footprint to preserve existing views from the east of the Wollemi National Park and associated escarpments. These design considerations were incorporated into the mine plan to minimise visual amenity impacts on receivers, principally to the east in Maison Dieu and Long Point.

Under the proposed modification, during indicative mine plan Stages 1 and 2, active emplacement areas are likely to be exposed for longer periods as the change in elevation is completed and the landform shaping activities undertaken to create a more natural looking final landform that complements the existing environment.

During these establishment activities in the short to medium term, moderate impacts are predicted for sensitive receivers east of HVO South (Maison Dieu and Long Point) and moderate/low for receivers along Jerrys Plains Road (some 10km from the proposed modification) and in Camberwell village (some 5.8km away). However, once the final landform height is achieved in these setback areas by the end of Stage 2 or approximately Year 2022, final rehabilitation will commence and reduce the visual impacts to these sensitive receivers for the final landform.

Rehabilitation will continue to be progressive, providing for the development of a more natural landscape that includes large areas of connected native vegetation and grassland to support land suitable for agriculture and native fauna movement.

In the longer term, the proposed modification will present moderate/low visual impact at viewpoints in Maison Dieu, Long Point, Jerrys Plains and Camberwell village. Changes to visual amenity are considered to be generally consistent with the 2008 assessed final landform. However, it is considered that the continued implementation of visual and lighting management measures, inclusive of progressive rehabilitation as soon as practical, along with the inherent design and mitigation measures for the post mining landform will reduce potential impacts on visual amenity associated with the proposed modification.

10 Groundwater

10.1 Introduction

The mining of the deeper Vaux and Bayswater seams and changes to the final landform, including final void, have the potential to influence the groundwater regime. Mining removes overburden and interburden material to enable the extraction of the Permian coal seams. The coal seams store water, although it is typically saline and of poor quality. The overburden units typically have a low ability to transmit groundwater. The removal of interburden and coal seams draws groundwater into the pit and reduces groundwater pressures, referred to as depressurisation, leading to a zone of lower groundwater levels (or drawdown) around a mine.

A groundwater assessment by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) is presented in full in Appendix G. The groundwater assessment was undertaken to contemporary standards in accordance with the AIP and included the development of a sophisticated numerical groundwater flow model. The model was developed using a comprehensive dataset and incorporated the extensive mining in the region including all currently approved and foreseeable mine plans within the region (ie HVO North, United Wambo Project, MTW, Cumnock, Ashton and Ravensworth Operations) allowing the assessment of cumulative impacts.

The model was independently peer reviewed by Dr Frans Kalf of Kalf and Associates Pty Ltd (KA), who has over 47 years of experience in hydrogeological investigations and specialises in peer reviews. The peer review concludes that the model is fit for purpose. The currently approved mine plan was remodelled to enable a comparative assessment of the proposed modification.

As described in Section 4.4.1, the proposed modification was referred under the EPBC Act (EPBC 2016/7641) on 29 January 2016. The referral included an assessment against the *Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments - Impacts on Water Resources* (DoE 2013 which concluded that the proposed modification is unlikely to have a significant impact on water resources. The Commonwealth Minister for the Environment will determine whether the proposed action is a controlled action requiring assessment and approval under the EPBC Act.

The groundwater study was completed with reference to:

- relevant NSW legislation including the Water Act and the WM Act and its associated WSPs;
- *Groundwater Quality Protection Policy* (Department of Land & Water Conservation [DLWC] 1998);
- *Groundwater Dependent Ecosystems Policy* (DLWC 2002);
- *Groundwater Quantity Management Policy* (NSW Office of Water 2012);
- the AIP;
- *Strategic Regional Land Use Policy* (DP&I 2012) and Upper Hunter SRLUP; and
- *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013).

As described in Section 3.3.1, AGE reviewed conceptual mine plans and provided input into the mine optimisation process.

10.1.1 NSW Water Management Act and associated Water Sharing Plans

As described in Section 4.3.2 the two key pieces of legislation for the management of water in NSW are the Water Act and the WM Act. Operations at HVO South have the potential to interact with water sources that require licensing under these acts and which are managed under three WSPs, namely:

- the *Hunter Regulated River Water Source Water Sharing Plan 2003* (Hunter Regulated WSP) which commenced on 1 July 2004. The Hunter Regulated WSP covers the water source between the banks of Hunter River and within the unconsolidated alluvial sediments underlying waterfront land on the Hunter River (accounted as surface water from the Hunter River for this assessment);

- the *Hunter Unregulated and Alluvial Water Sources Water Sharing Plan 2009* (Hunter Unregulated WSP) which commenced on 1 August 2009. The Hunter Unregulated WSP covers the Hunter unregulated rivers and creeks, the highly connected alluvial groundwater (above the tidal limit), and the tidal pool areas (accounted as surface water from the Wollombi Brook and consolidated alluvium surrounding the Hunter River and Wollombi Brook for this assessment); and

- the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources* (North Coast Fractured and Porous Rock Groundwater Sources WSP) which commenced on 1 July 2016. North Coast Fractured and Porous Rock Groundwater Sources WSP covers seepage of groundwater from the Permian and Triassic groundwater (ie from the coal seams and interburden) at HVO South.

10.1.2 Aquifer Interference Policy

The WM Act defines an aquifer interference activity as that which involves any of the following:

- penetration of an aquifer;

- interference with water in an aquifer;

- obstruction of the flow of water in an aquifer;

- taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations; and

- disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

Examples of aquifer interference activities include mining, coal seam gas extraction, injection of water, and commercial, industrial, agricultural and residential activities that intercept the water table or interfere with aquifers.

The AIP (Department of Primary Industries 2012) states that:

> all water taken by aquifer interference activities, regardless of quality, needs to be accounted for within the extraction limits defined by the water sharing plans. A water licence is required under the WM Act (unless an exemption applies or water is being taken under a basic landholder right) where any act by a person carrying out an aquifer interference activity causes:
>
> - the removal of water from a water source; or
> - the movement of water from one part of an aquifer to another part of an aquifer; or

- the movement of water from one water source to another water source, such as:
    - from an aquifer to an adjacent aquifer; or
    - from an aquifer to a river/lake; or
    - from a river/lake to an aquifer.

The AIP also requires the assessment of potential:

- water level, quality or pressure drawdown impacts on nearby water users who are exercising their right to take water under a basic landholder right;
- water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources;
- water level, quality or pressure drawdown impacts on groundwater dependent ecosystems;
- increased saline or contaminated water inflows to aquifers and highly connected river systems;
- to cause or enhance hydraulic connection between aquifers; and
- river bank instability, or high wall instability or failure.

In particular, the AIP describes minimal impact considerations for aquifer interference activities based on whether the water source is highly productive or less productive and whether the water source is alluvial or porous/fractured rock in nature.

A highly productive groundwater source is defined by the AIP as a groundwater source which has been declared in Regulations and datasets, based on the following criteria:

- has a total dissolved solids (TDS) concentration less than 1,500mg/L; and
- contains water supply works that can yield water at a rate greater than 5L/s.

'Highly productive' groundwater sources are further grouped by geology into alluvial, coastal sands, porous rock, and fractured rock. 'Less productive' groundwater sources include aquifers that cannot be defined as 'highly productive' according the yield and water quality criteria.

Assessment of the proposed modification against the requirements of the AIP was undertaken in the groundwater assessment and is summarised in Section 10.4.

10.2 Existing environment

10.2.1 Environmental setting

i Climate

Climate monitoring data was used in the assessment from the BoM station at Jerrys Plains Post Office. Interpolated rainfall and evaporation data closer to the project area was obtained from Queensland Department of Science, Information Technology and Innovation's (DSITI's) data drill (Queensland Government 2015). The average annual rainfall recorded at Jerrys Plains Post Office is 645mm with rainfall evenly distributed throughout the year. Interpolated rainfall at HVO is slightly higher at 675mm, with an annual evaporation of 1,514mm. Evaporation exceeds mean rainfall throughout the year, with the highest moisture deficit occurring during summer.

Monthly records from the DSITI dataset were used to calculate the Cumulative Rainfall Departure (CRD), or rainfall residual mass. The CRD indicates that the district experienced below average rainfall from 2000 to 2007, above average rainfall from mid-2007 to 2012, and generally average rainfall since 2012. The DSITI dataset also provides monthly pan evaporation and calculated plant evapotranspiration rates which indicates higher rainfall, evaporation and evapotranspiration during the summer months (especially in December and January). During the mid-year winter months, evaporation and evapotranspiration is lowest.

ii Terrain

At a regional scale, the terrain is characterised by a steep and incised range to the west, which falls generally towards the low lying floodplains of the Hunter River and Wollombi Brook. The main topographic highpoint within the region is Mount Wambo, which is within the Wollemi National Park west of the proposed modification.

The project area is gently undulating, with elevation ranging from 110mAHD along the western extent of Riverview Pit to 65mAHD at the northern edge of Riverview Pit. Outside of the project area, the topography grades into the flat alluvial lands associated with the adjacent watercourses. The elevation of the Hunter River and Wollombi Brook alluvial floodplains ranges from 50mAHD to 60mAHD. Within the Wollemi National Park to the west, the elevation generally ranges between 300mAHD and 650mAHD.

The project area is largely cleared of vegetation due to historical farming and mining. Riparian vegetation is present along the Hunter River and Wollombi Brook, including tree species such as the River Red Gum. Wollemi National Park is densely vegetated with various plant communities, including open forests dominated by eucalypt species.

iii Drainage

The project area is within the Hunter River Basin catchment and is drained by the Hunter River and Wollombi Brook and minor tributary drainage channels. The Hunter River flows in an easterly direction immediately north of the project area, flowing south further downstream. The Wollombi Brook flows in a north to north-easterly direction immediately south of the project area, and joins with the Hunter River. The minor drainage lines are ephemeral, flowing after rainfall events.

Real time stream flow data is monitored along the Hunter River and Wollombi Brook at DPI Water gauging stations via the Hunter Integrated Telemetry System. The closest upstream gauging station along the Hunter River is approximately 5km north of HVO South at the Liddell Power Station (210083). The closest gauging station along Wollombi Brook is at Warkworth (station 210004), 1km south of HVO South. Baseflow was estimated by comparing the monthly rainfall with total monthly stream flow. The results show that surface water flow is largely a function of rainfall and dam releases. The Hunter River has a median flow of 250ML/day which is largely due to continuous releases from Glenbawn Dam. The unregulated Wollombi Brook has a median flow over 38ML/day.

iv Landuse

Land use in the project area includes coal mining and stock agistment. Surrounding land uses include coal mining operations and agriculture. The project area is within the Hunter Valley coalfields, which has a long history of mining the Wittingham Coal Measures, dating back to the 1940s. Surrounding coal operations are described in Chapter 2 and shown in Figure 2.3. These surrounding coal mines extract similar coal seams from the Wittingham coal measures and influence groundwater levels. The potential for cumulative groundwater interactions is discussed in Section 10.3.

10.2.2 Geological setting

i Regional geology

The main structural feature of the regional geology is the Sydney Basin. The basin formed in the Late Carboniferous – Early Permian due to igneous rifting and crustal thinning, which resulted in the deposition of Permian and Triassic aged sedimentary sequences.

The Permian sequences form the Wittingham Coal Measures in the project area and include the economic coal seams. The coal measures outcrop to the east of HVO South and plunge in a west to south-westerly direction. The overburden and interburden units comprise sandstone, siltstone, tuffaceous mudstone and conglomerate.

The Permian coal measures are unconformably overlain by the Triassic Narrabeen Group, which formed from uplift during the Triassic. The Narrabeen Group comprises fluviatile deposits that form the ridges and a high plateau within the Wollemi National Park, west of the proposed modification. Surficial weathering is evident across the project area. The surficial weathering profile is typically present as thin heterogeneous layer of unconsolidated and highly weathered material (regolith) overlying bedrock.

ii Local geology

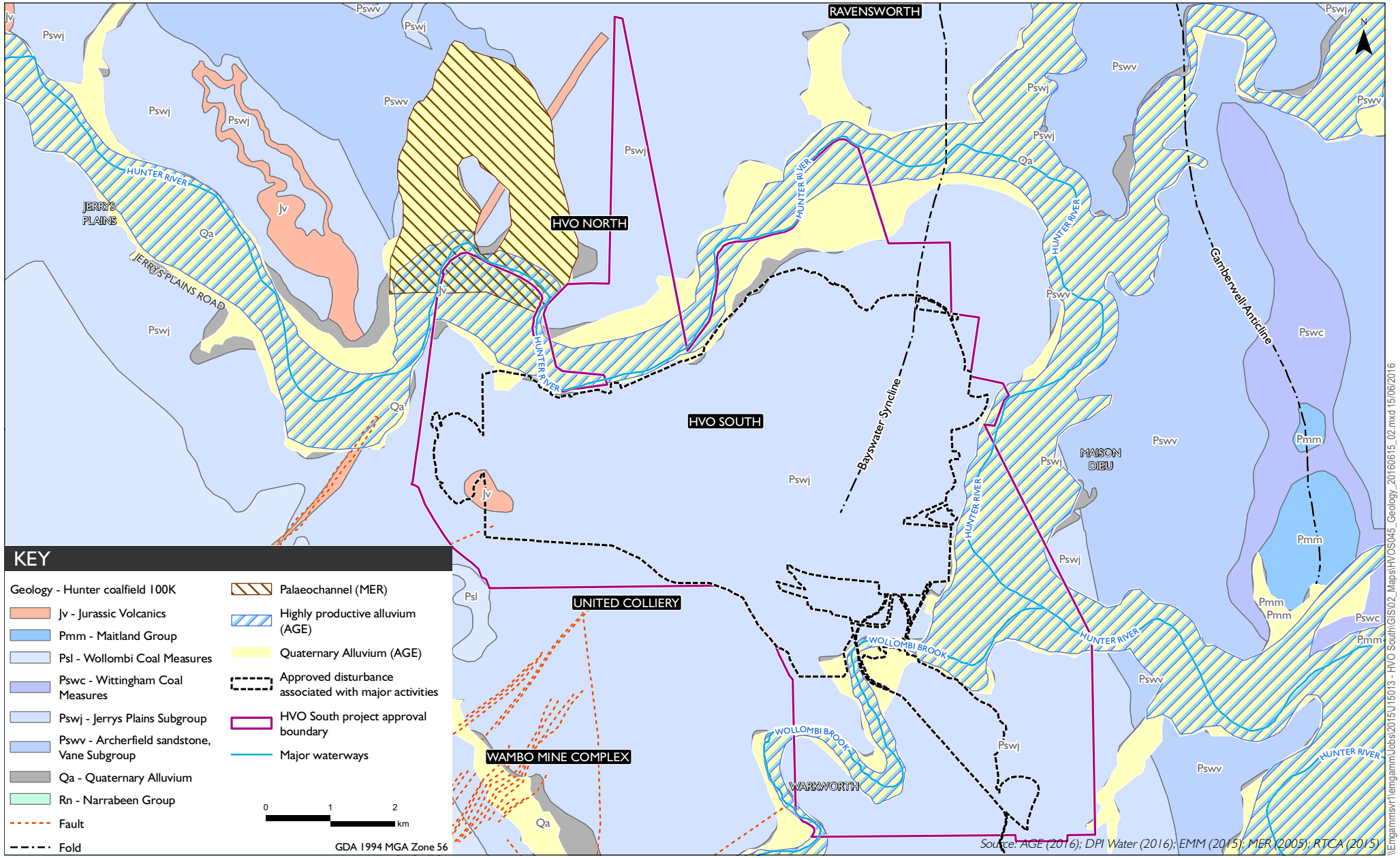
The main stratigraphic units within the project area are the Quaternary alluvium and the Permian Wittingham Coal Measures.

The Quaternary alluvium unconformably overlies the Permian and Triassic sediments along the Hunter River and Wollombi Brook. The alluvial material comprises shallow sequences of clay, silty sand and sand, underlain by basal sands and gravels. These basal sands and gravels form a highly productive groundwater source. Along the Hunter River and Wollombi Brook flood plains the productive basal sands are typically between 7m and 20m thick. The Hunter River alluvium and the Wollombi Brook alluvium have bores that meet the criteria of the 'highly productive' and 'less productive' alluvial water sources categories described in the AIP. The Permian coal measures (porous and fractured rock) are categorised as 'less productive'. Figure 10.1 shows the local surface geology including the highly productive alluvium.

The numerical groundwater model was developed and results extracted based on the extent of 'highly productive' alluvium.

To the east of Wollombi Brook, a sequence of aeolian sands, known as the Warkworth Sands Formation, forms a thin capping on the underlying weathered Permian bedrock. The Wittingham Coal Measures are up to 450m thick in the project area and comprise 15 economic coal seams that are extensively mined across the Hunter Valley. The coal seams are interbedded with relatively low permeability sequences of siltstone, sandstone and shale. The coal seams accessed by HVO South outcrop within the approved disturbance footprint with the exception of the Bayswater seam which outcrops to the east. Individual coal seams have an average thickness of 3m and the interburden strata have an average thickness of 25m, and a maximum thickness of 90m. The upper Permian bedrock has a weathered profile that extends to 50m below the surface.

North-east to south-west trending faults are mapped across HVO South. The Hunter Valley Cross Fault runs along the southern edge of Riverview Pit, and north of South Lemington Pits 1 and 2.



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Surface geology

HVO South Modification 5
Environmental Assessment

Figure 10.1

10.2.3 Hydrogeology

i Existing data and monitoring

The proponent has an extensive groundwater data network collected from long-term exploration drilling historic data collection and the existing monitoring network spanning the HVO North and HVO South operations. The groundwater assessment incorporated data collected at 251 bores and 17 vibrating wire piezometers (VWPs).

The current monitoring network includes 154 bores and one multiple-level VWP. This network is regularly monitored in accordance with the frequencies specified in the approved HVO Water Management Plan (WMP). The current and historic monitoring networks are shown in Figure 10.1.

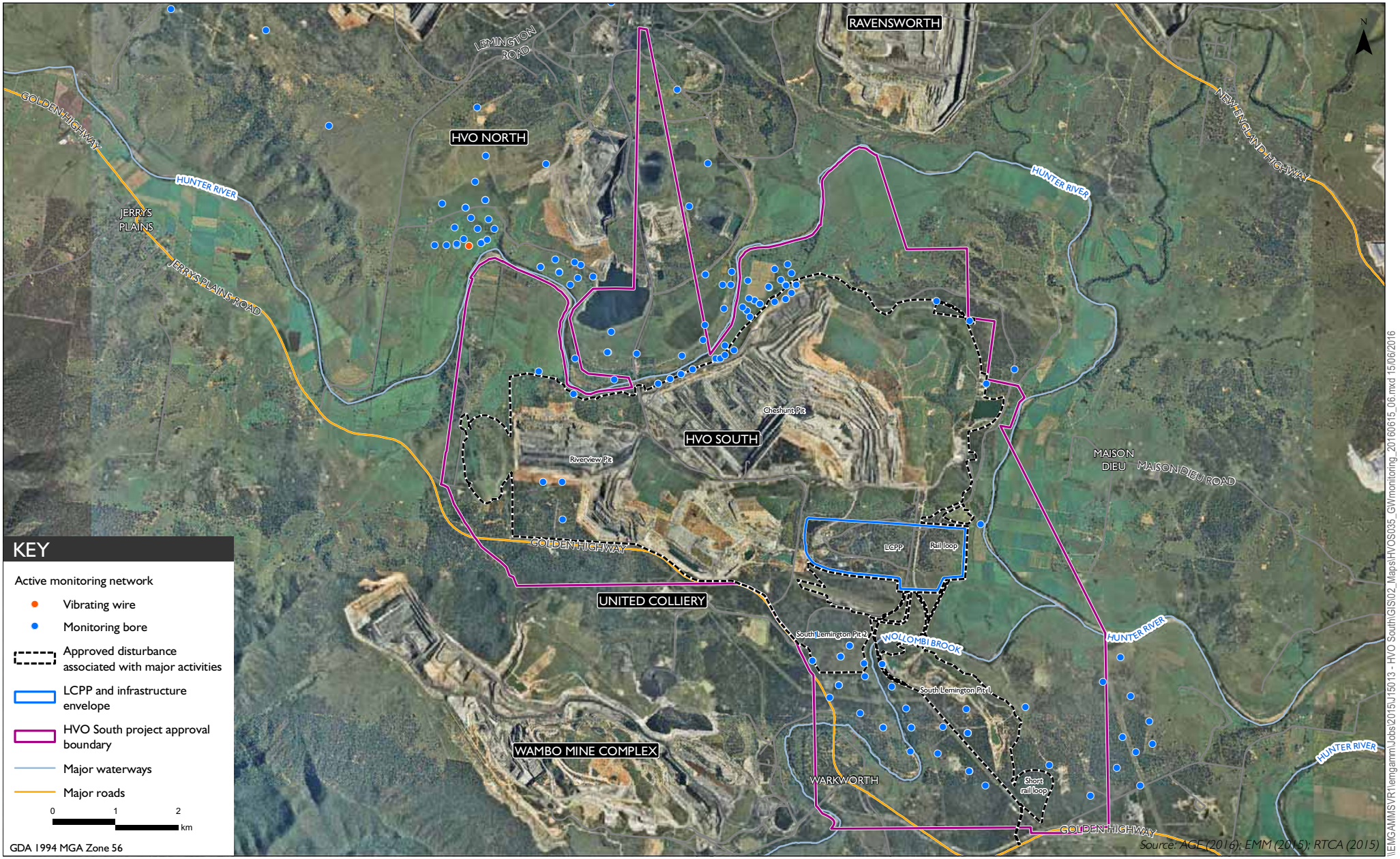
ii Surface geology

To characterise the existing hydrogeological setting, monitoring data from 1997 to 2015 were assessed along with the findings from previous groundwater studies at HVO South. A field investigation was specifically conducted in the vicinity north of Riverview Pit in September 2015 to provide additional data for the assessment of the proposed modification. The investigation comprised the installation of two additional monitoring bores and excavation of a shallow trench providing data on:

- the extent, thickness and characteristics of the alluvium associated with the Hunter River;
- the hydraulic properties of the alluvium to validate model assumptions; and
- identified gaps in routine monitoring coverage.

iii Hydraulic parameters

The results of hydraulic conductivity testing show that the alluvium has a relatively high hydraulic conductivity, which ranges between $5.3x10^{-2}$m/day and $3.7x10^{-2}$m/day. The coal seams are typically moderately to slightly permeable, with hydraulic conductivity generally around $1x10^{-2}$ m/day, and ranging between $5.24x10^{-7}$m/day and 12m/day. The hydraulic conductivity of the interburden material, including the Archerfield Sandstone, is generally less than coal but is highly variable, ranging between $1.87x10^{-7}$m/day and 1m/day, depending on the predominance of fractures in the rock mass. The hydraulic conductivity of the coal seams decreases with depth due to the closure of the cleats with increasing stratigraphic pressure.



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HVO groundwater monitoring network

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Environmental Assessment
Figure 10.2

iv Existing groundwater levels, flow directions and sub-surface recharge

Groundwater levels allow vertical and lateral hydraulic gradients and flow directions to be determined. Groundwater level trends from nested bores in the alluvium and Permian coal measures were analysed to examine flow directions and subsurface recharge. Monitoring results show variability in groundwater levels within the alluvium. Recharge to the alluvium occurs both via infiltration from rainfall and directly from the incised watercourses as well as some upwards leakage from the Permian strata below.

The groundwater elevation within the clay rich alluvium along the incised southern embankment of the Hunter River (north of Cheshunt Pit) is high in comparison to the groundwater elevation within the alluvial floodplains on the northern side of the river. The alluvial floodplains on the northern side of the Hunter River are comprised of basal sands and gravel and have increased permeability. This shows that the Hunter River is both a losing and gaining system in this area, likely due to the heterogenous distribution of the quaternary alluvium and incised nature of the river.

Monitoring data shows the groundwater elevation within Wollombi Brook alluvium at HVO is generally 4m below stream levels. This indicates that Wollombi Brook loses water to the alluvium in this area.

Under pre-mining conditions, the pore pressures in the confined Permian strata resulted in upwards leakage from the hard rock groundwater flow systems to the unconfined alluvial aquifers. Historic (and currently approved) mining operations have since depressurised these systems. Composite pressure heads in the Permian strata are now 15m to 30m below the groundwater table in the overlying alluvium in the area influenced by mining. In these areas, the hydraulic gradient has been reversed with leakage from the alluvium into the underlying hard rock groundwater flow systems.

v Groundwater quality

Water quality monitoring is undertaken at HVO in accordance with the approved WMP. This includes quarterly field measurements of electrical conductivity (EC) and pH and annual sampling at selected bores for more extensive water quality analysis.

An assessment of the water quality monitoring data collected since 2000 was completed to characterise the potential beneficial use value of each water source at HVO South. For the purpose of this assessment, groundwater quality data has been compared to guideline values from the ANZECC (2000) guidelines for short and long-term irrigation and livestock watering (beef cattle).

The Hunter River alluvium and Wollombi Brook alluvium have bores that meet the criteria of the 'highly productive' and 'less productive' alluvial water sources categories defined in the AIP. The Permian coal measures (porous and fractured rock) are categorised as 'less productive'.

The groundwater quality results for the alluvium ('highly productive' and 'less productive') indicated that the groundwater is not suitable for long-term irrigation based on the ANZECC (2000) guideline levels for total manganese.

The results indicated that groundwater within the 'highly productive' alluvium is suitable for stock water supply. The laboratory TDS results show that the average salinity is below 1,020mg/L in the 'highly productive' alluvium, the 95th percentile for TDS (laboratory and calculated from EC) is 1,499mg/L. These results are below the ANZECC (2000) adverse levels for stock (eg sheep, beef cattle, dairy cattle, horses, pigs and poultry).

The laboratory TDS results for the 'less productive' alluvium show that the average salinity is generally below 4,610mg/L. However, as detailed above, the 95th percentile for TDS (laboratory and calculated from EC) is 6,702mg/L. The results show that the 'less productive' alluvium has a higher salinity compared to the 'highly productive' alluvium. In addition, measured TDS concentrations are above the ANZECC (2000) guideline level for adverse impacts on pigs and poultry (3,000mg/L), dairy cattle (4,000mg/L), beef cattle (5,000mg/L) and horses (6,000mg/L). However, the measured TDS is below the ANZECC (2000) guideline level for adverse impacts on sheep. Overall, the results indicate that groundwater within the less productive alluvium is not suitable for stock water supply (excluding sheep) in accordance with the ANZECC (2000) guidelines. However, alluvial groundwater is occasionally used for stock (cattle) water supply within the region.

Groundwater within the Permian strata had measured total manganese concentrations above the ANZECC (2000) long-term irrigation trigger. Measured total selenium concentrations were above the ANZECC (2000) guideline level for short-term irrigation. The results for spoil showed average sulphate concentrations greater than 1,000mg/L, which is above the ANZECC (2000) trigger for stock water supply (pigs). The results also indicated that groundwater within the Permian coal measures and spoil is not suitable for stock water supply or irrigation according to the ANZECC (2000) guidelines, as presented in Appendix A of the groundwater study.

vi Groundwater use

a. Private water use

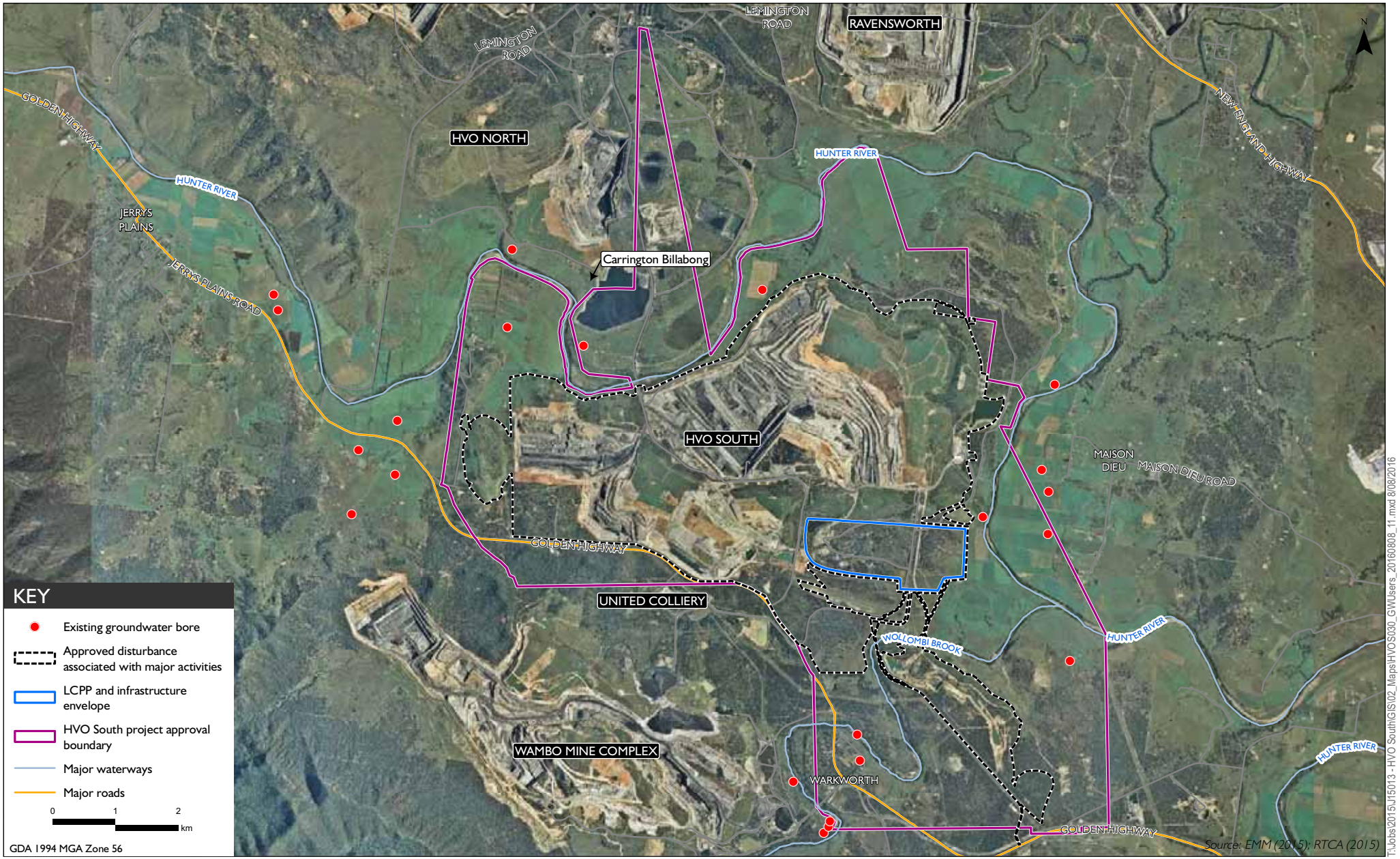
The locations of private groundwater users in proximity to the project area are shown in Figure 10.3. These were located by a search of the National Groundwater Information System database which identified 41 registered bores within 4km of the project area. A further bore census was undertaken in August 2015 to identify any bores not on the register within this 4km zone. An additional two unregistered water supply bores were identified.

Of the 43 bores, 16 have been abandoned and destroyed with another eight abandoned but in a usable condition. Of the remaining 19 existing bores, two are on land owned by the proponent and are utilised for routine monitoring, seven are on land owned by surrounding mine operations and one is used for groundwater monitoring. The other nine existing bores on privately owned land are largely used for stock water supply.

b. Potential groundwater dependent ecosystems

There are no GDEs in the vicinity of the project area as mapped in the *National Atlas of Groundwater Dependent Ecosystems* (refer to Section 12.2.2).

Ecosystems that potentially use groundwater have been identified at six locations from surveys in the area by the proponent as part of previous assessment processes. These comprise the vegetation communities and populations of River Red Gums, Hunter Flood Plain Red Gum Woodland and Hunter Valley River Oak, as well as the ephemeral wetland, Carrington Billabong. For the purposes of this assessment, these ecosystems are referred to as E1 to E6 (refer to Figure 10.4). E1 to E3 are within Hunter River alluvium north of Riverview Pit, while E4 to E6 are within alluvium along Wollombi Brook, near South Lemington Pits 1 and 2. These ecosystems are described in Section 12.2.2 of the ecology chapter.



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Groundwater users

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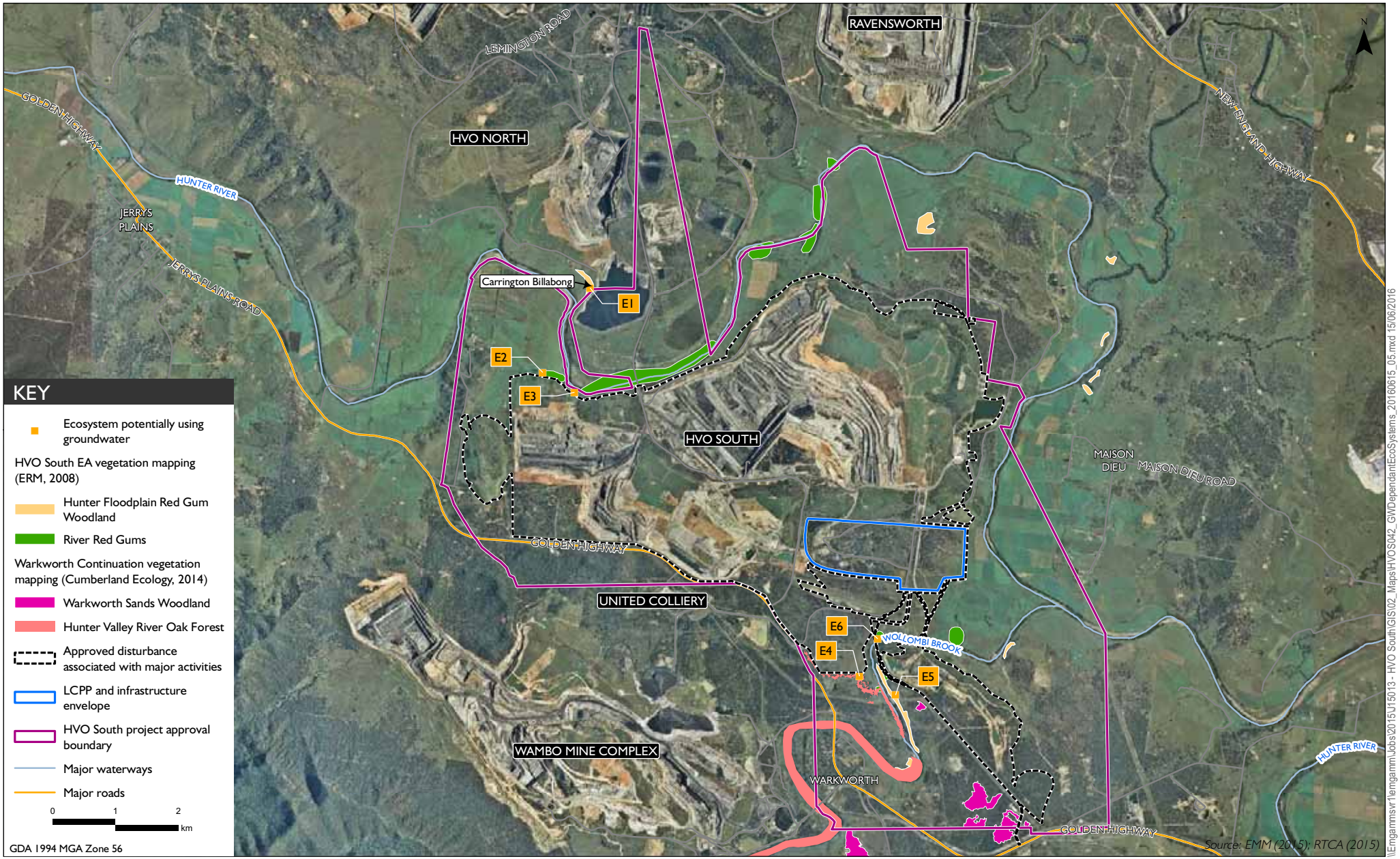
Figure 10.3



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Ecosystems that potentially use groundwater

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Environmental Assessment
Figure 10.4

It is noted that Warkworth Sands Woodland occurs on Aeolian sands overlying areas of the Permian coal measures are located to the west and south of South Lemington Pits 1 and 2, respectively (Cumberland Ecology 2014). Vertical flow of groundwater is impeded by a layer of clay at the base of the sands forming a thin ephemeral perched water table, which is recharged from rainfall through the sandy soils. The perched water table is not in direct hydraulic connection with the underlying Permian fractured rock (AGE 2014). Given the lack of direct hydraulic connection, there is little potential for impacts on the water table in this community from mining (refer to Sections 12.2.2 and 12.2.3).

Ecosystems that potentially use groundwater are discussed in further detail in Chapter 13.

vii Conceptual model

The processes that control and influence the storage and movement of groundwater in the hydrogeological system are summarised below and are described further in Section 10.3.2. These processes informed the development of the model described in Section 10.3.1.

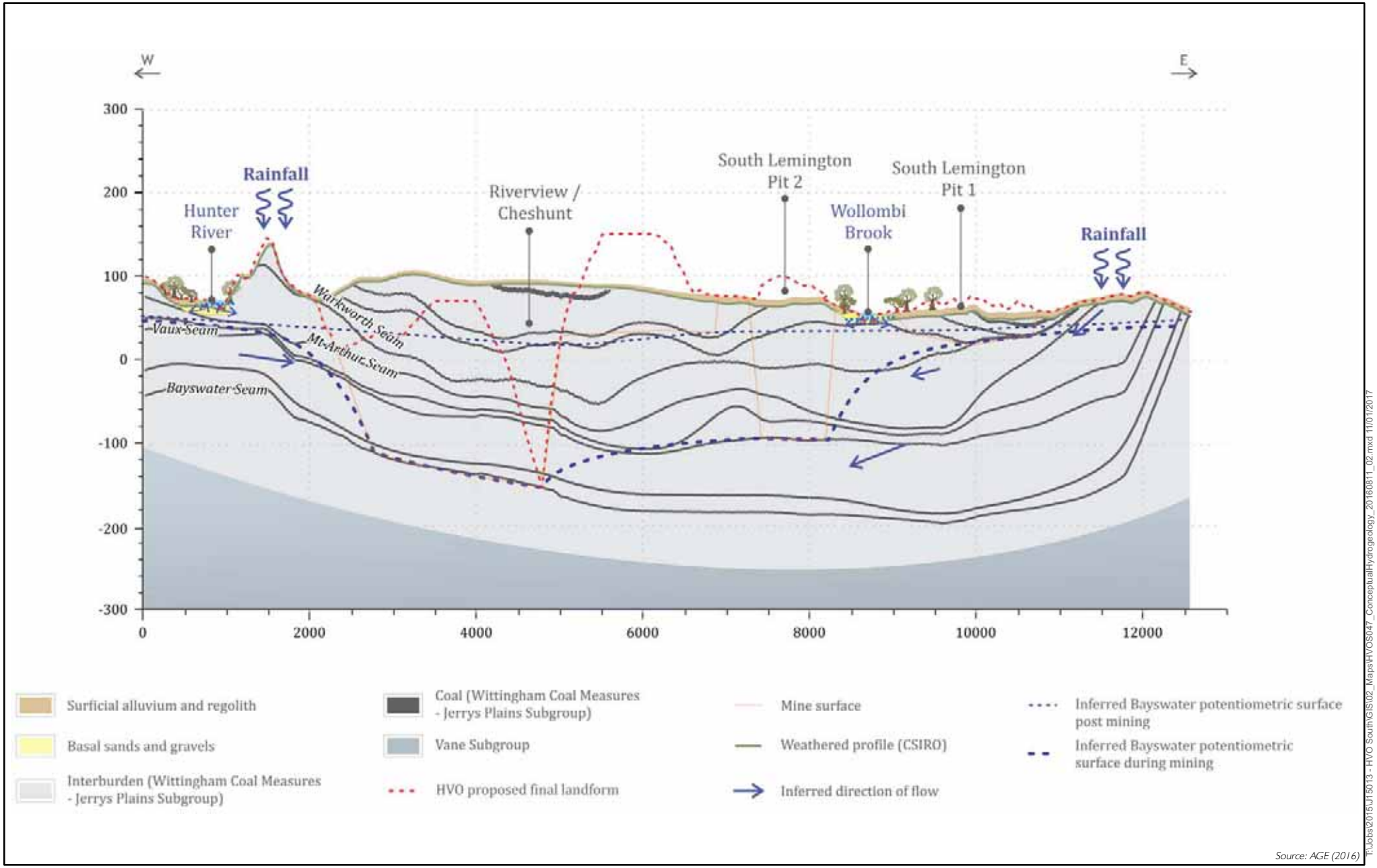
- The main groundwater bearing unit occurring near HVO South is the alluvial aquifers, with less productive groundwater occurring within coal seams of the Wittingham Coal Measures.

- Groundwater flows from areas of high head (pressure plus elevation) to low head. Recharge occurs from direct rainfall to the ground surface, infiltrating into the formations through the thin soil cover and weathered profile. The coal measures also occur at subcrop in localised zones beneath alluvium associated with the Hunter River and Wollombi Brook, where the unit is recharged by downward seepage.

- Groundwater within the Hunter River alluvium flows in an easterly direction. Groundwater within the Wollombi Brook alluvium flows in a north to north-easterly direction. The direction of groundwater flow for the Wittingham Coal Measures is influenced by the local geomorphology and structural geology, as well as the long history of mining within the region.

- The Quaternary alluvium is an unconfined groundwater system that is recharged by rainfall infiltration, streamflow and upward leakage from the underlying stratigraphy particularly along the Wollombi Brook.

- Most agricultural producers utilise surface water resources in preference to alluvial groundwater. There is no significant usage of groundwater from the Permian coal measures.



Source: AGE (2016)

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Schematic section showing conceptual hydrogeology - west to east

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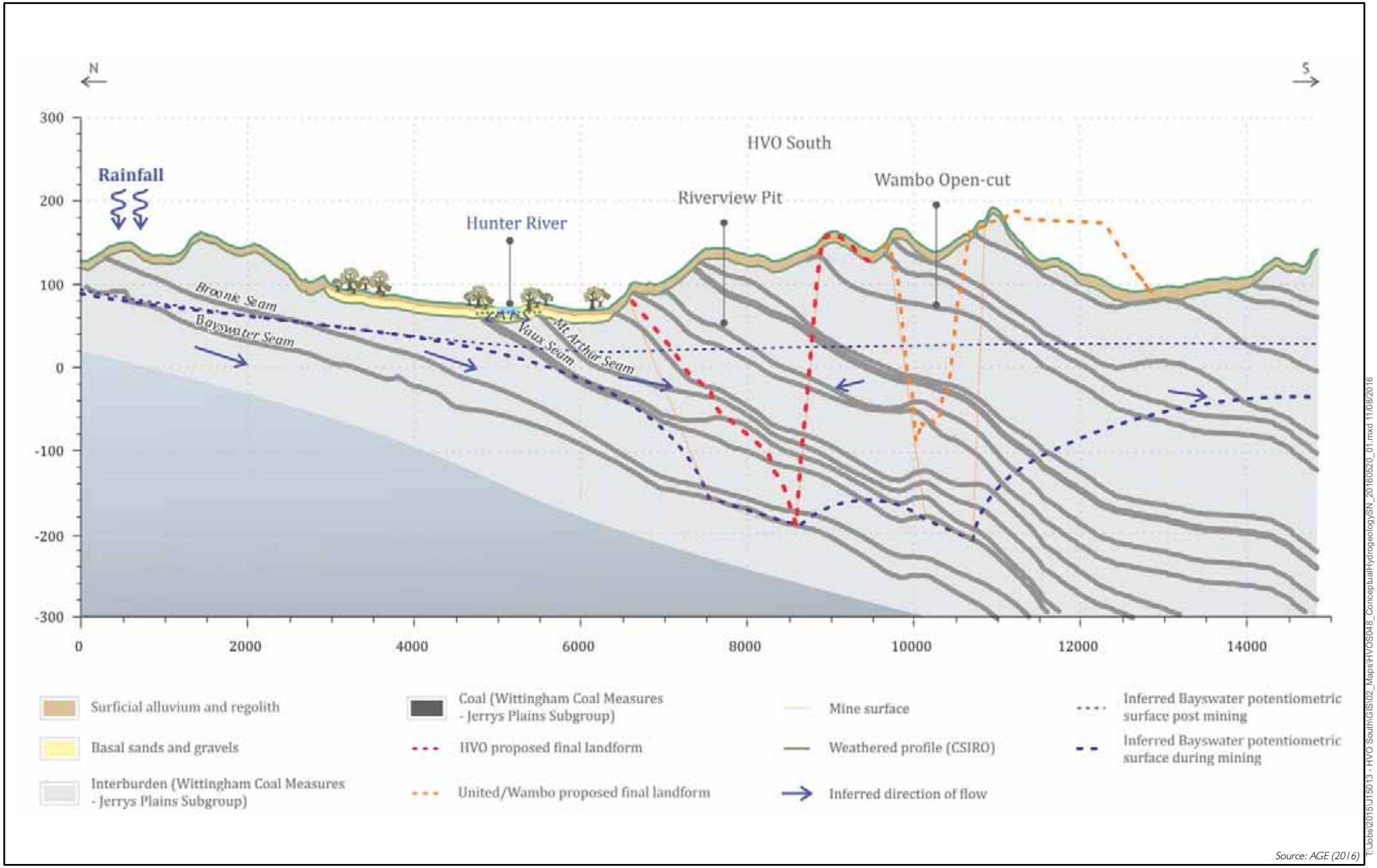
Environmental Assessment
Figure 10.5



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Schematic section showing conceptual hydrogeology - south to north

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Environmental Assessment
Figure 10.6

10.2.4 Previous groundwater studies

As previously stated, mining operations first commenced in the area that is now HVO in 1949, over 65 years ago. HVO South has developed various modifications to its mine plan during the life of its operations. Since 1998, four groundwater studies involving numerical groundwater modelling have been conducted for the now approved HVO South mine plan (Cheshunt, Riverview and South Lemington Pits). These are:

- Mackie Environmental Research (1998) – developed a one layer regional scale MODFLOW groundwater model to assess the groundwater impacts of a revised mine plan for Cheshunt Pit and Riverview Pit (both to be mined to the base of the Vaux seam);
- Rust PPK (1998) – developed a three layer AQUIFEMN model to assess the impact of developing South Lemington Pits 1 and 2 (both to be mined to the base of the Bowfield seam);
- Mackie Environmental Research (2005) – developed 12 layer sectional models (2D models) using FEFLOW to assess the impact of reducing the 150m buffer between Cheshunt Pit and the Hunter River alluvium to 100m; and
- ERM (2008) – developed two small 3D FEFLOW models with five to six layers to assess the impact of revising the footprint and deepening mining at Cheshunt Pit (to the base of the Bayswater seam), mining of Riverview Pit (to the base of the Vaux seam), and revising the footprint at South Lemington Pit 1 (to the base of the Bowfield seam).

Similar groundwater impacts were identified by each of these historic groundwater studies listed above. The outcomes of these groundwater studies include:

- reduced flow of groundwater from the Permian to the alluvium, as well as reduced flow from the alluvium to the Hunter River and Wollombi Brook (ie reduced baseflow contributions);
- reduced groundwater levels within the alluvium along the Hunter River and Wollombi Brook. (These studies also identified that the River Red Gum communities are largely reliant on a surface water flood regime and as a result, there were no predicted impacts on ecological communities due to the modelled alluvial groundwater drawdown);
- groundwater drawdown in the Permian coal measures was predicted to extend 2km to 3km from the active mining area, however, the impact on surrounding groundwater users was considered negligible given the low yields and poor water quality in the Permian strata;
- no significant drawdown (>2m) or adverse water quality impacts were predicted at privately owned groundwater bores;
- no other bores were identified as being potentially impacted as drawdown was largely restricted to mine owned land, and alluvial impacts were expected to be buffered by surface water recharge; and
- the final landforms showed that the final voids would act as a ‘sink’, drawing groundwater in and preventing migration of spoil leachate into the alluvial or surface water systems.

10.3 Impact assessment

10.3.1 Overview

Under natural conditions groundwater flows from the Permian strata into and out of the alluvial aquifer which in turn flows into and out of the surface water of the Hunter River and Wollombi Brook as baseflow.

The existing approval and the proposed modification require the extraction of water in the Permian coal seam (direct take). Although there is no direct take of water through interception of the Quaternary alluvial aquifers, the extraction of groundwater from the Permian strata depressurises the alluvial aquifers resulting in a net reduction in groundwater (indirect take) from the Permian into the alluvium and, in turn, from the alluvium into the surface water baseflow.

Historic and ongoing approved mining operations have already reduced the regional aquifer pressures in the area with existing water take from the Hunter River Regulated WSP (ie Hunter River surface water) and from the Hunter River Unregulated WSP (ie Wollombi Brook surface water and consolidated alluviums associated with the Hunter River and Wollombi Brook). By mining the deeper Vaux and Bayswater seams, the proposed modification will result in additional drawdown within these seams with additional take from the Hunter River Regulated WSP and Hunter River Unregulated WSP.

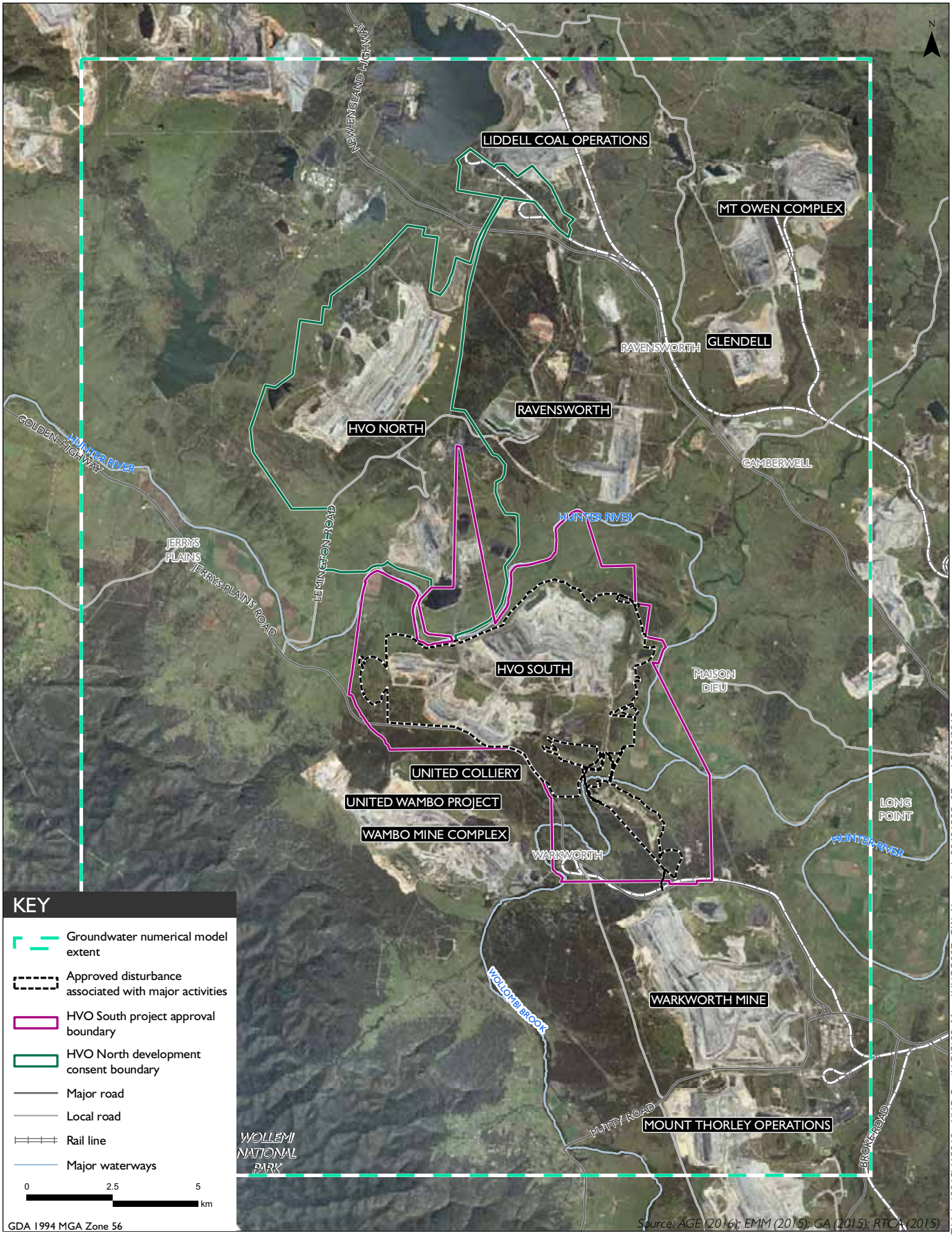
To determine the incremental change of the proposed modification as well as the cumulative effects, a contemporary numerical model was developed. The following sections provide a summary of the model development and its quantified outputs in accordance with the requirements of the AIP.

10.3.2 Numerical model design

A contemporary numerical groundwater flow model was developed for the proposed modification in MODFLOW-USG. The model was used to identify the influence of the proposed modification on the groundwater regime by comparing the impacts generated by the remodelled approved mine plan (from the end of 2015 onwards) and proposed mine plan for HVO South. Approved interactions with the groundwater system for the approved mine plan as predicted in the ERM (2008) EA are also considered.

The model was based on the conceptual groundwater model summarised in Section 10.2.3. Model development updated existing HVO groundwater models with data from the HVO geological model as well as publicly available data, inclusive of data collected from HVO's extensive groundwater monitoring network.

The model represented the key geological units as 34 layers, aligned in a general north-south direction. The model extends approximately 27km from east to west, and 39km from north to south and comprises up to 71,049 cells per layer. The model incorporates the extensive mining in the region including all currently approved and foreseeable mine plans within the region (ie HVO North, United Wambo Project, MTW, Cumnock, Ashton and Ravensworth Operations) allowing the assessment of cumulative impacts. The model extent is shown in Figure 10.7.



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Groundwater numerical model extent

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Environmental Assessment
Figure 10.7

The model was calibrated with a pre-mining steady state run (1970 to 2003), and a transient run (1970 to 2015) using existing groundwater levels at representative bores within the model domain. The model was then run from the end of 2015 onwards for the approved operations (referred to as the 'remodelled approved mine plan') and used to predict the groundwater levels, drawdown and inflow rates in response to the proposed modification. The sensitivity of the model predictions to the input parameters was also analysed.

As noted in Section 10.1, an external independent peer review of the numerical groundwater model was conducted by Dr Frans Kalf of KA, in accordance with the AIP. The peer review is presented in Appendix C of AGE's technical study in Appendix G.

The contemporary model quantifies the individual water take from each water source, which is a requirement of the AIP. Previous modelling for the ERM (2008) EA was completed prior to the enactment of the Hunter River Unregulated WSP and, therefore, was not required to partition the water take from this water source.

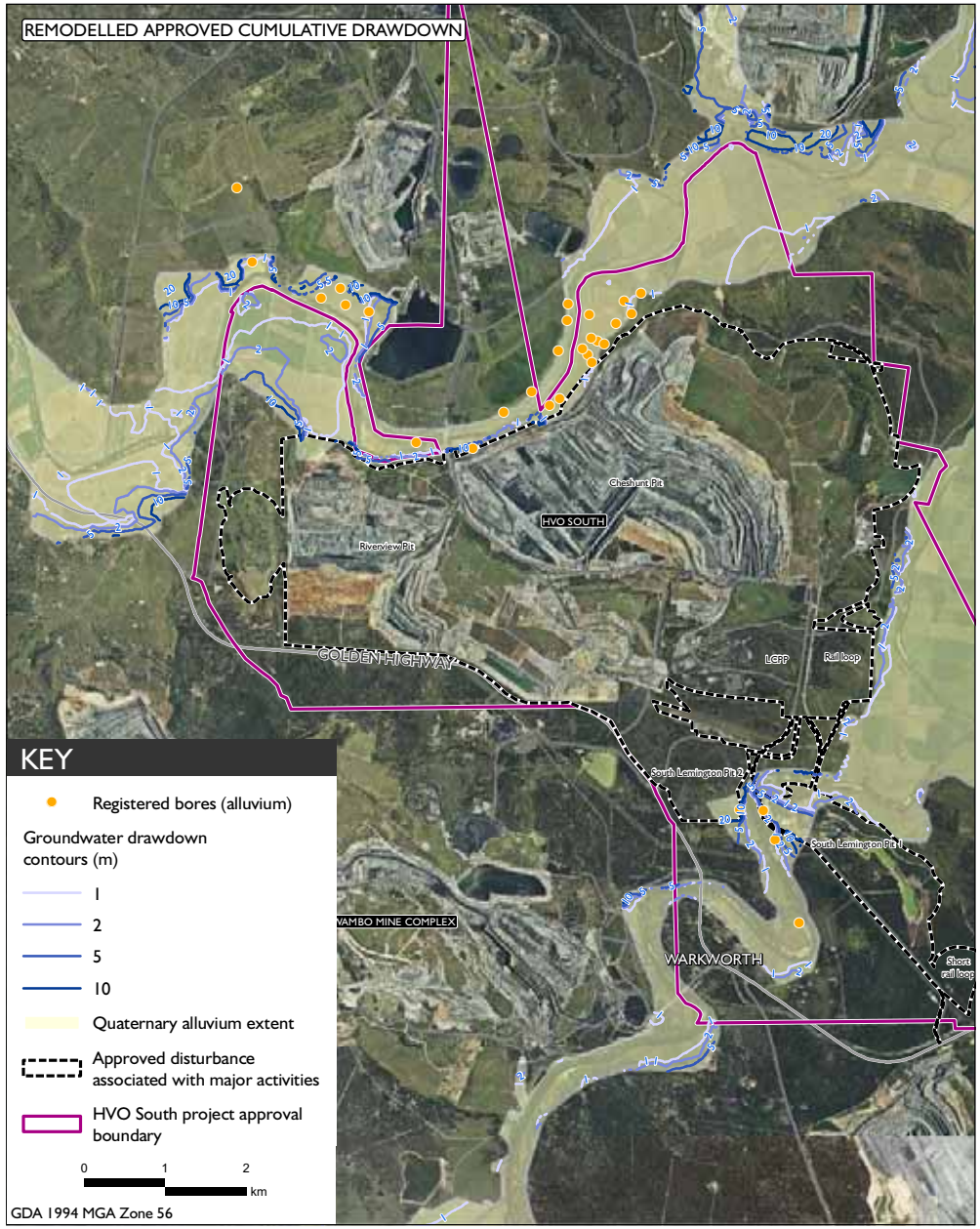
10.3.3 Zone of groundwater drawdown

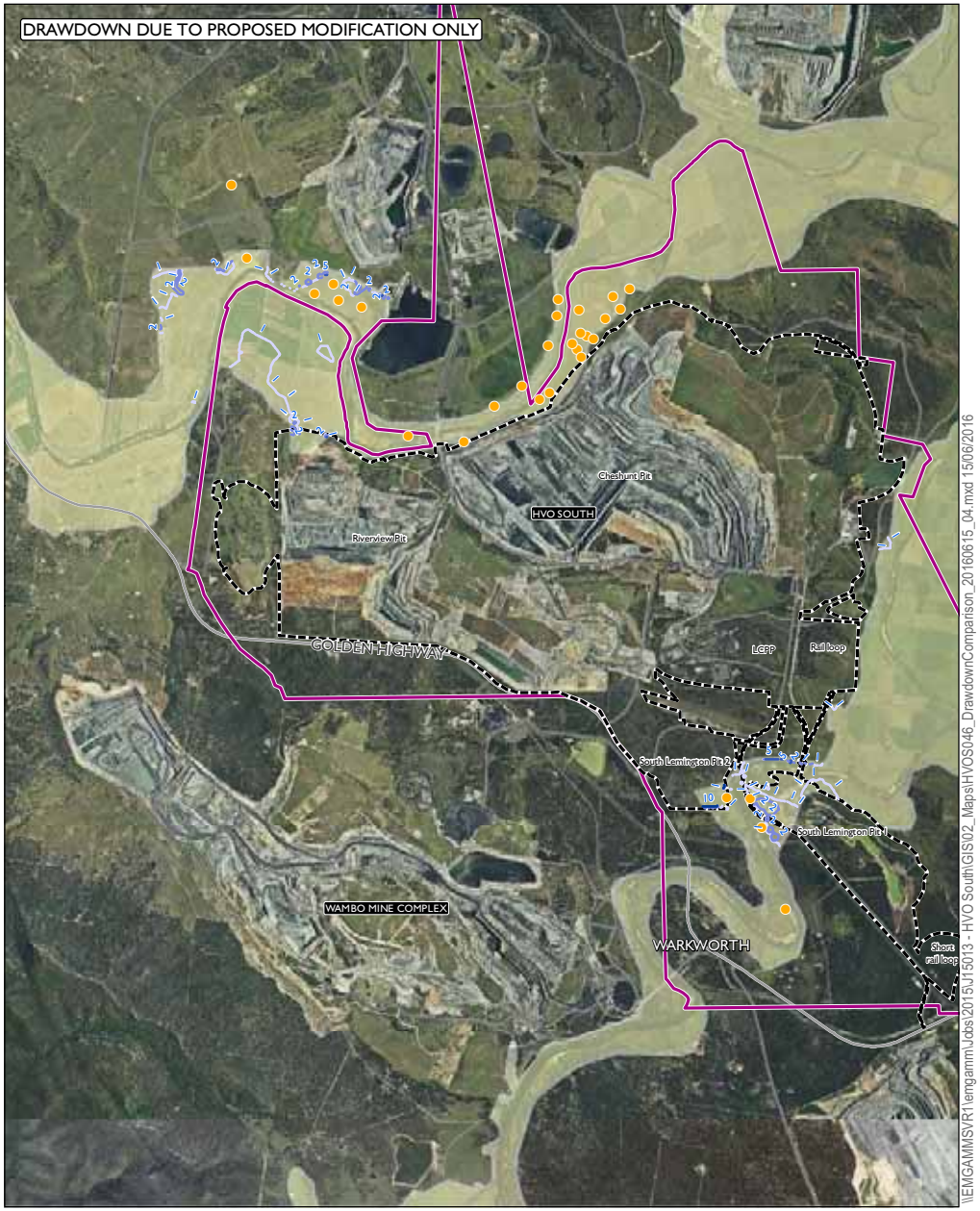
i During mining

Approved coal mines within the region operate below the water table and therefore extract groundwater. When mines are in close proximity to each other the zone of drawdown generated by each can overlap. Within these overlapping areas, the drawdown from each project combines to create a larger cumulative footprint on the groundwater system. Cumulative impacts were accounted for in the groundwater model by representing all currently approved and foreseeable mining operations, along with the proposed modification. The surrounding mines include HVO North, United Wambo Project, MTW, Cumnock, Ashton and Ravensworth Operations that mine the same economic coal seams of the Wittingham Coal Measures.

Figure 10.8 shows that the remodelled approved HVO South is predicted to generate zones of drawdown at the fringes of the alluvium where the mining operations are in relatively close proximity. The drawdown attributable to the proposed modification occurs in only small isolated zones to the north and west of Riverview Pit and south of South Lemington Pit 2. It should be noted that the drawdown levels are a reflection of drawdown through the model cells, irrespective of actual saturated thickness within the aquifer. Therefore, water table drawdown can exceed the saturated thickness along the edges of the alluvium in some areas.

Figure 10.9 shows the drawdown within the Quaternary alluvium when the proposed modification is represented by the model, showing the maximum cumulative impact. The drawdown is similar to the remodelled approved drawdown, indicating the mining of the deeper Bayswater seam has only limited impacts on the alluvial system. This is because the Bayswater seam is relatively deep and overlying layers retard the hydraulic connectivity with the alluvium.





COAL & ALLIED

Maximum zone of drawdown due to the proposed modification - Quaternary alluvium

HVO South Modification 5
Environmental Assessment
Figure 10.8

COAL & ALLIED

Cumulative drawdown extent - Quaternary alluvium

HVO South Modification 5
Environmental Assessment
Figure 10.9

ii Post mining

Post mining conditions were simulated over a period of 1,000 years. Groundwater inflows to the final void during recovery were provided to the surface water specialists and results incorporated in a high-resolution surface water model (see Appendix H). Pit lake level recovery rates from the surface water model were reinstated to the groundwater model using a series of constant heads over time. This is discussed further in Section 11.3.4.

The long-term equilibrium water level for the proposed evaporative basin within the void will be reached approximately 300 years after mining and be approximately 30mAHD. This long-term equilibrium water level is predicted to be about 20m to 30m below pre-mining groundwater levels and about 40m below natural surface levels of 70mAHD, indicating that the void will act as a sink in perpetuity with no escape of contained void water. The evaporative basin at its equilibrium level for the proposed modification is approximately 500m from the Hunter River compared with approximately 250m with its approved location at its closest point.

Approved and proposed final void characteristics are discussed in Sections 11.3.4 and 13.3.2.

Should the LCPP be constructed, South Lemington Pit 1 and Pit 2 will be backfilled at closure. The numerical model predicts post mining groundwater levels will rise and re-saturate the backfilled spoils, but not reach the re-profiled land surface at each of these pits. At South Lemington Pit 2 groundwater levels will recover to about 41mAHD, about 37m below the re-profiled land surface. At South Lemington Pit 1 water levels will recover to about 48mAHD, some two metres below the lowest point of the pit landform at about 50mAHD.

The recovery and filling process will progressively decrease the hydraulic gradient and, therefore, magnitude of drawdown immediately surrounding the mined areas, and a new equilibrium groundwater level will be established around the pits.

10.3.4 Groundwater directly intercepted by mining area

i During mining

Figure 10.10 shows the volumes of groundwater predicted to be intercepted from the Permian coal measures by both the proposed modification and the remodelled approved mining at HVO South. It also shows the volumes predicted to be intercepted by each mining area.

As shown, the volume of groundwater intercepted from the Permian coal measures for the remodelled approved mining plus the proposed modification peaks at 1,591ML/year in year 11. The proposed modification accounts for about one third of the groundwater intercepted, with the remainder occurring due to the approved mining.

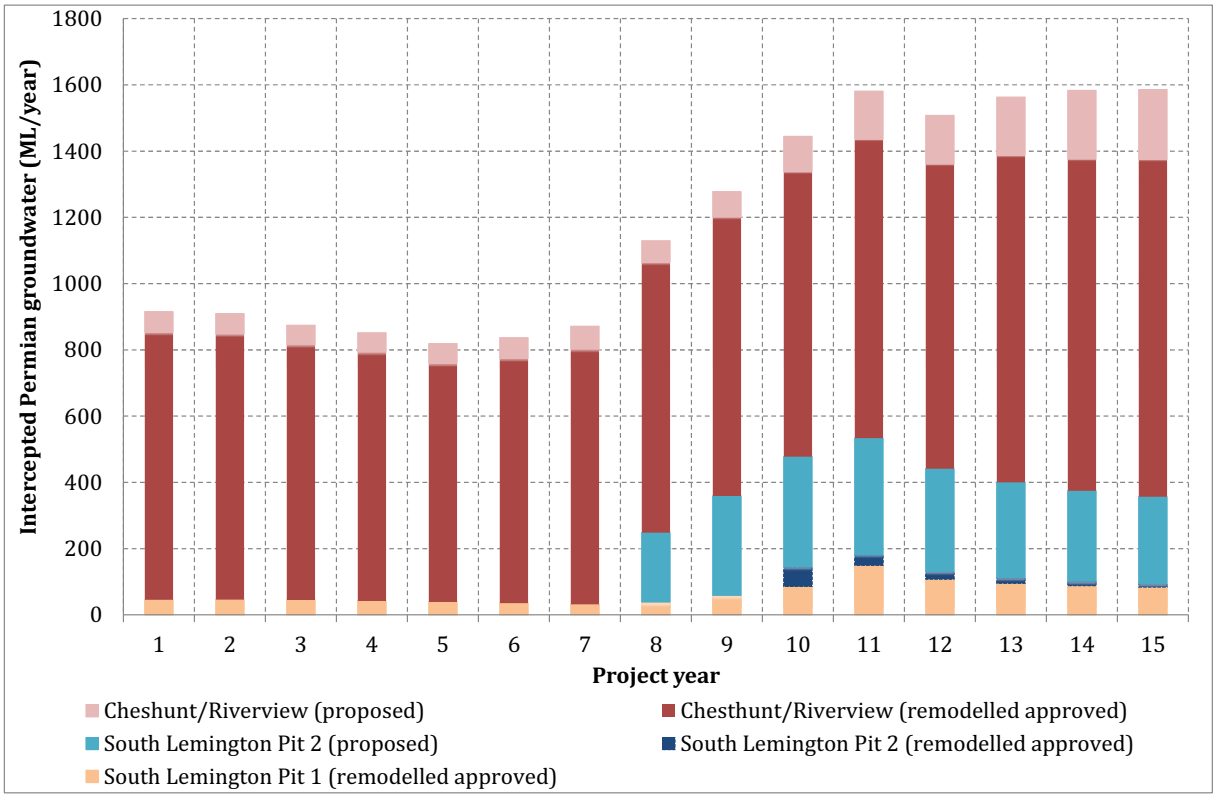


Figure 10.10 Simulated groundwater from Permian coal measures intercepted by proposed and approved mining

ERM (2008) predicted a peak of 3,299ML/year (combined water take from Permian, alluvium and Hunter), which comprised 2,672ML/year of groundwater intercepted by the Cheshunt Pit, 310ML/year due to the Riverview Pit and 317ML/year for South Lemington Pits 1 and 2. The composition of the Cheshunt Pit and Riverview Pit inflows were estimated to comprise one third alluvial groundwater, one third Permian groundwater and one third groundwater stored within the extracted Permian coal seams (bound water). No commentary was provided on pit inflows from the South Lemington Pits. ERM (2008) EA predictions are discussed further in Section 10.3.5i.

ii Post mining

Post closure the groundwater system will reach a new equilibrium due to the changes induced in the groundwater system by mining activities (refer to Section 11.3.4). The water level within the proposed pit void is predicted to recover to an elevation of around 30mAHD.

Modelling indicates the remodelled approved HVO South plus the proposed modification will induce upwards leakage from the Permian coal measures into the proposed final void at an initial rate of approximately 597ML/year 12 years post mining, reducing over time reducing to approximately 206ML/year at equilibrium after approximately 300 years.

10.3.5 Water take

i During mining

The AIP requires the accounting for all groundwater take, either directly or indirectly. As described in Section 10.3.4, groundwater intercepted from the mining area is considered to be a direct take from the Permian strata.

The Hunter River and Wollombi Brook alluvium contain groundwater adjacent to the mining area. Mining will not directly intercept alluvial aquifers, however, an indirect or 'incidental' water take may occur as the Permian strata becomes depressurised and the volume of groundwater flowing from the Permian to the alluvium within the zone of depressurisation progressively reduces. Whilst this water does not necessarily enter the mine workings, the volume of groundwater entering the alluvial groundwater systems is reduced by lower pressures within the Permian due to mining. This has been considered as an indirect take.

Whilst mining reduces the volume of groundwater entering the alluvium from the Permian, the quality of the Permian water entering the alluvium is often poor due to high concentrations of dissolved salts. The reduced flow of Permian groundwater to the alluvium can therefore have a short-term beneficial effect as it reduces the proportion of higher salinity water entering the alluvial system.

The peak take for the proposed modification has been disaggregated into the relevant water source in accordance with the AIP (see Section 10.4), comprising:

- Hunter Regulated Water WSP – Hunter River surface water;
- Hunter Unregulated WSP – alluvial groundwater; and
- North Coast Fractured and Porous Rock WSP - groundwater from the coal measures.

Table 10.1 summarises the predicted 'water take' (direct from Permian and indirect from alluviums) for the approved mining plus the proposed modification.

Table 10.1 Annual groundwater take for each WSP - during mining

Mining year	'Water take' (ML/year)		
	Hunter Regulated WSP (Indirect)	Hunter Unregulated WSP (Indirect)	North Coast Fractured and Porous Rock WSP (Direct)
1	0	167	917
2	39	317	911
3	107	342	876
4	159	358	853
5	205	353	821
6	246	360	839
7	286	360	875
8	327	358	1,134
9	366	348	1,284
10	403	374	1,460
11	436	367	1,591

Table 10.1 Annual groundwater take for each WSP - during mining

Mining year	'Water take' (ML/year)		
	Hunter Regulated WSP (Indirect)	Hunter Unregulated WSP (Indirect)	North Coast Fractured and Porous Rock WSP (Direct)
12	468	423	1,510
13	507	365	1,563
14	548	385	1,581
15	584	385	1,582
Maximum	**584 (Year 15)**	**423 (Year 12)**	**1,591 (Year 11)**

The peak indirect take from the Hunter alluvium is partially comprised of water from the Hunter River which consists of surface water that is managed under the Hunter Regulated WSP. Therefore, the total indirect take is considered to be the Hunter River alluvium minus the induced Hunter River take, leaving the residual amount as the alluvial water take. The same process is used to ensure there is no double accounting of groundwater and surface water take from Wollombi Brook. The remodelled approved peak take from all water sources is predicted at approximately 2,598ML/year, although this does not occur in the same mining year as shown in Table 10.1.

ERM (2008) predicted a peak of 3,299ML/year (combined water take from Permian, alluvium and Hunter), which comprised 2,672ML/year of groundwater intercepted by the Cheshunt Pit, 310ML/year due to the Riverview Pit and 317ML/year for South Lemington Pits 1 and 2. The total maximum and annual water take from Table 10.1 is within these previously predicted maximum water takes for the approved operations. The current version of the model was informed by more monitoring data allowing calibration to a longer timeframe. It therefore provides improved estimates of water take compared to previous assessments.

Modelling predicts that the proposed modification accounts for less than 12 per cent of the peak water take. This is because the proposed modification is within the same footprint as the approved mining, and the majority of the drawdown is induced by approved mining of the shallower geological units, which are better connected to the alluvium.

Stream flow gauge data indicates that the Hunter River flows at an average rate of 343,137ML/year (between 1997 and 2015). Therefore, the maximum predicted reduction in baseflow contributions of approximately 584ML/year due to the remodelled approved mine plan and proposed modification accounts for only a minor proportion (0.2 per cent) of total flows.

Stream flow gauge data indicates that the Wollombi Brook flows at an average rate of 73,883ML/year (between 1997 and 2015). Therefore, the maximum predicted reduction in baseflow contributions of approximately 107ML/year due to the remodelled approved mine plan and proposed modification accounts for only a minor proportion (0.2 per cent) of total flow.

ii Post mining

Post mining, the direct and indirect water take will gradually reduce over time as the mine pit fills and the groundwater system equilibrates to the modified landform. This process is predicted to take around 300 years post mining. The modelling indicates that when equilibrium conditions return post mining, there will be a residual water take that requires long term water licensing.

Table 10.2 summarises the post mining peak take at equilibrium.

Table 10.2 Groundwater peak take - post mining equilibrium (~300 years)

	Model output (ML)	AGE (2016) figure reference	Hunter Regulated WSP (Indirect)	Hunter Unregulated WSP (Indirect)	North Coast Fractured and Porous Rock WSP (Direct)
Hunter river alluvium	318[a]	Figure B-18		30 [(a minus b)]	
Hunter river baseflow	288[b]	Figure B-22	288[b]		
Wollombi Brook alluvium	0[c]	Figure B-19		0 [(c minus d)]	
Wollombi Brook baseflow	+9[d]	Figure B-23		0*	
Permian	206	Section B4.1.2			206
Total	**-**	**-**	**288**	**30**	**206**

*Note: * the net gain predicted for the Wollombi Brook baseflow has not been considered in water licensing.*

10.3.6 Changes to groundwater use

i Drawdown in private bores

The ERM (2008) EA predicted drawdown from the approved HVO South mine plan to be negligible to private groundwater users in the area of the Hunter River and less than 2m in the area of Wollombi Brook. The ERM (2008) EA stated that the predictions for Wollombi Brook were likely to be overstated due to the modelling being under steady state conditions with actual impacts likely to resemble the predictions for the Hunter River completed under transient conditions.

Two levels of minimal impact considerations are specified in the AIP. If the predicted impacts are less than the Level 1 minimal impact considerations (less than 2m drawdown), then these impacts are considered to be acceptable. The AIP stipulates that for any bores where the maximum cumulative decline in groundwater levels is predicted to exceed 2m due to mining a make good agreement between the landholder and the proponent should be in place.

The proposed modification is not predicted to reduce groundwater levels by over 2m at any registered groundwater bores on privately owned land (Figure 10.9). Groundwater modelling predicts no drawdown in private bores exceeding the AIP's Level 1 minimal impact considerations and, therefore, the impacts are considered acceptable satisfying the relevant aspects of Clause 12AB(7) of the Mining SEPP.

A single bore on land owned by the Ravensworth Mine (10011459) is predicted to decline by a maximum of 2.7m (total cumulative drawdown). This decline is predominantly due to already approved operations, with the proposed modification only contributing 0.3m of drawdown.

ii Impact on potential groundwater dependent ecosystems

An assessment of the potential impacts on ecosystems potentially using groundwater from the proposed modification is provided in Section 13.3.2. This assessment considers aspects influencing these ecosystems including flooding, surface water flow and groundwater.

The numerical model quantified the predicted drawdown from the proposed modification within the Hunter River and Wollombi Brook alluviums. Drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium. However, in areas adjacent to South Lemington Pit 2 (which is north of Wollombi Brook) where the existing approved operations are expected to result in drawdown of up to 7m, the proposed modification is predicted to further decrease groundwater levels by up to an additional 2.8m. Groundwater levels within alluvium south of Wollombi Brook are predicted to decrease by less than 1m due to the proposed modification.

10.3.7 Water quality

Overburden will continue to be placed within the open cut pit and progressively rehabilitated during mining. Under the approved operations, inclusive of the proposed modification, water will evaporate from the evaporative basin surface, and draw in groundwater from the surrounding geological units. Evaporation from the basin's surface will concentrate salts in the evaporative basin gradually over time, up to 20,000µS/cm (Appendix H). However, as noted previously this gradually increasing salinity will not pose a risk to the surrounding groundwater regime as the final void will remain a permanent sink.

Analysis of spoil leachate has been presented by MER (1998). It was found that the long-term water quality for the bulk of the spoils is approximately 3,700mg/L, assuming complete leaching. The Permian coal measures are predominately classified as moderately saline, with a salinity of between 1,500mg/L and 7,000mg/L. As concluded by MER (1998), the water quality from the recharged spoil could provide some improvement in salinity for the void water quality post mining. In addition, the final void has been developed to act as a 'sink', drawing groundwater in and reducing upward seepage of groundwater from the Permian strata to the alluvium around the mine. Reduction in upward leakage of the more saline groundwater from the Permian coal measures has the potential to improve water quality within alluvium.

10.4 NSW Aquifer Interference Policy

A full assessment of the proposed modification against the AIP is given in Appendix G, including:

- accounting for, or preventing the take of water;
- determining water predictions in accordance with the AIP; and
- other requirements to be reported in accordance with the AIP.

The proposed modification is generally consistent with the objectives of the AIP.

No drawdown greater than 2m is predicted on any private bores and drawdown in ecosystems that may potentially use groundwater from the proposed modification has been assessed as negligible.

The predicted peak water take from each connected water source as a result of the proposed modification during mining and post mining are detailed in Table 10.1 in Section 10.3.3. Sufficient licensed water entitlements are held by HVO to accommodate the proposed modification as shown in Table 10.3.

Table 10.3 Licensed water entitlements for HVO

Water source	WSP	Water source - management zone	Maximum take (ML)		HVO total share component (units or ML/a)	Water Access Licence No.	WAL share component (units of ML/a)
			Current approved	Current approved + proposed modification			
Hunter River Surface Water	Hunter Regulated River	Zone 1B/2A	555	584	4,655	WAL 962*	3,165
						WAL 970*	500
						WAL 1006*	500
						WAL 1070*	500
Hunter River Alluvium	Hunter Unregulated and Alluvial Water Sources	Hunter Regulated River Alluvial Water Source - Upstream Glennies Creek Management Zone	253	358	383	WAL 18127	383
Wollombi Brook Surface Water and Alluvium	Hunter Unregulated and Alluvial Water Sources	Lower Wollombi Brook Water Source	74	131	144	WAL 23889	144
Permian Coal Seams	North Coast Fractured and Porous Rock Groundwater Sources	Sydney Basin - North Coast Groundwater Source	1,113	1,591	4,840	#WAL 39798	1,800
						WAL 40462	2,400
						WAL 40463	180
						WAL 40466	460

Notes: ** WALs also linked to Hunter River pump stations for water supply purposes if required.*

 # WAL 39798 also linked to Bore for water supply purposes if required.

10.5 Management and monitoring

A WMP for HVO, prepared in consultation with DPI Water and EPA, was approved in May 2014 and updated in July 2015. The WMP fulfils the requirements of the HVO EPL and project approvals together with commitments made in the respective environmental assessments, environmental impact statements and relevant legislation, standards and guidelines.

The WMP includes the HVO groundwater monitoring programme described in Section 10.2. Groundwater levels and water quality is monitored on a monthly, quarterly, or 6-monthly basis as per the WMP. Results of the monitoring are reported annually in the HVO annual review. The existing WMP details performance criteria and trigger levels and a response protocol should any exceedances be identified.

The annual review considers if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken. Every five years, the validity of model predictions will be assessed and, if the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for simulation of mining.

Groundwater will continue to be managed in accordance with the WMP under the proposed modification.

10.6 Conclusions

As a result of the long history of mining at HVO and associated groundwater monitoring, the hydrogeology within and surrounding the project area is well understood. Routine monitoring has established that the impacts of approved mining are within the conservative predictions from previous assessments.

The groundwater study used a contemporary numerical groundwater model to assess the potential impacts of the proposed modification on the existing groundwater environment in accordance with the relevant legislative, licensing and policy requirements, including the AIP. The groundwater modelling was independently peer reviewed with the reviewer's recommendations addressed in the groundwater study.

The independent peer review concluded that 'the model is fit for purpose' and 'the predictions of drawdown due to the proposed modification together with the existing approved mine plan and cumulative effects will have minimal influence on the environment'.

A summary of the assessment outcomes is provided below.

- The model predicts a peak take from the Permian strata (North Coast Fractured and Porous Rock WSP) of 1,591ML/year at Year 11. The model predicts a peak indirect take of 423ML/year under the Hunter Unregulated WSP and 584ML/year under the Hunter Regulated WSP. These volumes are within previously predicted maximum water takes for the currently approved operations stated in ERM (2008) and accommodated with existing licensed entitlements held by HVO.

- Modelling indicates there will be undetectable volumes (0.2 per cent) of indirect take for the remodelled approved HVO South plus proposed modification from the baseflow of surface water and alluvium sources for the Hunter River and Wollombi Brook compared to the average annual flows.

- The proposed modification will not impact groundwater levels within any private bores by more than the trigger of 2m specified within the AIP. The relevant non-discretionary standards in clause 12AB(7) of the Mining SEPP will be met.

- Drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium. However, in areas adjacent to South Lemington Pit 2 (which is north of Wollombi Brook) where the existing approved operations are expected to result in drawdown of up to 7m, the proposed modification is predicted to further decrease groundwater levels by up to an additional 2.8m. Groundwater levels within alluvium south of Wollombi Brook are predicted to decrease by less than 1m due to the proposed modification.

- The final void will remain a permanent water sink, capturing groundwater, and preventing any degradation in groundwater quality outside of the void.

Existing management and monitoring measures currently implemented through the relevant management plans required PA 06_0261, such as the WMP, will continue under the proposed modification, with regular review, optimisation and reporting.

11 Surface water

11.1 Introduction

This chapter provides a summary of the surface water study prepared by WRM Water and Environment Pty Ltd (WRM) which is presented in full in Appendix H. A water balance for the proposed modification was prepared by Hatch Pty Ltd (Hatch), which is included as Appendix B to the surface water study.

The proposed changes to pit depths, extraction and processing rates, overburden emplacement and final landform are likely to result in changes to the water management system (WMS). In accordance with normal operational management procedures, adjustments will be made to the WMS through the remainder of the project approval period to accommodate mine plans associated with the proposed modification. Anticipated changes to the WMS, the associated impacts on surface water and proposed management or mitigation measures are described in this chapter.

As the proposed modification does not change the approved disturbance footprint and existing flooding regime, the results of previous flooding studies (ERM 2008) are not repeated and remain applicable.

The surface water study was completed with reference to:

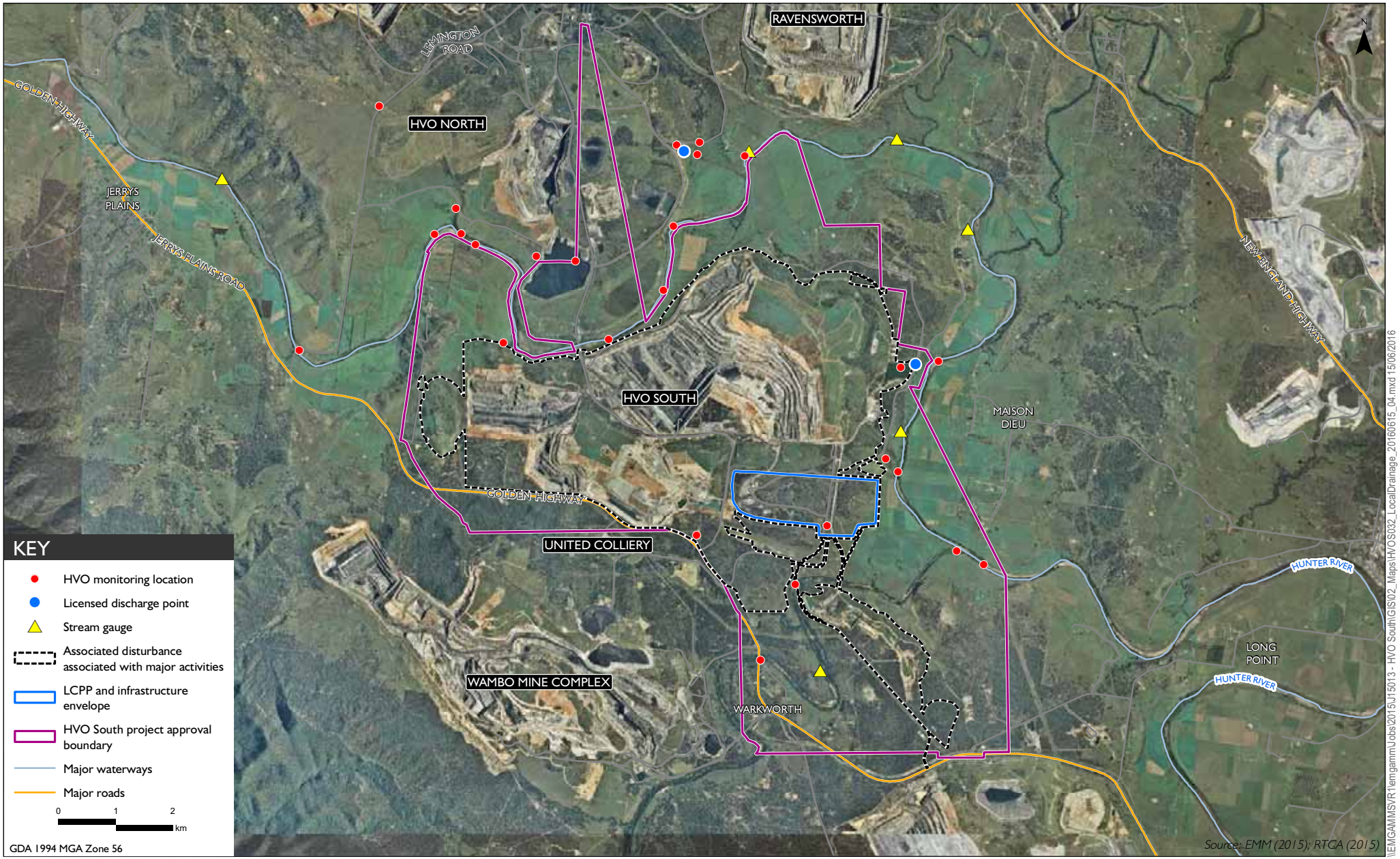
- relevant NSW legislation including the POEO Act, Dams Safety Act, Water Act, WM Act and its associated WSPs;
- the *Strategic Regional Land Use Policy*;
- *National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment Conservation Council [ANZECC] and the Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ] 2000);
- NSW Government Water Quality and River Flow Objectives;
- *Managing Urban Stormwater Soils and Construction – Volume 2E Mines and Quarries*, (Department of Environment and Climate Change [DECC] 2008); and
- *Managing Urban Stormwater, Soils and Construction*, (Landcom 2004).

11.2 Existing environment

11.2.1 Environmental setting

i Drainage network

The local drainage network is shown in Figure 11.1. The drainage network within the project area has been heavily modified by mine operations with the majority of the local catchment captured by the WMS. Lake James, which is adjacent to the Hunter River on the eastern side of the current mining operations, is a key mine water storage and the Hunter River Salinity Trading Scheme (HRSTS) release point for HVO South.



COAL & ALLIED

Monitoring locations

HVO South Modification 5
Environmental Assessment
Figure 11.1

ii Rainfall and evaporation

Rainfall and evaporation data was obtained from the closest BoM stations to the site at Jerrys Plains Post Office and Bulga (South Wambo), with the latter measuring rainfall data only. The data was compared against the Queensland DSITI's data drill service which is interpolated between BoM stations to provide a complete data set that eliminates missing data and accumulated daily totals (Jeffrey et al. 2001).

Mean annual rainfall in the data drill dataset is 634mm, similar to the annual average of 645mm and 667mm recorded at Jerrys Plains Post Office and Bulga (South Wambo) rainfall stations. Annual total rainfall varies significantly from year to year, with annual totals ranging from 295mm in 1980 to 1,161mm in 1950. Rainfall is relatively evenly distributed throughout the year.

The average data drill pan evaporation is 1,553mm/month which is generally consistent to the Jerrys Plains Post Office monthly average of 1,642mm/month. As reported in Section 10.2.1, while average monthly pan evaporation is similar to rainfall in the winter months, it is significantly higher in the summer months (especially in December and January).

iii Streamflow

Data to characterise existing streamflow was obtained from DPI Water stream gauging stations in the vicinity of HVO South. As reported in Section 10.2.1, the closest upstream gauging station is at Liddell Power Station, 5km north of HVO South.

The highest recorded water level and discharge in the Hunter River (at Liddell Power Station, approximately 5km upstream from HVO South) are 15.48m in February 1971 and 385,652ML/day in June 2007, respectively. An analysis of flow frequency shows daily streamflow has exceeded 83ML/day for 90 per cent of the flow record, and median daily flow is over 250ML/day for all years of data. Hunter River flows at the Liddell Power Station are regulated by Glenbawn Dam.

The highest recorded water level and discharge in the Wollombi Brook (at Warkworth) occurred in February 1955 at 10.14m and 394,000ML/day, respectively. An analysis of flow frequency shows daily streamflow has exceeded 2.5ML/day for 80 per cent of the flow record, and median daily flow is over 38ML/day. Wollombi Brook flows are not regulated.

iv Surface water quality

Water quality is monitored in on-site dams and receiving waters (Hunter River and Wollombi Brook) as part of the HVO surface water monitoring programme. Monitoring locations are shown in Figure 11.1. Water quality statistics were compared with the NSW water quality objectives (the NSW WQOs) for 'Protection of Aquatic Ecosystems'.

Median pH values along the Hunter River are relatively similar (8.2 to 8.3) with a slight reduction in pH (median of 8.0) observed downstream of Wollombi Brook. The pH value has the same median of 8.2 both upstream and downstream of the HVO South release point. Values for pH are typically within the range of the NSW WQOs.

A plot of electrical conductivity (EC) along the Hunter River adjacent to the project area indicates no adverse impact from HVO South releases to the river. Downstream EC values are slightly lower than EC further upstream. Impacts on EC at the release point are very small, with an increase of less than 2 per cent. EC is less than the NSW WQO of 2,200µS/cm at all monitoring locations and less than the lower HRSTS salinity target of 900µS/cm most of the time.

For sulphate and total suspended solids (TSS) the water quality data indicates no adverse impact on water quality, with downstream values similar to or lower than upstream values. Sulphate and TSS 80th percentile values decrease slightly downstream of the release point. Similar to locations upstream, EC is less than the NSW WQO of 2,200µS/cm at all monitoring locations and less than the lower HRSTS salinity target of 900µS/cm most of the time.

The Wollombi Brook water quality data shows similar water quality to that within the Hunter River with no significant deterioration in water quality along the monitored reach.

Median EC for Lake James, the licensed release point for HVO South, is 5,200µS/cm. However, the median EC of discharges is significantly less (3,140µS/cm) likely due to dilution from freshwater inflows during wet periods that result in the need to discharge. Releases ph value (9) is generally higher than background pH in the Hunter River (typically in the range 8.0 to 8.5). All licensed discharges are undertaken in accordance with the rules and regulations of the HRSTS.

11.2.2 Water licensing

The site is within the Hunter Regulated River and Hunter Unregulated Alluvial water sources and, therefore, the provisions of the WM Act and the relevant WSPs apply to the proposed modification.

HVO holds both High and General Security Water Access Licences (WAL) to extract water from the Hunter River to comply with its licence obligations, as shown in Table 10.3. HVO participates in the HRSTS and currently holds 145 credits, allowing it to release up to 14.5 per cent of the total allowable discharge salt tonnage during periods of 'high' or 'flood' flows in accordance within the scheme rules. HVO's EPL 640 authorises HRSTS discharges at three release points (shown in Figure 11.1).

11.2.3 Existing water management strategy and infrastructure

i HVO Water Management System

Water at HVO is managed according to type. Water type is determined by catchment source, quality and use with the main types being either mine water (pit water, CPP water supply or tailings water) or runoff water (clean catchment non-mined and ancillary catchment, unconsolidated mine spoil, rehabilitated mine spoil and active mining areas).

The objectives of the WMS are to:

- minimise fresh water usage;
- minimise impacts on the environment and HVO neighbours; and
- minimise interference to mining production.

The existing WMS comprises an extensive network of surface water storage ponds, inactive mining pits (providing bulk water storage), interconnecting water transfer infrastructure (pumps and pipelines, etc) sediment ponds and drainage. The total capacity of the WMS is 6,450ML (or 6.45GL). Key water storages are linked by pipelines to allow water to be transferred around the WMS. The largest storage, Riverview Pit is an inactive open cut pit used to store up to 4,000ML (or 4GL) of mine water (more than half the total WMS mine water storage capacity). Excess water in HVO South is stored in Riverview Pit.

Integration of the HVO and MTW water management systems is currently approved with an 11ML/day pump and pipeline to be constructed in 2016 to connect the two operations, with the system planned to pump directly into Riverview Pit.

Other key features of the WMS are summarised below.

- Tailings from the HVCPP are currently actively managed in North Pit Tailings Dam (Dam 29N in HVO North). Tailings from the HCPP are currently managed in Dam 6W and planned to be pumped to Cumnock void from 2016.
- Water usage for haul road dust suppression varies with prevailing weather conditions and, in the 2014-15 financial year, totalled 2,465ML with approximately half used at HVO South.
- Total groundwater inflow at HVO was approximately 3ML/day between 2012 and 2014.
- Water sharing with neighbouring operations (ie Wambo Mine) subject to relevant approvals.
- Following prolonged periods of drought, HVO can supplement site water from a number of sources. HVO holds both High and General Security WALs to extract water from the Hunter River. Should more water be required, entitlements can be traded to this licence to increase output through the scheme.
- HVO currently has 19 on-site packaged sewerage management systems. The sewage treatment and disposal facilities consist of sewage treatment plants which treat, disinfect and re-use the treated effluent on-site. The remaining effluent from some septic systems that can't be treated on site is sent to approved facilities for disposal.

ii HVO Water Management Plan

A WMP for HVO, prepared in consultation with DPI Water and EPA, was approved in May 2014 and updated in July 2015. The WMP fulfils the requirements of the HVO EPL and project approvals together with commitments made in the respective environmental assessments, environmental impact statements and relevant legislation, standards and guidelines.

The WMP describes procedures required to achieve compliance with conditions of the approvals relating to potential water impacts as well as the HVO WMS and the site water balance, erosion and sediment controls, water monitoring programmes, water management protocols and response procedures. It also provides a mechanism for assessing water quality and quantity monitoring results.

The site water balance model is updated on a regular basis to record the status of inflows (water capture), storage and consumption (eg CPP usage, return water from co-disposal areas, dust suppression and HRSTS discharges) and to optimise water management performance. The results of site water balance reviews are reported in the Annual Review as required in the project approval.

Water at HVO is also managed through protocols and procedures outlined in the HVO Surface Water Management and Monitoring Plan as well as erosion and sediment controls outlined in the WMP.

The WMP identifies activities that could cause soil erosion and generate sediment and describe the specific controls (including locations, function and structure capacities) to minimise the potential for soil erosion and transport of sediment off-site.

The HVO Surface Water Management and Monitoring Plan of the WMP outlines how monitoring is undertaken for the project in accordance with the *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC and ARMCANZ 2000) and *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (DEC 2004).

11.3 Impact assessment

11.3.1 Proposed water management strategy and infrastructure

The proposed WMS infrastructure will be progressively developed over the life of the proposed modification to meet the water management objectives of HVO South. The primary changes to components of water-related infrastructure for the proposed modification are consistent with this progressive development of the WMS to accommodate mining operations. Examples of the changes in the proposed WMS are:

- removal of some existing mine water dams and to collect runoff from the CPP and coal stockpile areas; and
- the addition of sediment dams to collect and treat runoff from the redesigned overburden emplacement areas.

Other changes proposed are described in the sections below.

i Mine water management storages

No new major mine water dams are proposed with mine water continuing to be managed in the existing WMS dams. However, in accordance with normal operational management procedures, adjustments will be made to the WMS through the remainder of the project approval period to accommodate mining activities such as pit dewatering and water transfers. This may include removal of some mine storages associated with Cheshunt Pit such as:

- D9 dam;
- Saline water dam;
- Sediment dam; and
- Subzero's dam.

The existing water storage in Riverview Pit may be backfilled and rehabilitated in Stage 4. Should this occur, it will result in a significant reduction in out-of-pit mine water storage capacity. A suitable in-pit storage at HVO will be utilised as an option for future excess water storage from Stage 4 as required. The HVO pump and pipeline network will be modified if required to enable transfer between HVO and MTW to continue after Riverview Pit has been backfilled.

ii Sediment dams

There is likely to be changes to the number of sediment dams to collect and treat runoff from overburden emplacement areas due to the proposed modification. The number, location and size of these dams may be modified as the design and staging of overburden emplacement area rehabilitation is refined and finalised.

Consistent with the existing WMS, any new sediment dams will be sized in accordance with recommended design standards (Landcom 2004, DECC 2008).

iii Water recycling for LCPP

The potential commissioning of the LCPP at HVO South in Stage 3 will result in changes to the way water is recycled for CPP process water make-up supplies. LCPP will be supplied from the local surface water dam - Dam 19S (which, in turn, will supplied from Dams 17S, 18S, 15S and 16S). Riverview Pit has also been nominated as a potential site for LCPP tailings deposition after Stage 3, and is scheduled to be backfilled and rehabilitated in Stage 4.

iv Summary

A summary of the anticipated key changes of the proposed WMS is provided below.

- The total catchment areas will change during operation of the proposed modification compared to the existing approved operations as mining progresses. The total HVO South area captured will peak in Stage 2 at 2,067ha, an increase of approximately 10 per cent over existing conditions, due to mining areas at South Lemington Pits 1 and 2. At the end of Stage 4, the rehabilitation and diversion of parts of the proposed overburden emplacement areas will result in a 17 per cent reduction in the area captured compared to existing conditions.

- Initially tailings from HVCPP and HCPP will be emplaced to the existing facilities (Dam 29N and Cumnock void), before transitioning to an approved out-of-pit TSF to be constructed near the Carrington Pit at HVO North from Stage 2. Projected CPP water demand will peak in Stage 1 at 3,490 ML/year.

- Water demand for haul road dust suppression will be between 2,160ML (Stage 4 minimum) and 4,255ML (Stage 2 maximum) compared to the minimum of 2,255ML/year and maximum of 3,155ML/year for the existing operations.

- Pumpable groundwater inflow rates will peak in Stage 3 at 1,625ML/year.

11.3.2 Water balance modelling

i Method

HVO has developed and maintains an operational water balance model for the site using the OPSIM software platform. The model simulates the operation of all major components of the WMS, including: catchment runoff, water inventory fluctuation and overflow, pump and gravity transfers, industrial water extraction and return, climatic influence, groundwater inflow, open cut mine dewatering, tailings hydrology and opportunistic controlled release of mine-affected water to the Hunter River under HRSTS.

The HVO water balance model is comprised of a collection of inter-connected nodes incorporating two sub models of HVO North and HVO South. The current MTW model is also partially included to properly simulate approved site transfers.

The HVO water balance model was updated and used to assess the performance of the WMS during the operation of the proposed modification by Hatch (Appendix B of Appendix H).

The model uses the Australian Water Balance Model (AWBM) to simulate the runoff characteristics from the various landuses across the mine site using daily rainfall and catchment evapotranspiration, with some components collating over 120 years of recorded climate and rainfall data. The AWBM parameters were calibrated to historical on-site inventory over the period January 2014 to June 2015. The calibration showed that the model simulated both the performance of the overall site water balance and the sub model water balance reasonably well and that the adopted parameters were suitable for the purposes of high level water balance modelling.

ii Results

The combined storage capacity during Stages 1 to 4 of 6,450ML has an AEP of 10 to 25 per cent. Should the stored site inventory exceed the available out-of-pit storage volume, an existing active pit will be temporarily used to store the excess water to manage operational risks.

The highest water import requirements are simulated in Stage 1, primarily associated with increasing CPP water usage (with no moisture return from HCPP tailings) and increasing dust suppression usage, with comparatively little change in groundwater and catchment to offset. The AEP of requiring imported water in this stage is 70 per cent and the annual volumes of imported water are typically around 1.8GL higher than base case results. Existing water supply entitlements should be adequate to provide HVO South with reliable water supply under all but very severe dry periods over the duration of the proposed modification. Should very extreme dry conditions occur, options such as maximising the return of water from the Cumnock void or the use of dust suppressant agents will be investigated.

There is an annual probability of approximately 50 per cent of discharging water to the Hunter River under the HRSTS in all scenarios except for Stage 1, in which probability reduces to 40 per cent. The annual probability of discharging greater than 2,000ML/year under the HRSTS is approximately 10 per cent in all scenarios. Other than releases from the HRSTS dams, the modelling predicts no overflows from the mine water dam.

The average annual water balance for each modelled stage is presented in Table 11.1.

Table 11.1 Average annual water balance

Item	Base case (2016)	Stage 1 (2019)	Stage 2 (2022)	Stage 3 (2025)	Stage 4 (2028)
Inflows					
Rainfall and Runoff	7,045	7,550	7,565	7,725	7,545
Groundwater	975	1,010	860	1,625	1,240
ROM moisture	1,425	1,755	1,950	2,250	2,250
Pumped from MTW	440	530	430	380	395
External water supply	830	1,715	1,195	1,030	750
Sub-total	***10,715***	***12,560***	***12,000***	***13,010***	***12,180***

Table 11.1 Average annual water balance

Item	Base case (2016)	Stage 1 (2019)	Stage 2 (2022)	Stage 3 (2025)	Stage 4 (2028)
Outflows					
Evaporation	1,755	1,715	1,780	1,775	1,815
Tailings moisture retention	1,825	2,830	1,410	1,870	1,870
Haul road dust suppression	2,610	3,135	3,520	3,520	2,485
Misc. demands & vehicle wash	605	605	605	620	620
Pumped to MTW	305	250	270	275	315
Product coal moisture	1,410	1,685	1,880	2,160	2,160
Coarse reject moisture	555	730	810	950	950
HRSTS discharges	710	590	710	760	780
Mine-water dam discharges	0	0	0	0	0
Sediment dam discharges	940	1,020	1,015	1,080	1,185
Sub-total	***10,715***	***12,560***	***12,000***	***13,010***	***12,180***

11.3.3 Water quality impacts

The results of the water balance modelling indicate that under the model assumptions and configuration, there are no uncontrolled spills of mine-affected water under the proposed modification. Therefore, the WMS is sufficient to prevent adverse impacts on the environmental values of the receiving waters. Water will continue to be released to the Hunter River in accordance with the EPL and the HRSTS.

With the implementation of management measures in the existing WMP (see Section 11.4) for HVO, the potential adverse impacts of the proposed modification on downstream water quality will be too small to measure.

The water balance model results show that the untreated mine water is unlikely to flow into the receiving environment. It is, therefore, likely that salt will accumulate within the WMS, and the total salt load released from HVO South to the receiving environment during operations will be less than that released by pre-mine conditions.

Sediment dams will only discharge following periods of rainfall that generate runoff in adjacent catchments. It is likely that the quality of water collected in sediment dams will be improved by fresh surface runoff inflows, and the total impact on downstream salinity will be small.

Sediment dams are designed to overflow during wet periods that exceed the design standard of the sediment control system. In some cases these overflows will report to the pit and in other cases, depending on the status of mining and rehabilitation in the area, these overflows will flow to the surrounding environment. Overflows will only occur during significant rainfall events which will also generate runoff from surrounding undisturbed catchments. Hence, it is unlikely that sediment dam overflows will have a measurable impact on receiving water quality.

Runoff from rehabilitated areas will continue to be captured by sediment dams until water quality is within the range of water quality recorded from analogue sites and does not pose a threat to downstream water quality. Therefore, the total salt load released from the proposed final conceptual landform to the receiving environment will be generally consistent with pre-mine conditions.

11.3.4 Final landform

The change in mine plan to access the deeper coal seams also results in changes in the size and location of the final void and associated evaporative basin. The development of the final void, its alignment with final landform objectives and its role in post-mining water management (preventing saline water leaving the site) were important considerations in the development of the proposed mine plan. As such, the landform has been designed to minimise the surface water catchment draining to the void within Riverview Pit. The accumulation of surface runoff combined with groundwater inflows will, however, result in the formation of an evaporative basin where water levels will rise until the average rate of inflow is balanced by evaporation from its surface. This is referred to as the equilibrium level.

The long-term equilibrium water level was determined using the OPSIM software, a technically robust platform to assess water recovery levels over a comprehensive time series using multiple inputs. Catchment runoff and evaporation were calculated from historical climate data on a daily time step from the catchment area and daily water surface area. The model used these inputs to simulate the behaviour of the final void in the long-term.

The proposed void has been designed to achieve its primary objective of functioning as a groundwater sink, maximising groundwater flow across back-filled pits to the final void, preventing release of saline water into the surrounding environment. This has the indirect benefit of reducing the inflow of saline Permian water into the Hunter River and Wollombi Brook under natural gaining conditions.

It is noted that the equilibrium evaporative basin level is relatively sensitive to changes in long-term inflow rates (due to the relatively small increase in surface area with height). However, significant changes in water level influence the groundwater pressure differentials driving pit inflows, and result in changes to the rate of groundwater inflow. In assessing the long-term behaviour of the void, groundwater inflows and outflows were therefore modelled using storage level versus flow relationships developed through groundwater modelling presented in the groundwater study in Appendix G.

Table 11.2 provides the inflows and outcomes of the proposed final void.

Table 11.2 Equilibrium water balance of the proposed final void

Item	Inflow (ML/year)	Outflow (ML/year)
Catchment Runoff	621	0
Direct Runoff	2,113	0
Groundwater Inflow	541	0
Evaporation	0	3,223
Change in storage	0	52
Total	3,275	3,275

Chapter 13 considers the proposed indicative landform including final void compared with the existing approval. Tables 13.1 and 13.2 in Chapter 13 provide the approved and proposed final void characteristics, including void size and slope.

The long-term equilibrium water level for the proposed evaporative basin is approximately 30mAHD. This level is greater than 42m below crest of the void, or the spill level. The contemporary assessment of the long-term behaviour of the approved final void was also simulated using OPSIM software. The evaporative basin is predicted to reach a long-term equilibrium level of approximately 32mAHD approximately 250 years after mining.

It is noted that the ERM (2008) EA predicted the long-term equilibrium level in the evaporative basin of approximately 0mAHD after 250 years. The information presented in that report, based on spreadsheet modelling, does not clearly state the assumed groundwater inflow at equilibrium, and appears to significantly overestimate the surface area of the approved void. This is illustrated in Figure 11.2, which compares the surface area versus elevation relationships for the proposed and approved voids with the relationship described in ERM (2008).

The present study includes a more rigorous representation of the void geometry, as well as catchment and water storage response to historical daily climate conditions. It is therefore considered to be more likely to be representative of long-term behaviour given the predicted groundwater inflows.

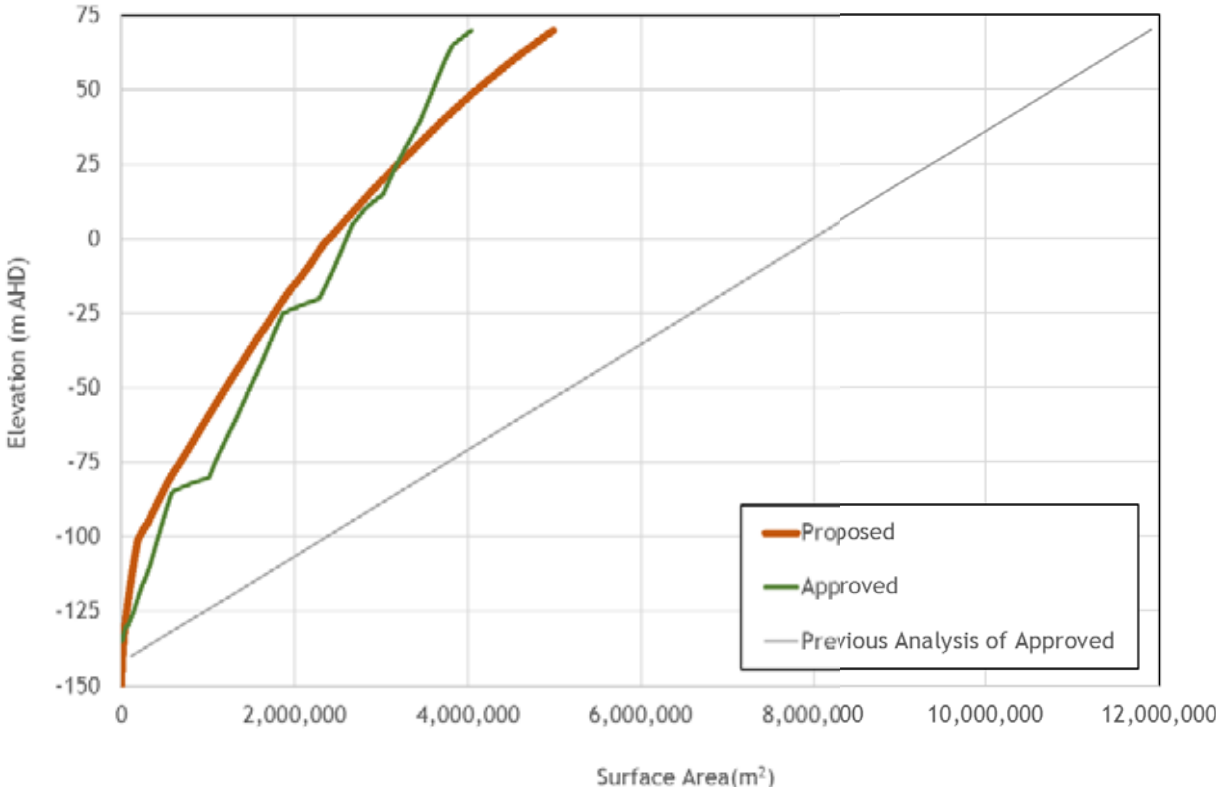


Figure 11.2 Modelled final void evaporative basin water level and groundwater inflows

The use of an OPSIM model in the WRM (2016) study to determine the long-term behaviour of the final void is a more rigorous representation of the void geometry, as well as catchment and water storage response to historical daily climate conditions. It is therefore considered to be more likely to be representative of long-term behaviour given the predicted groundwater inflows and has therefore been adopted in this EA.

11.3.5 Cumulative impacts

Cumulative surface water impacts may result from nearby operations including United Wambo Project, MTW and Bulga mines, and the Redbank Power Station.

Cumulative impacts on salinity, a key potential impact of coal mining, are managed at a whole-of-catchment scale through the HRSTS. HVO South currently participates in the HRSTS and from time to time makes releases of water from the site in accordance with the scheme rules. As demonstrated by analysis of historical surface water quality data to date, HVO South has not resulted in a measurable adverse impact on water quality in the Hunter River.

There are not expected to be any additional water quality impacts associated with the proposed modification. Further, the proposed modification will not result in an increase in the amount of captured catchment area at HVO. Therefore, the proposed modification will not contribute to cumulative impacts.

Any water taken from the Hunter River Regulated Water Source is taken under a WAL which are allocated by considering water availability and community water use requirements across the entire catchment. The use of water allocated under a WAL will not adversely affect the opportunity of other licence holders to access their licensed water entitlement (subject to water availability as determined by climatic conditions).

11.4 Management and monitoring

The surface water assessment demonstrates that impacts of the proposed modification on surface water resources can be managed and mitigated by implementing the existing WMS with the changes detailed in Section 11.3.1. The existing documents used to manage water on-site will be updated to incorporate the proposed modification as detailed below.

- The existing WMP will be reviewed and revised to incorporate the proposed modification including water management protocols and response procedures for the WMS that will be adhered to throughout the operation of the proposed modification.
- The site water balance model will continue to be reviewed and progressively refined on a regular basis.
- The erosion and sediment control section in HVO's WMP will be reviewed and updated for the proposed modification.

The existing surface water monitoring programme is considered sufficient for the purposes of monitoring potential impacts associated with the proposed modification. The disturbance footprint remains within the existing approved disturbance area and, therefore, monitoring of additional areas is not required.

11.5 Conclusions

An assessment of the proposed modification's surface water impacts was undertaken with reference to a water balance model for HVO which has been updated to incorporate the proposed modification.

Consistent with the requirements of the current project approval, a final void management plan will be developed prior to decommissioning in consultation with regulators.

The potential impacts of the proposed modification on surface water resources (water quality and quantity) can be managed and mitigated by the updating and implementing the existing water management strategy. The WMP and associated existing documents will be reviewed and updated to incorporate the proposed modification. The existing surface water monitoring programme is sufficient for the purposes of monitoring potential impacts associated with the proposed modification.

The proposed revisions to the WMS provide a sufficiently reliable water supply over the life of the proposed modification. The proposed modification will result in small changes (up to a maximum of 10 per cent of which occurs in Stage 2) to the captured catchment areas at HVO South due to the South Lemington Pit 1 mining area and mining development in South Lemington Pit 2, however no additional impacts on downstream flows are anticipated.

Controlled release of excess mine water to the Hunter River will continue to be made in accordance with the HRSTS. The water balance modelling results show that the proposed modification will not significantly change the frequency or magnitude of releases under the HRSTS. The water balance modelling results demonstrate the proposed WMS will result in no uncontrolled releases of mine water to the receiving environment under historical climate conditions.

The final landform has been designed to minimise the surface water catchment draining to the void. The long-term equilibrium water level for the proposed evaporative basin is approximately 30mAHD some 300 years post mining. This level is greater than 42m below crest of the void, or the spill level. This is similar to a contemporary assessment of the long-term behaviour of the approved final void which predicted a long-term equilibrium level of approximately 32mAHD approximately 250 years after mining. The proposed void has been designed to achieve its primary objective of functioning as a groundwater sink, maximising groundwater flow across back-filled pits to the final void, preventing release of saline water into the surrounding environment.

12 Ecology

12.1 Introduction

The proposed modification does not change the approved disturbance footprint and therefore there will be no additional direct impacts as a result of the proposed modification. Changes to the groundwater regime (refer Chapter 10) have the potential for indirect impacts on ecosystems that potentially use groundwater which are assessed below.

12.2 Existing environment

12.2.1 Previous study

The ERM (2008) EA included an assessment of potential ecological impacts and comprised:

- a review of relevant reports and data sources relating to the ecology of HVO South;
- a gap analysis of previous ecological work in the area and key findings;
- field surveys of flora and fauna (May and June 2006) to ground truth results of previous survey and desktop assessments, and to reassess areas that had not been recently surveyed;
- an assessment of the potential ecological impacts of the project; and
- a review of the existing management measures.

The assessment concluded that no threatened or endangered species or communities will be significantly impacted by the HVO South Coal Project. Some of the vegetation approved to be cleared has subsequently been listed under the EPBC Act as Central Hunter Valley Eucalypt Forest and Woodland critically endangered ecological community. This is the primary subject of a separate EPBC referral (EPBC 2016/7640) for some areas of both HVO North and HVO South which was submitted to DoE in December 2015 (refer to Section 4.4.1).

The previous study also assessed the potential impacts on the ecosystems that potentially use groundwater in the vicinity of HVO South including vegetation within the alluvium of the Hunter River and Wollombi Brook. These are discussed in Section 12.2.2. The study found that the ecosystems that potentially use groundwater would not be impacted by the HVO South Coal Project.

Condition 36 within Schedule 3 of the project approval (PA 06_0261) requires the preparation and implementation of a Rehabilitation and Biodiversity Management Plan for HVO South which includes a Biodiversity Offset Strategy. The Biodiversity Offset Strategy (described in Condition 29 within Schedule 3 of the project approval (PA 06_0261)) nominates the Goulburn River Biodiversity Area to be provided as a Biodiversity Enhancement Area to offset impacts due to clearing of 140ha of remnant and regenerating vegetation for the HVO South Coal Project described above. Coal & Allied has lodged a BioBanking agreement with the NSW Government to protect the Goulburn River Biodiversity Area in perpetuity in accordance with the relevant provision of the TSC Act.

It is noted that two offset areas for the nearby Warkworth Mine (Southern Biodiversity Area and Northern Biodiversity Area) are partially within the HVO South project approval boundary and managed through the MTW Biodiversity Offset Strategy. As outlined in Condition 29B within Schedule 3 of PA 06_0261, no mining operations or development is permitted within these areas other than any conservation-related activity under an approved Rehabilitation and Biodiversity Management Plan.

12.2.2 Ecosystems that potentially use groundwater

GDEs are defined as ecosystems that rely in some part for their survival on groundwater. Dependence ranges from complete reliance for some systems to others that rely partially on groundwater, particularly during times of drought. In general, the majority of Australian ecosystems have little dependence on groundwater, however there are some localised or extensive ecosystems in Australia with at least a high dependence on groundwater (Hatton and Evans 1998).

The Commonwealth Government has established the *National Atlas of Groundwater Dependent Ecosystems* (GDEs) (the Atlas), based on the current knowledge of GDEs across Australia. The Atlas shows known GDEs and is considered the most comprehensive inventory of the location and characteristics of GDEs in Australia. The Atlas does not identify GDEs in the vicinity of HVO South along the Hunter River or Wollombi Brook.

Ecological surveys conducted as part of the HVO South Coal Project (2008) identified ecosystems in the vicinity with potential to use groundwater. For the purposes of this assessment, six ecosystems are labelled E1 to E6. Ecosystems E1 to E3 are within Hunter River alluvium north of Riverview Pit and ecosystems E4 to E6 within alluvium along Wollombi Brook, near South Lemington Pits 1 and 2. These ecosystems are described in the sections below and shown in Figure 12.1.

i River Red Gums, Hunter Floodplain Red Gum Woodland and Hunter Valley River Oak Forest

The previous ecological surveys (ERM 2008) identified River Red Gums *(Eucalyptus camaldulensis*) in the vicinity of HVO South which primarily occur as scattered occurrences or individuals along the banks of the Hunter River (Figure 12.1). The River Red Gums rely on flooding regimes for recruitment with only opportunistic use of groundwater.

River Red Gums were listed as an endangered population in the Hunter Catchment on 29 April 2005 under the TSC Act. They also comprise part of the Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions, listed as an endangered ecological community on 23 April 2010 under the TSC Act, subsequent to the ERM (2008) study.

Some stands of River Red Gums also occur within the floodplains and along the banks of the Hunter River with denser areas of Hunter Floodplain Red Gum Woodland along both the Hunter River and Wollombi Brook. River Red Gum stands in the HVO South project area are significantly modified from their original state in floristic composition, structure and connectivity. Most stands are small and isolated and highly affected by weed invasion and tree dieback (Umwelt 2010).

Photographs 12.1 to 12.4 (taken in June 2016) show the scattered occurrences and stands of River Red Gums along the southern bank of the Hunter River within E3. Photograph locations are shown in Figure 12.1.

Photograph 12.1 also shows an area of very limited (previously cleared) alluvial floodplain between the Hunter River and the mining operations (Cheshunt Pit), whereas Photograph 12.2 shows an area of previously cleared alluvial floodplain between the river and Cheshunt Pit with no River Red Gums other than those on the river bank.

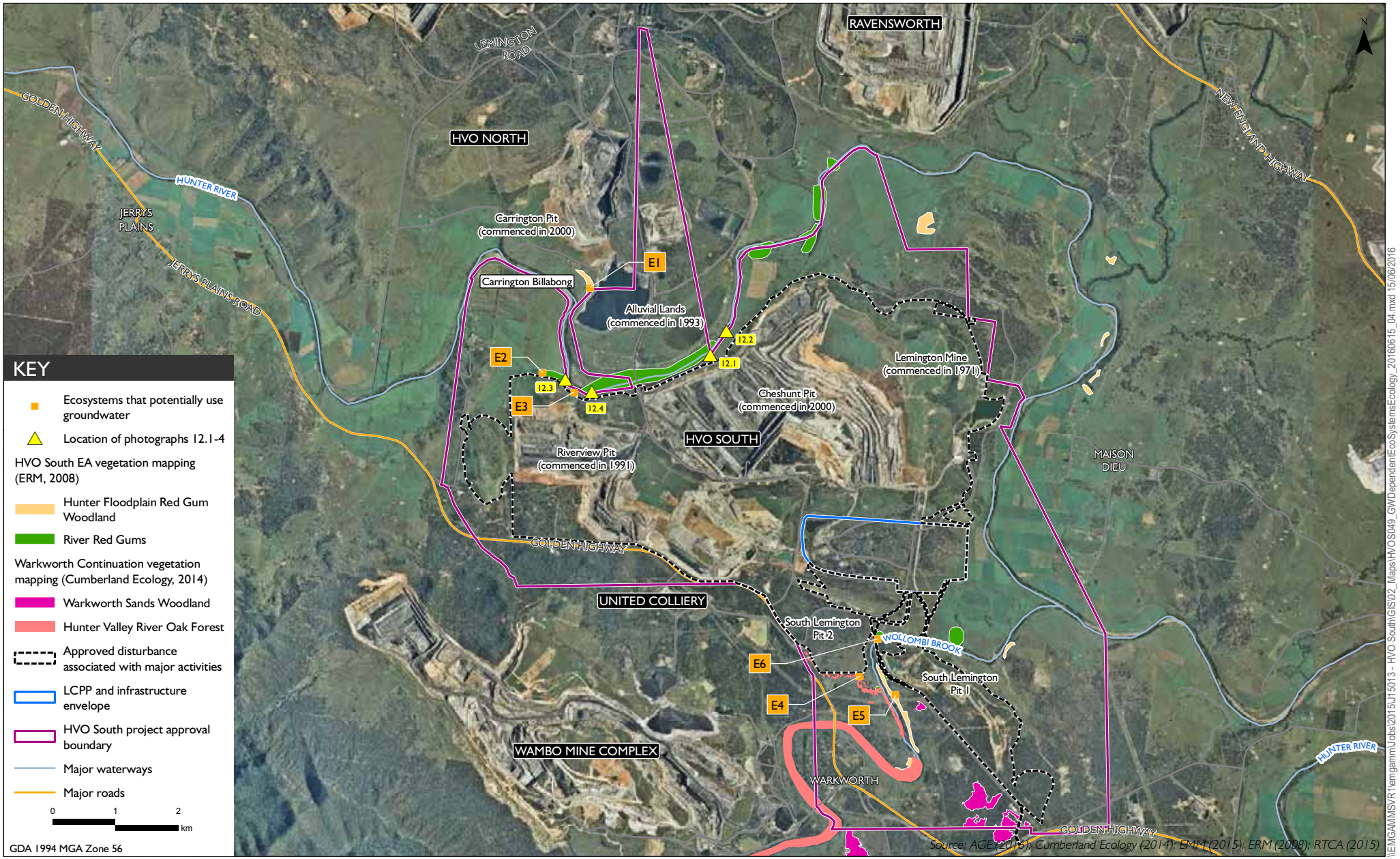
Photographs 12.3 and 12.4 show River Red Gums (near E2 and E3) in reasonable health on the river bank in areas of limited floodplain between the river and the mining operations (Riverview Pit).

Photograph 12.1 **Scattered occurrences of River Red Gums (E3) along the southern bank of the Hunter River with very limited alluvial floodplain between the river and Cheshunt Pit (view towards south-west)**

Photograph 12.2 **Scattered occurrences of River Red Gums (E3) along southern bank of the Hunter River with previously cleared alluvial floodplain between the river and Cheshunt Pit (view towards north-east)**

Photograph 12.3 **Scattered occurrences of River Red Gums (E2) along southern bank of the Hunter River with limited floodplain between the river and Riverview Pit (view towards north-west)**

Photograph 12.4 **Isolated occurrence of River Red Gum (E3) along southern bank of the Hunter River with limited alluvial floodplain between the river and Riverview Pit (view towards south-west)**



COAL & ALLIED

Ecosystems that potentially use groundwater

HVO South Modification 5
Environmental Assessment
Figure 12.1

These River Red Gums are restricted to the banks of the river rather than outside its stream flow within the floodplain. Compared with floodplain remnants elsewhere in the Hunter Valley, these stream bank remnants were found to have higher levels of recruitment - due to greater availability of water and lower impact by stock. However, River Red Gums restricted to the banks (eg E3) are also subject to more erosion, with bank undercutting and slumping prominent (Umwelt 2010).

Carrington Billabong, an ephemeral freshwater wetland comprising Hunter Floodplain Red Gum Woodland, is adjacent to HVO North within the Hunter River alluvium and floodplain (refer to Figure 12.1). Due to the proximity of historical and currently approved mining activities within HVO North, Coal & Allied has undertaken regular investigations on the condition of the Carrington Billabong as part of the Umwelt (2010) River Red Gum Restoration Strategy (the Strategy). The Strategy was initially a management commitment and development consent condition for HVO North (DA 450-10-2003) and then subsequently included within the current conditions of the project approval (PA 06_0261). The Strategy is prepared for the combined HVO complex in accordance with the relevant conditions of both approvals rather than for the separate mining operations.

Umwelt (2010) assessed the condition of River Red Gums across the Hunter Valley after a long period with no significant floods, in which 25 out of 39 sites known to comprise River Red Gums were visited and a further three were assessed using satellite imagery. The condition assessment identified that:

- 28 per cent of trees were healthy with no obvious canopy dieback;
- 53 per cent of trees were showing signs of stress;
- 10 per cent were slightly stressed;
- 2 per cent were senescent;
- 7 per cent were dead; and
- recruitment of new individuals was poor.

The assessment identified that the main threats to condition were alterations to flow regimes, weed invasion, poor recruitment, dieback and fire. Umwelt (2010) subsequently completed a post-flood assessment at Carrington Billabong to detect any changes in condition in the River Red Gums assessed for the Umwelt (2007) surveys. The most significant finding of the report was that natural seedling recruitment was evident in areas that had been subject to prolonged inundation following flooding. This 2007 study supported the preparation of the Strategy.

The Strategy includes a monitoring programme to assess the changes in environmental conditions over time with a feedback loop used between monitoring outcomes and tailored management actions. Numerous historical factors were determined to have contributed to the condition of Carrington Billabong and River Red Gums along the Hunter River and Wollombi Brook, with these being:

- alteration of the water regime through irrigation;
- alteration of the water regime after the commissioning of Glenbawn Dam in 1958 and recently modified surface runoff;
- unrestricted grazing across most of Carrington Billabong;
- pest plants and animals; and

- previous vegetation clearance.

Areas with known occurrences of River Red Gums and Hunter Floodplain Red Gum Woodland in the vicinity of the Hunter River and Wollombi Brook are shown in Figure 12.1.

Subsequent surveys (Cumberland Ecology 2014) identified Hunter Valley River Oak Forest west and south of South Lemington Pits 1 and 2, respectively, along the Wollombi Brook. The Hunter Valley River Oak Forest relies on high levels of soil moisture, which is why the community occurs adjacent to a waterway which is periodically inundated with flood water.

ii Warkworth Sands Woodland

Areas of Warkworth Sands Woodland growing on Aeolian sands which overlie areas of the Permian coal measures are west and south of South Lemington Pit 1 along Wollombi Brook (refer to Figure 12.1). Vertical flow of groundwater is impeded by a layer of clay at the base of the sands forming a thin ephemeral perched water table, which is recharged from rainfall through the sandy soils. Warkworth Sands Woodland would access this perched water table during low rainfall periods.

As described in Chapter 10, the water table formed at the base of the Warkworth sands is not in direct hydraulic connection with the underlying Permian fractured rock (AGE 2014). Given the lack of direct hydraulic connection, there is little potential for impacts on the water table in this community from mining associated with the proposed modification.

12.2.3 Ecosystems not dependent on groundwater

Several other native vegetation types were recorded within and surrounding the HVO South project approval boundary during surveys for the ERM (2008) EA, comprising:

- Central Hunter Box - Ironbark Woodland;
- Central Hunter Bulloak Forest Regeneration;
- Central Hunter Ironbark - Spotted Gum - Grey Gum Forest;
- Hunter Valley Vine Thicket; and
- Narrabeen Footslopes Slaty Box Woodland.

The above vegetation types represent endangered ecological communities listed under the TSC Act, with the exception of Narrabeen Footslopes Slaty Box Woodland. Central Hunter Box - Ironbark Woodland, Central Hunter Ironbark - Spotted Gum - Grey Gum Forest and Narrabeen Footslopes Slaty Box Woodland represent Central Hunter Valley Eucalypt Forest and Woodland, listed as a critically endangered ecological community under the EPBC Act.

These vegetation types are not groundwater dependent.

12.3 Impact assessment

12.3.1 Disturbance assessment

There are no changes to the State-approved footprint of disturbance associated with the proposed modification. The proposed modification will therefore have no additional impacts on ecology from direct disturbance other than those already approved and offset for the existing operations.

12.3.2 Assessment of ecosystems that potentially use groundwater

i River Red Gums, Hunter Floodplain Red Gum Woodland and Hunter Valley River Oak Forest

For the purposes of this assessment, representative locations of ecosystems that potentially use groundwater have been identified where the maximum predicted incremental drawdown due to the proposed modification is to occur (refer to Figure 12.1). E1 to E3 are in the vicinity of Riverview and Cheshunt Pits within the Hunter River floodplain and E4 to E6 are near South Lemington Pits 1 and 2 within the Wollombi Brook floodplain.

a. Previous approved mining in proximity to the floodplains

Numerous approved mining activities have been undertaken in proximity to the Hunter River and Wollombi Brook floodplains. These include:

- mining activities south of the Hunter River in proximity to the floodplain, which commenced in Riverview Pit in 1991 and Cheshunt Pit in 2000;
- mining of the Alluvial Lands (HVO North) immediately north of the Hunter River which commenced in 1993;
- mining of Carrington Pit (HVO North) north of the Hunter River which commenced in 2000;
- mining in proximity to Hunter River which commenced in 1971 as part of the former Lemington Mine (east of the existing Cheshunt Pit - now rehabilitated); and
- mining in South Lemington Pit 1 near the Wollombi Brook which commenced in 1998 but was suspended in 2001.

Drawdown of the alluvial aquifers associated with these historical approved mining activities has already occurred (MER 2005).

The approved mining activities in Cheshunt and Riverview Pits are in proximity to E2 and E3, and Carrington Pit (HVO North) in proximity to E1. Similarly, the approved mining at South Lemington Pit 1 is adjacent to E5. It should be noted that the approved mining of South Lemington Pit 2 (adjacent to E4 and 6) has yet to commence and, therefore, the associated predicted drawdown has yet to occur.

b. Alluvial recharge and water availability

Ecosystems E1 and E3 are in proximity to the approved historical and ongoing mining activities, where previous assessments have predicted alluvial groundwater drawdown.

Further, monitoring data (refer to Appendix B1 of the groundwater study in Appendix G and Figures 12.3 and 12.4) indicates alluvial groundwater levels have remained relatively stable within the alluvium despite active mining at adjacent pits. This indicates that there is limited hydraulic connection between the alluvium and the underlying depressurised coal measures in these areas, and that the system is largely recharged by rainfall and stream flow events.

The numerical groundwater model used for the proposed modification comprised average quarterly climatic conditions and, therefore, does not account for daily rainfall or streamflow events to accurately simulate the rapid alluvial recharge that follows flooding and above average rainfall. As a result, the decline in groundwater levels predicted by the model is considered conservative, which is confirmed through measured alluvial groundwater levels over time.

River Red Gums, Hunter Floodplain Red Gum Woodland and Hunter Valley River Oak Forest are dependent on relatively high levels of water availability, which is why they occupy the niche adjacent to waterways and on the floodplains of waterways that are periodically inundated and where standing water persists for several days or weeks following flooding.

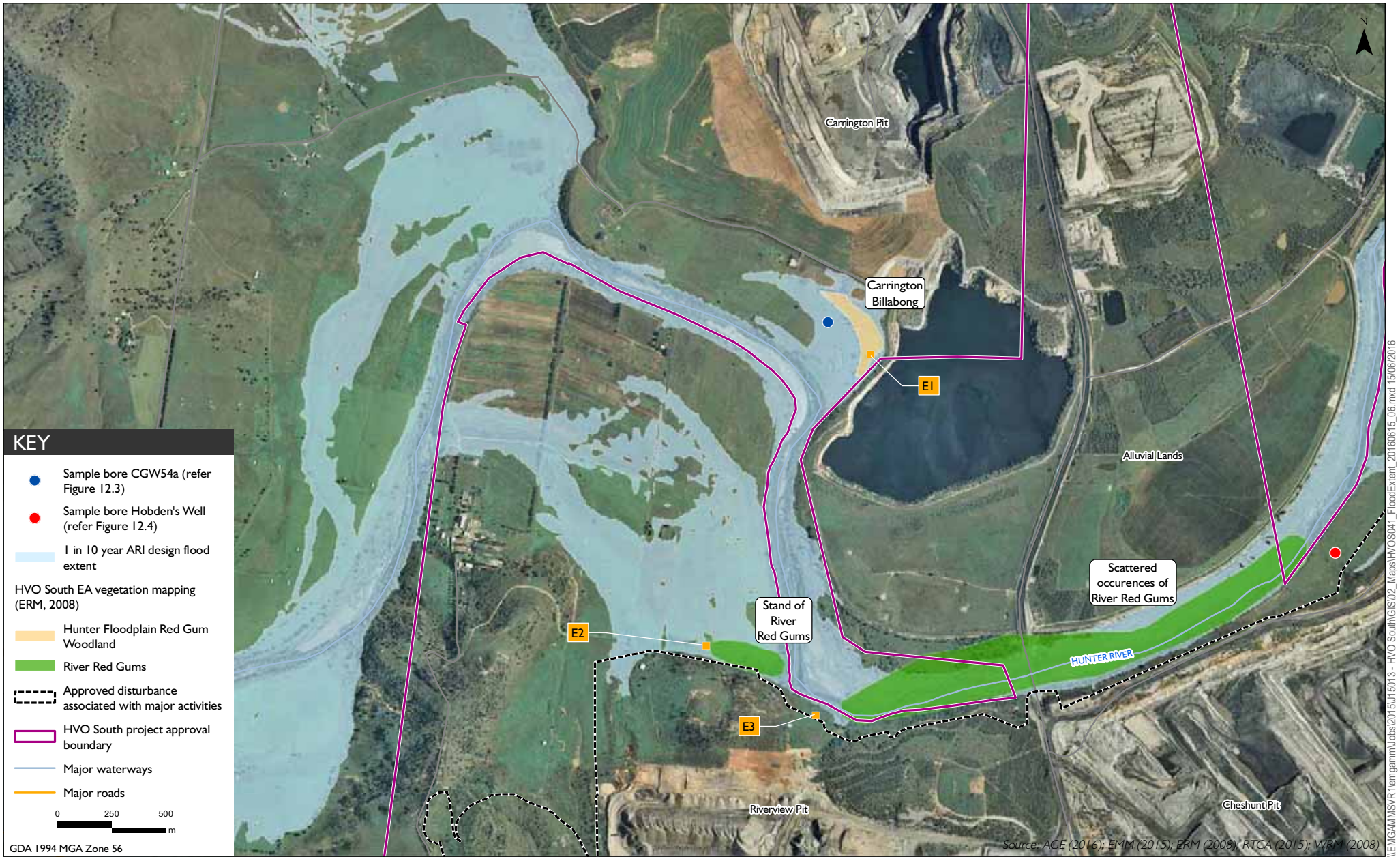
Figure 12.2 shows the 1 in 10 year annual recurrence interval (ARI) design flood event for the Hunter River in the vicinity of HVO South and the identified vegetation (and representative locations of ecosystems that potentially use groundwater) within the alluvium and floodplain. The 1 in 10 year ARI largely inundates these areas of vegetation as well as other areas of the floodplain. Without this regular inundation, trees can become water stressed and produce less seed with the community realising lower levels of natural recruitment (Jensen 2008).

The predicted drawdown within the Hunter River alluvium and floodplain north of Cheshunt and Riverview Pits is in areas of identified River Red Gums and Hunter Floodplain Red Gum Woodland, such as the Carrington Billabong. However, historic groundwater monitoring undertaken in these areas of the Hunter River adjacent to active mining has demonstrated that although groundwater levels fluctuate, the alluvium has remained saturated during mining (Figures 12.4 and 12.5). This saturation is a response to rainfall and flooding events, such as the 1 in 10 year ARI, that recharge the alluvial aquifers.

Figure 12.3 shows the rapid recharge and slow decline in the alluvial groundwater level in response to streamflow (or rainfall) events in an area adjacent to E1 (ie Hunter Floodplain Red Gum Woodland) within the floodplain of the Hunter River. Similarly, Figure 12.4 also shows the fluctuations in shallow alluvial groundwater levels over time, with rapid recharge of the alluvium occurring following streamflow (or rainfall) events adjacent to the area comprising stands of River Red Gums (E3) immediately north of Cheshunt and Riverview Pits. Due to the large storage capacity and relatively low leakage rates (MER 2005) the alluvium can remain saturated for prolonged periods between recharge events.

Figure 12.5 shows the water levels in the alluvium in the area adjacent to South Lemington Pit 2 and near E6 (ie isolated stand of River Red Gums adjacent to Wollombi Brook). The alluvium shows sustained levels of partial saturation in the alluvium with minor fluctuations due to rainfall and creek flow.

Consistent with the conclusions of the previous ecology study in the ERM (2008) EA and the Strategy (Umwelt 2010), this alluvial recharge process provides an ongoing water supply for these vegetation communities.



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Modelled 1 in 10 year ARI design flood extent

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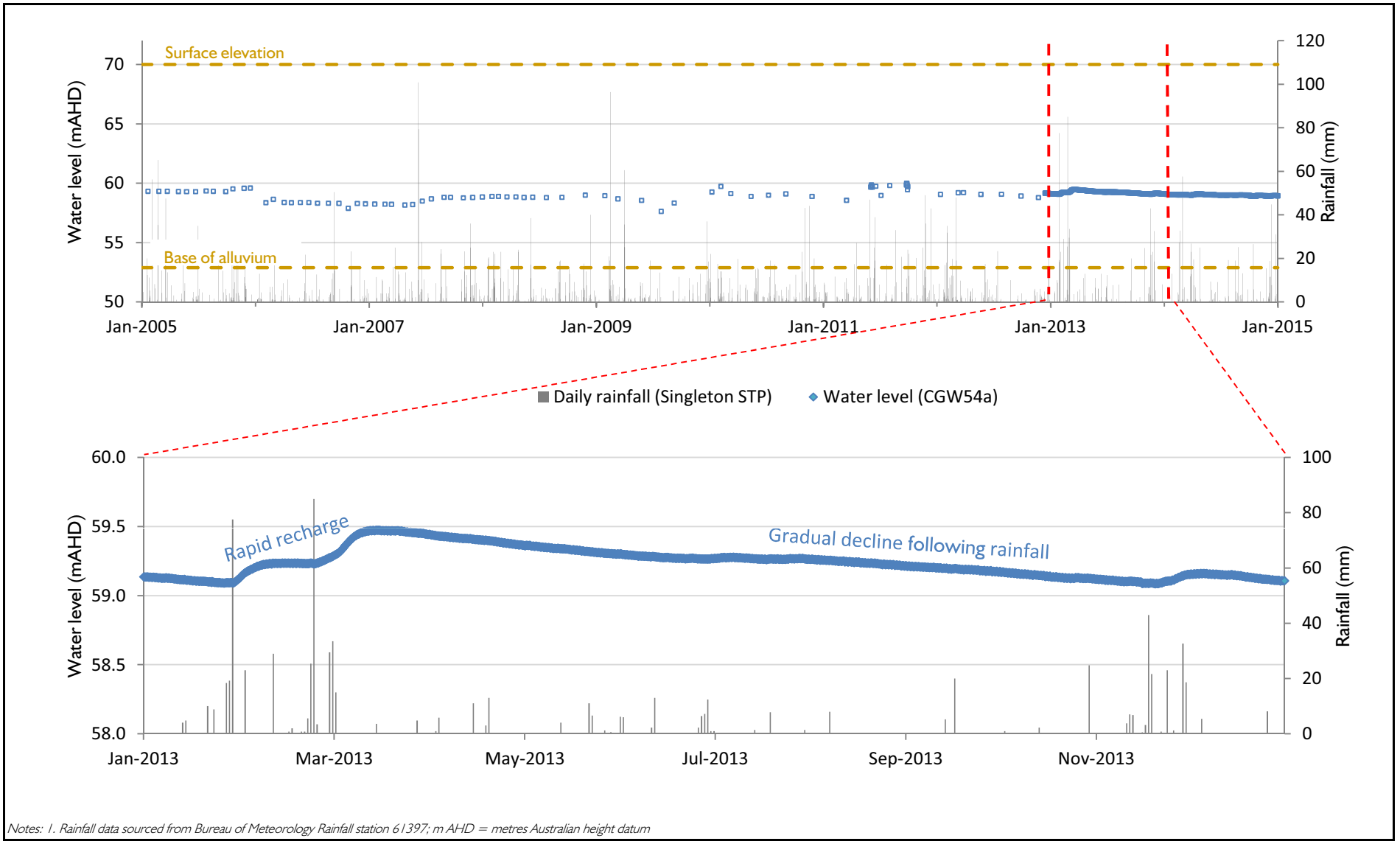
Environmental Assessment
Figure 12.2



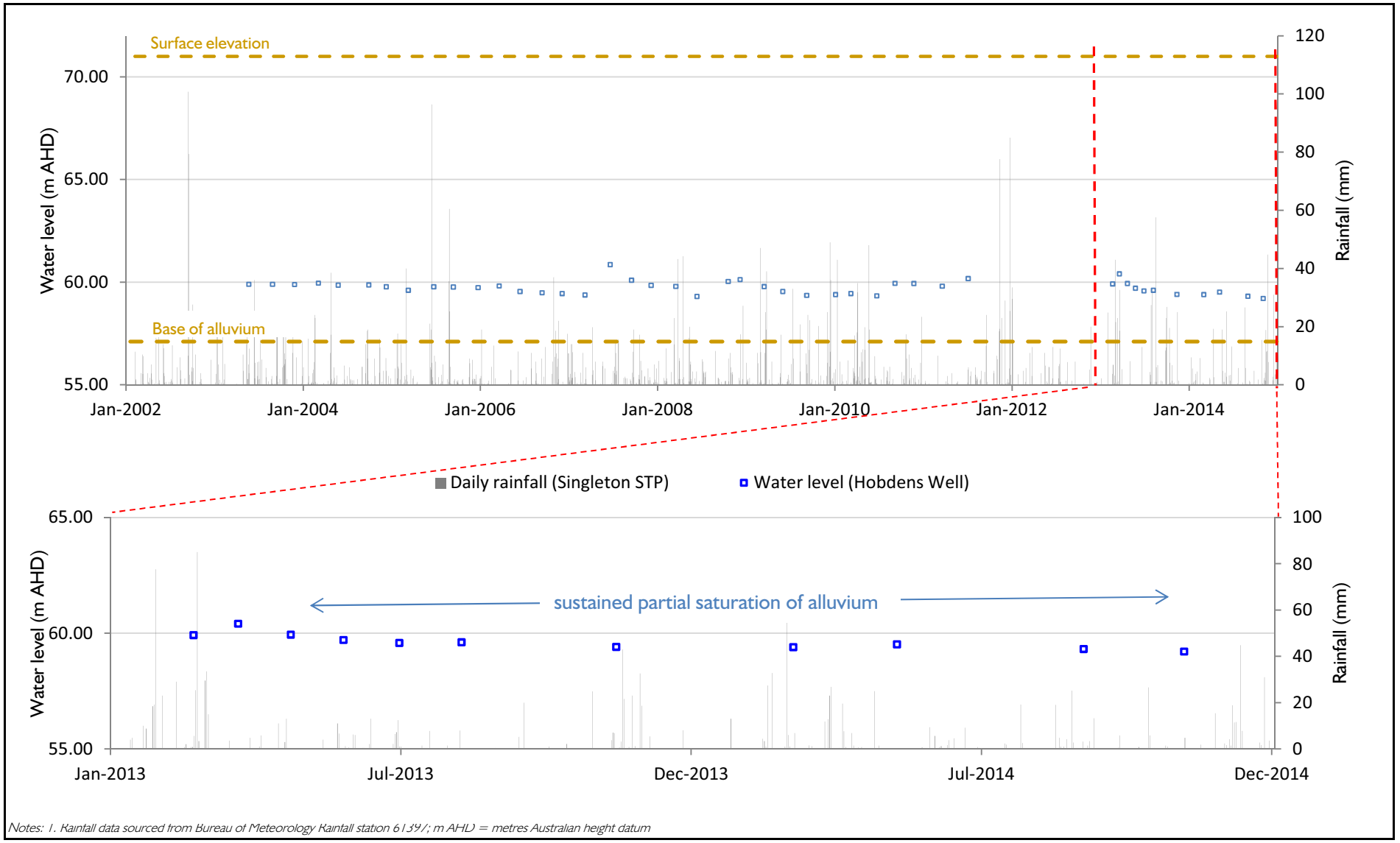
Notes: 1. Rainfall data sourced from Bureau of Meteorology Rainfall station 61397; m AHD = metres Australian height datum

Hydrograph: Hunter River alluvium (CGW54a – E 1)

HVO South Modificaton 5

Environmental Assessment

Figure 12.3



Notes: 1. Rainfall data sourced from Bureau of Meteorology Rainfall station 61397; m AHD = metres Australian height datum

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Hydrograph: Hunter River alluvium (Hobdens Well – E 3 – east)

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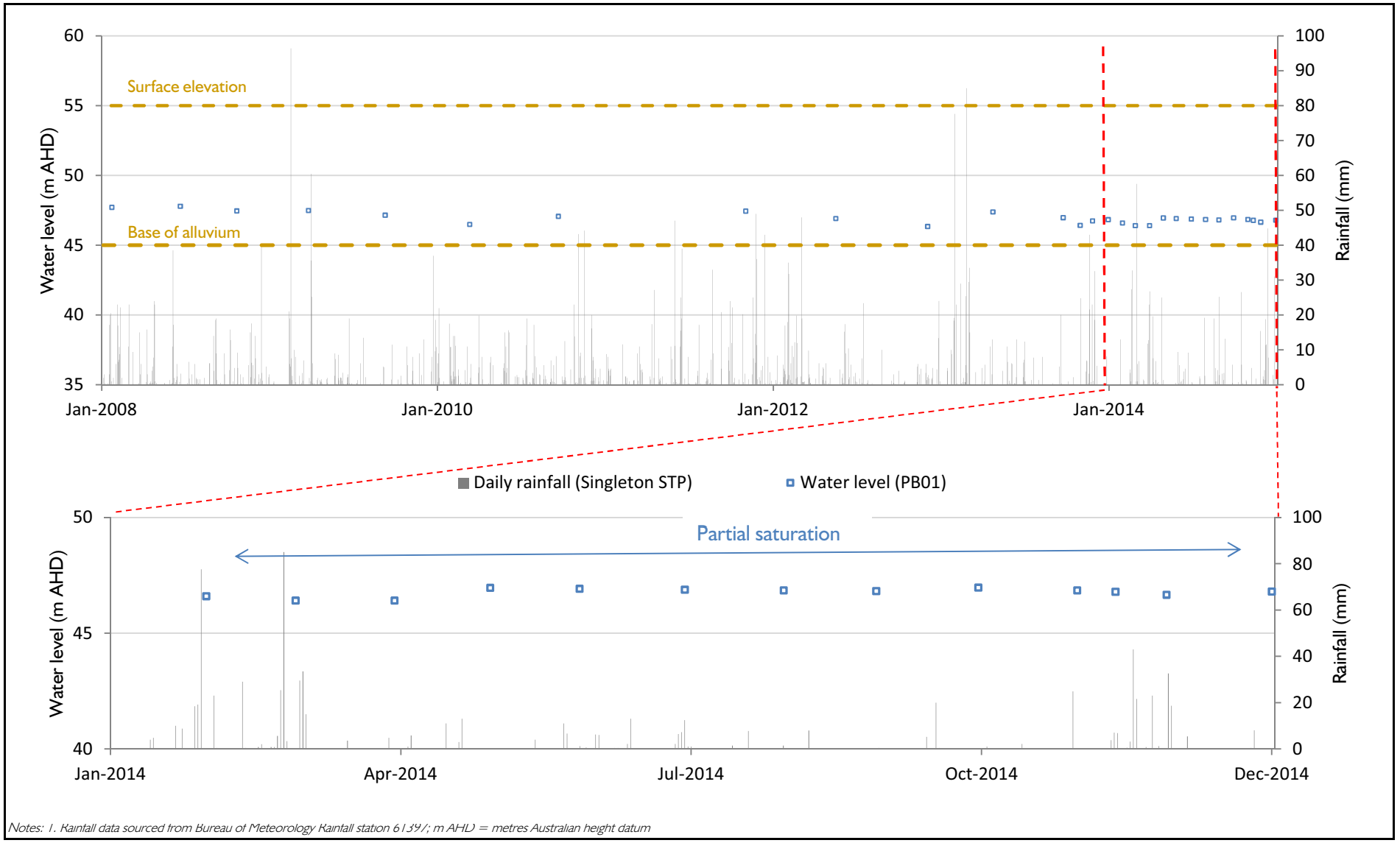
Figure 12.4



Notes: 1. Rainfall data sourced from Bureau of Meteorology Rainfall station 61397; m AHD = metres Australian height datum

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Hydrograph: Wollombi Brook alluvium (PB01 – E6)

HVO South Modificaton 5
Environmental assessment
Figure 12.5

c. Predicted groundwater drawdown

The groundwater drawdown predicted for the proposed modification is largely contained within the extent of the predicted drawdown for the approved operations.

As described in Chapter 10, drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium. However, in areas adjacent to South Lemington Pit 2 (which is north of Wollombi Brook) where the existing approved operations are expected to result in drawdown of up to 7m, the proposed modification is predicted to further decrease groundwater levels by up to an additional 2.8m. Groundwater levels within alluvium south of Wollombi Brook are predicted to decrease by less than 1m due to the proposed modification.

As identified above, the Hunter Floodplain Red Gum Woodland in Carrington Billabong (E1) and the isolated stands and scattered occurrences of River Red Gums north of Riverview Pit (E2 and E3, respectively) are reliant on flooding regimes for recruitment with opportunistic use of groundwater only. Due to the high frequency of recurring saturation of the alluvial aquifers (ie rainfall and flooding) no impacts on the Hunter Floodplain Red Gum Woodland or the River Red Gums are predicted due to the proposed modification.

The proposed modification is predicted to result in additional drawdown at isolated stands of River Red Gums (E4 and E6) within the Wollombi Brook alluvium. Umwelt (2010) identifies stands in this area (ie E6) to be a low priority for restoration and recovery activities, as the ecosystem is considered to be in poor health with limited potential for recovery.

The Wollombi Brook alluvium is hydraulically connected to Wollombi Brook. When the flows in Wollombi Brook are high, water is transmitted into the adjacent alluvium replenishing the alluvial aquifers (Rust PPK 1997). Wollombi Brook is also partially regulated in the area by licensed discharges to Redbank Creek (upstream of E6) increasing flows. These isolated stands within the Wollombi Brook will therefore likely continue to have water accessibility and considered unlikely to be adversely impacted by the proposed modification.

ii Warkworth Sands Woodland

The proposed modification does not result in additional drawdown in the shallow groundwater in the vicinity of Warkworth Sands Woodland. As previously stated, the water table formed at the base of the Warkworth sands is perched and not in direct hydraulic connection with the underlying Permian fractured rock (AGE 2014). Therefore, the proposed modification is not expected to impact on the Warkworth sands ephemeral aquifer or the associated vegetation community.

12.4 Management and monitoring

The existing Rehabilitation and Biodiversity Management Plan for HVO South and the relevant aspects of the MTW Biodiversity Offset Strategy will continue to be implemented for the proposed modification. These plans were prepared in consultation with DPI Water, Division of Resources and Energy (DRE) and Singleton Council and to the satisfaction of the Director-General (now Secretary) of DP&E and the Executive Director, Minerals Resources within DRE.

The River Red Gum endangered population (and Hunter Floodplain Red Gum Woodland) in Carrington Billabong is currently managed in accordance with the Strategy, required under Condition 30 Schedule 3 of the project approval (PA 06_291) for HVO South as well as part of the existing HVO North development consent (DA 450-10-2003) to extend open cut mining in the Carrington Pit. River Red Gums at HVO South (and HVO North, including Carrington Billabong) will also continue to be managed in accordance with the measures identified in the Strategy.

12.5 Conclusions

The proposed modification does not change the approved disturbance footprint and therefore there will be no additional direct impacts on ecology as a result of the proposed modification.

There are no GDEs in the vicinity of the project area as mapped in the Commonwealth Government's *National Atlas of Groundwater Dependent Ecosystems*, however previous ecological surveys identified ecosystems that potentially use groundwater in the vicinity of HVO South. These ecosystems that potentially use groundwater included River Red Gums, Hunter Flood Plain Red Gum Woodland and Hunter Valley River Oak Forest as well as the ephemeral wetland, Carrington Billabong.

A review of monitoring data in the locality indicates that measured groundwater levels have remained relatively stable within the alluvium with active mining in adjacent pits. This indicates that there is limited hydraulic connection between the alluvium and the underlying depressurised coal measures in the areas, with the system largely recharged by rainfall and therefore, the modelling predictions of drawdown are considered to be conservative.

Of these ecosystems that potentially use groundwater, six representative locations were selected for the purposes of the assessment. Drawdown from the proposed modification is predicted to not exceed 0.5m at any of the locations within the Hunter River alluvium, however groundwater levels will decrease by up to an additional 2.8m adjacent to South Lemington Pit 2 (E4 and E6) within the Wollombi Brook alluvium, with negligible drawdown predicted at E5.

The proposed modification will not have a significant impact on ecosystems that potentially use groundwater as a result to predicted changes in the groundwater regime. The ecosystems that potentially use groundwater are opportunistic groundwater users and inhabit the niche on the floodplain due to the flooding regime rather than water supplied directly from the groundwater system. The proposed modification does not change the local flooding regime and, therefore, impact on these communities is not expected. This is consistent with previous assessments.

The proposed modification will therefore have no additional impacts on ecology other than those already approved and offset for the existing operations. No additional management and monitoring measures will be required under the proposed modification.

13 Final landform, rehabilitation and landuse

13.1 Introduction

The proposed modification requires a change in the overburden emplacement strategy and final landform to accommodate an additional volume of overburden material to access the deeper coal seams. The change in overburden emplacement strategy has provided an opportunity to change the shape and slopes of the final landform that incorporates micro-relief. The change in mine plan to access the deeper coal seams also results in changes in the size and location of the final void and associated evaporative basin.

This chapter further describes these changes compared to the existing approval.

As the proposed modification does not change the approved disturbance footprint, the results of previous soil and land capability studies (GSSE 2007; ERM 2008) are not repeated and remain applicable.

13.2 Existing environment

13.2.1 Landform

The conceptual final landform developed for the existing approval as outlined in the ERM (2008) EA considered previous and surrounding land use; external and internal planning requirements; existing rehabilitated landforms and ecological and sustainability values. The landform and land use was intended to meet the requirements of the *Synoptic Plan – Integrated Landscapes for Coal Mine Rehabilitation for the Hunter Valley of NSW* (Synoptic Plan) (Department of Mineral Resources 1999) to integrate biodiversity enhancement with sustainable agricultural practices.

To achieve the Synoptic Plan's regional planning vision, the landscape and rehabilitation planning process must actively link with neighbouring mine plans and consider surrounding and regional land uses and ecosystems for sustainability and compatibility of final land uses.

Rehabilitation is carried out progressively throughout the life of the mine and includes reshaping of mined landforms (emplacement areas and pits) and drainage channels, topsoil haulage and placement, ripping, seeding and vegetation planting, erosion control, weed control and fencing to obtain the final landform design outcome.

The pre-mining landscape at HVO South was heavily cleared (approximately 90 per cent of the project area). The conceptual final landscape across HVO South is planned to be an undulating, free-draining landform with a post mining land capability which supports land for predominately cattle grazing and native habitat. The approved landform aims to reflect the natural features and complement the previously created landforms.

In accordance with its existing project approval, HVO South is a multiple strip mining operation (refer Figure 3.1, Section 3.1.2) with strips between 45m and 120m wide depending on the equipment used in each strip. On average, each pit advances one strip in approximately 12 months. Once each pit has reached its lower limit, the strip is released for emplacement. Once the outer edge of the emplacement has reached the required height, the land is rehabilitated and the emplacement progresses forward as mining is completed and a new strip is released for emplacement. Rehabilitation is undertaken as soon as it is practical to do so.

A large area of rehabilitation is complete to the north-east of the Cheshunt Pit. Other areas of completed rehabilitation are to the west of Riverview Pit (area referred to as the western out-of-pit overburden emplacement or western out-of-pit emplacement) and east of South Lemington Pit 1. Temporary rehabilitation has occurred in several areas throughout the mining area including to the north-east and south of the Cheshunt Pit and central part of Riverview Pit.

Photographs 2.1 and 2.2 (Section 2.1) provide examples of progressive rehabilitation completed at HVO South to date. This progressive rehabilitation reduces the amount of land that is disturbed and exposed at any one time to minimise dust generation and assist with visual amenity.

The majority of the rehabilitated landform is approved to be revegetated to improved pastures, with native vegetation species forming livestock shelter and habitat corridors that aim to provide connectivity to remnant forest and woodland.

13.2.2 Final void

The various pits that currently form HVO South were original separate pits that would have resulted in five final voids comprising Riverview Pit, Cheshunt Pit, South Lemington Pit 1 and South Lemington Pit 2 with a scraper slot void near South Lemington Pit 1.

These pits have been combined and consolidated over the years with the five final voids reduced to a single void. The surface area of the approved final void, when measured at a natural surface level of approximately 70mAHD is approximately 404ha.

The evaporative basin is the area of water stored in the final void. As discussed in Section 11.3.4, a contemporary assessment of the long-term behaviour of the approved final void was simulated by WRM (2016) using OPSIM software. The evaporative basin is predicted to reach a long-term equilibrium level of approximately 32mAHD approximately 250 years after mining which equates to a surface area of 403ha.

The approved final void has a net inward hydraulic gradient forming a sink, resulting in no release of water from the void to the surrounding environment. This provides an indirect benefit of reducing saline water from the Permian strata flowing into the Hunter River and Wollombi Brook under natural gaining conditions (refer to Chapter 10).

Characteristics of the approved final void are compared with the proposed final void in Section 13.3.2.

It is noted that ERM (2008) predicted the long-term equilibrium level in the evaporative basin of approximately 0mAHD after 250 years. The information presented in that report, based on spreadsheet modelling, does not clearly state the groundwater inflow at equilibrium, and appears to significantly overestimate the surface area of the approved void. This is discussed further in Section 11.3.4.

The WRM (2016) study includes a more rigorous representation of the void geometry, as well as catchment and water storage response to historical daily climate conditions. It is therefore considered to be more likely to be representative of long-term behaviour given the predicted groundwater inflows.

13.3 Impact assessment

13.3.1 Landform

Mining of the deeper seams has been designed to occur within the existing approved disturbance footprint. The additional volume of overburden material to access the deeper seams requires a revision of HVO South's overburden emplacement strategy. This strategy requires an increased emplacement height in some areas up to 240mAHD and provides the opportunity to develop a more natural landscape into the post mining landform design using micro-relief design techniques.

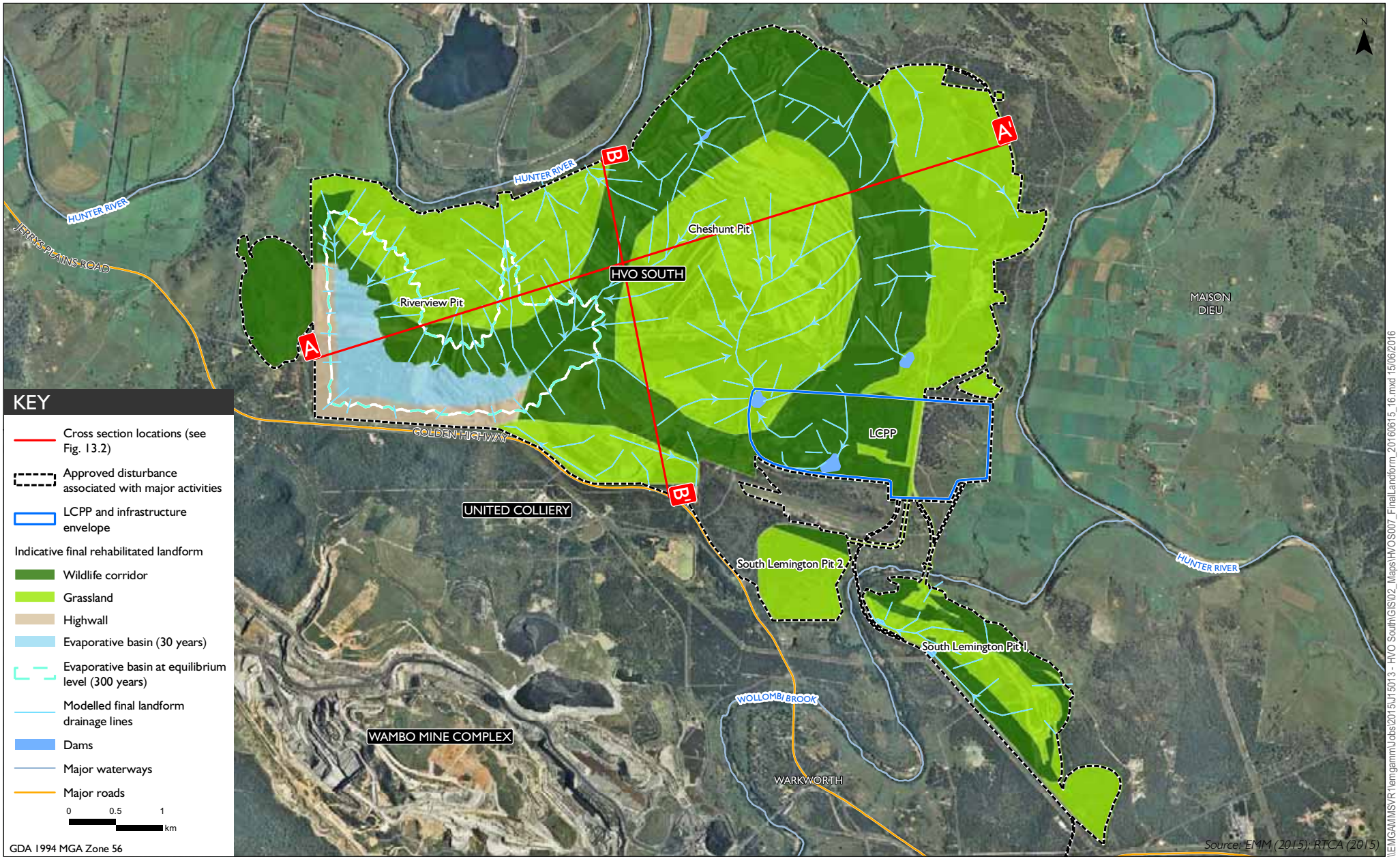
The change in overburden emplacement strategy has provided an opportunity to change the shape and slopes of the final landform that incorporates micro-relief. An indicative final landform is presented in Figure 13.1 with associated cross sections in Figure 13.2.

The rehabilitated landform will be revegetated to areas of grassland, trees over grassland and woodland. Following mining, the landform will be rehabilitated to be undulating and free-draining with a land capability that supports predominately cattle grazing and native habitat.

Condition 34 of the existing project approval (PA 06_0261) requires rehabilitation at HVO South to be undertaken progressively in a manner that is generally consistent with the final landform set out in the EA (shown conceptually in Appendix 6 of PA 06_0261).

The progressive rehabilitation will continue to be overseen by an on-site specialist who, along with mine planners, ensures that future rehabilitation resource requirements are available to enable the objectives of rehabilitation domains to be met. Final landform and rehabilitation are discussed further in Chapter 9.

The HVO South MOP and the HVO South Rehabilitation and Landscape Management Plan will be updated to incorporate the proposed modification. The HVO South MOP also contains a detailed description of rehabilitation objectives and domains, measurable performance criteria and corrective triggers to achieve rehabilitation outcomes.



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Indicative final rehabilitated landform

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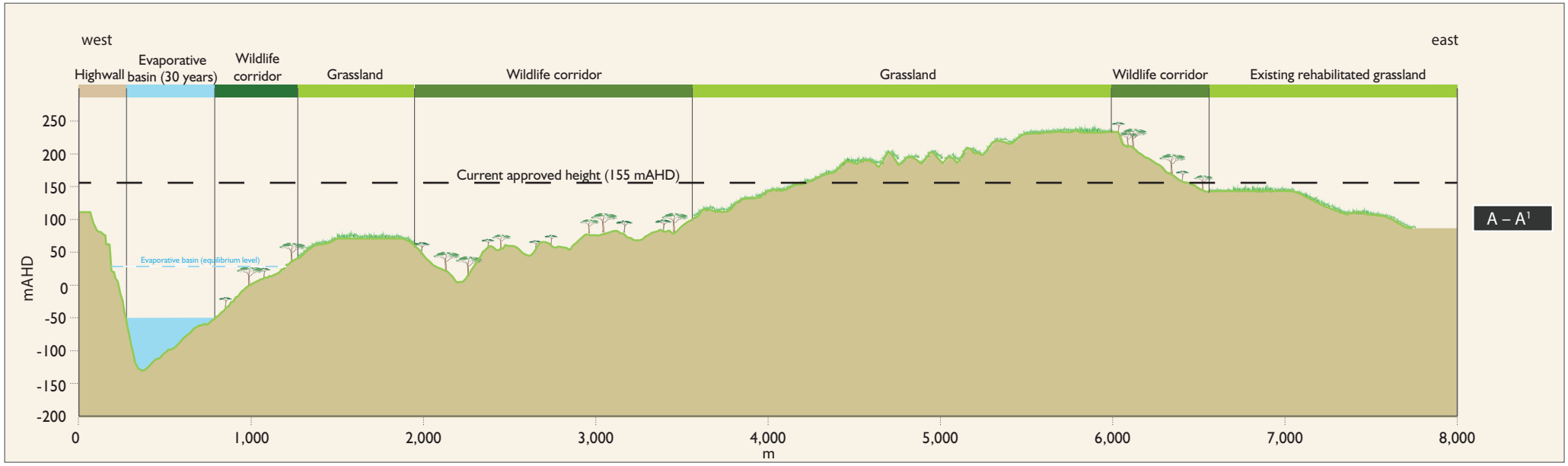
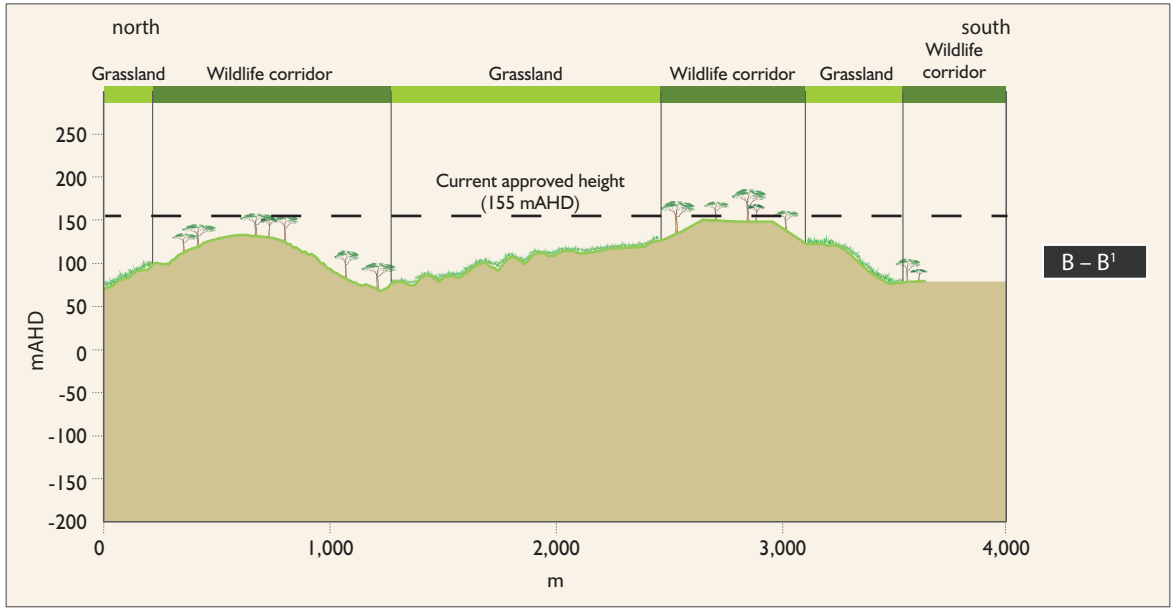
Environmental Assessment
Figure 13.1





KEY

- Grassland
- Wildlife corridor
- Evaporative basin (30 years)
- Highwall

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Indicative final rehabilitated landform cross-sections
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Environmental Assessment
Figure 13.2

13.3.2 Final void

The development of the final void, its alignment with final landform objectives and its role in post-mining water management (preventing saline water leaving the site) were important considerations in the development of the proposed mine plan. Although not required for the proposed modification, the void optimisation process considered the *Indicative Secretary's Environmental Assessment Requirements (SEARs) Guideline for State Significant Mining Developments* (DP&E 2015a) and *Mine Application Guideline* (DP&E 2015b).

In accordance with contemporary development consent conditions, the final void has been designed, where reasonable and feasible to:

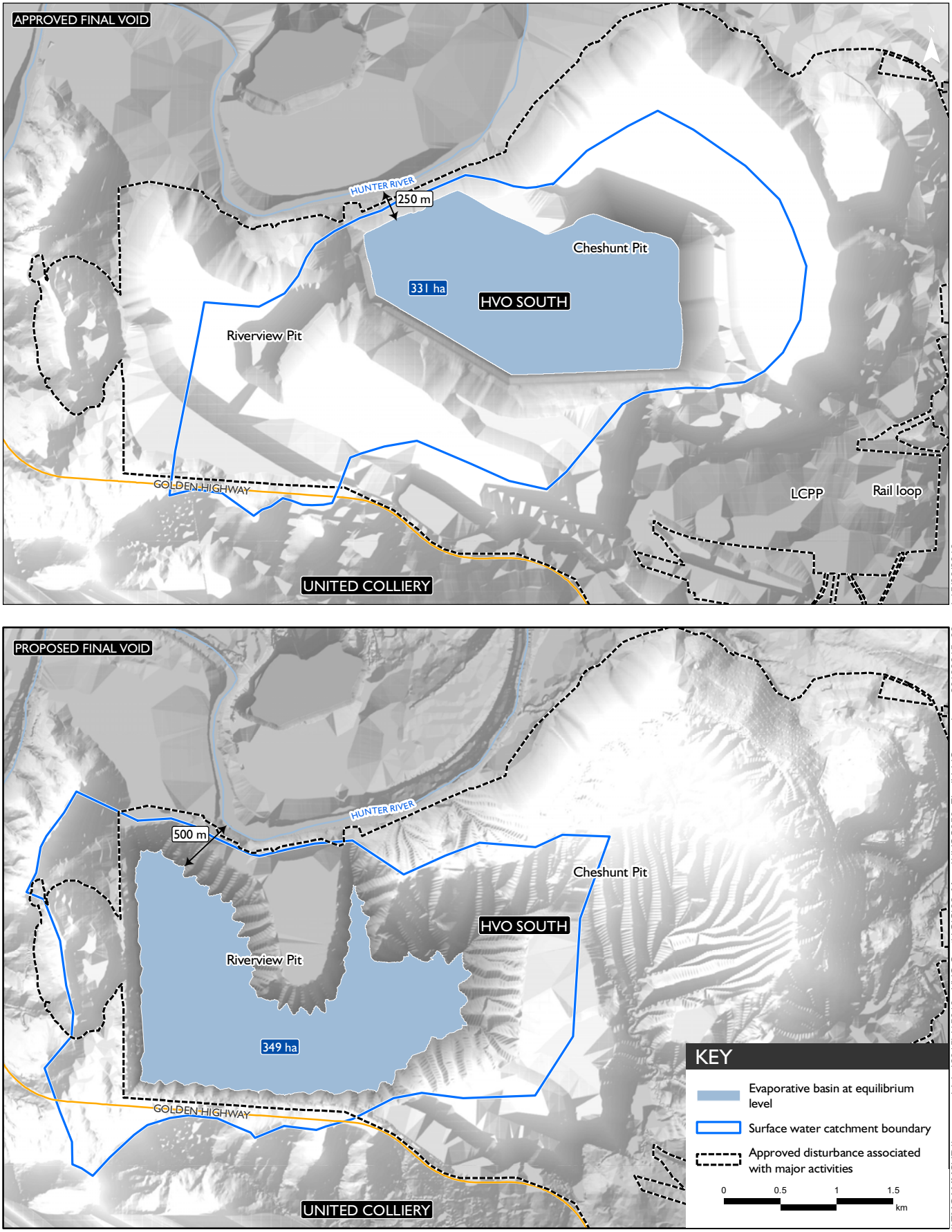
- act as a groundwater sink and maximise groundwater flow across back-filled pits to the final void;
- minimise the size, depth, catchment and highwall instability; and
- have flood protection.

i Evaporative Basin

The proposed void has been successfully designed to achieve its primary objective of functioning as a groundwater sink, maximising groundwater flow across back-filled pits to the final void, preventing release of saline water into the surrounding environment. This has the indirect benefit of reducing the inflow of saline Permian water into the Hunter River and Wollombi Brook under natural gaining conditions.

The proposed indicative final landform has been shaped to minimise the surface water catchment draining to the void. As a result, whilst the proposed mine plan enables access to the deeper seams, the surface water catchment area draining to the final void under the proposed modification is smaller than under the approved mine plan. The catchment boundaries for the approved and proposed final voids are shown in Figure 13.3.

The distance between the Hunter River and the evaporative basin is greater under the proposed modification compared with its approved location. The evaporative basin at its equilibrium level for the proposed modification is located approximately 500m from the Hunter River compared with approximately 250m with its approved location (refer Figure 13.3).



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Location and arrangement of approved and proposed final voids

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Environmental Assessment
Figure 13.3

Table 13.1 provides a comparison of the approved and proposed evaporative basin characteristics.

The long-term equilibrium water level for the proposed and approved evaporative basin as simulated by WRM (2016) using OPSIM software is similar, with the former approximately 30mAHD, and the latter approximately 32mAHD. Under both scenarios, this level is greater than 40m below crest of the void, or the spill level. The proposed modification results in a reduction of surface area at the equilibrium level of the evaporative basin, with an area of 372ha compared to a larger 403ha for the approved evaporative basin.

Table 13.1 Approved and proposed final void characteristics

Characteristic	Approved	Proposed
Catchment area (ha)	1,190	1,145
Distance from Hunter River (m)	250	500
Spill level (mAHD)	72.5	72.5
Equilibrium (years)	250	300
Equilibrium (mAHD)	32	30
Equilibrium surface area (ha)	403	372
Equilibrium depth below spill level (m)	40.5	42.5

ii Final void area and use

The nature of strip mining requires the progressive extraction of overburden material and disposal of this material behind the active mining strip. As follows, when the last strip of coal extraction is reached, there is no further overburden won to enable the reasonable and feasible filling, resulting in a final void.

The final void is typically measured from the level of ground surface at the highwall (outer edge of the pit) to the low-wall (the inner slope of the overburden emplacement). Table 13.2 provides a comparison of the approved and proposed final void measured at a natural surface level of 70mAHD.

The approved final void assessed by ERM (2008) has a low-wall slope of 14 to 18 degrees with an area of approximately 404ha from natural surface level of approximately 70mAHD. The proposed final void, with a low-wall slope of 8 to 10 degrees has an area of approximately 523ha from natural surface level of approximately 70mAHD. The area of the proposed final void is larger than the approved final void predominately due to the gentler slope to enable micro-relief and, to a lesser extent, the deeper pit floor. An indicative final void slope comparison is provided in Figure 13.4.

Table 13.2 Approved and proposed final void size and low-wall slope

	No.	Natural surface level		Slope
		mAHD	Area	
Approved (2008)	1	70	404ha	14-18°
Proposed (2016)	1	70	523ha	8-10°

The land on the low-wall slope may continue to be used in accordance with the indicative final rehabilitated landform. A comparison of the useable land with the final void that has a slope of 10 degrees or less (providing for increased land use optionality) under the approved and proposed final void designs is presented in Table 13.3. The area of useable land within the final void under the proposed modification over time is on shown in Figure 13.5.

Table 13.3 Final void land useability

	Water level (mAHD)		Final void area (ha)[1]		Unusable area (ha)[2]		Useable area (ha)[3]	
Time after mining (Years)	**Approved**	**Proposed**	**Approved**	**Proposed**	**Approved**	**Proposed**	**Approved**	**Proposed**
0	-135	-150	404	523	284	123	120	400
30	-50	-50	404	523	348	169	56	354
300	32	30	404	523	403	372	1	151

Notes: 1.Final void area at natural surface level of 70mAHD.

2. Area within void with either slope greater than 10 degrees or developed as evaporative basin.

3. Useable area with slope less than or equal to 10 degrees.

4. All areas are approximate.

At the completion of mining, the proposed modification will provide approximately 400ha of useable land with a slope less than or equal to 10 degrees compared with 120ha under the current approval. This represents an increase of approximately 280ha of useable land immediately post mining and about 298ha some 30 years post mining.

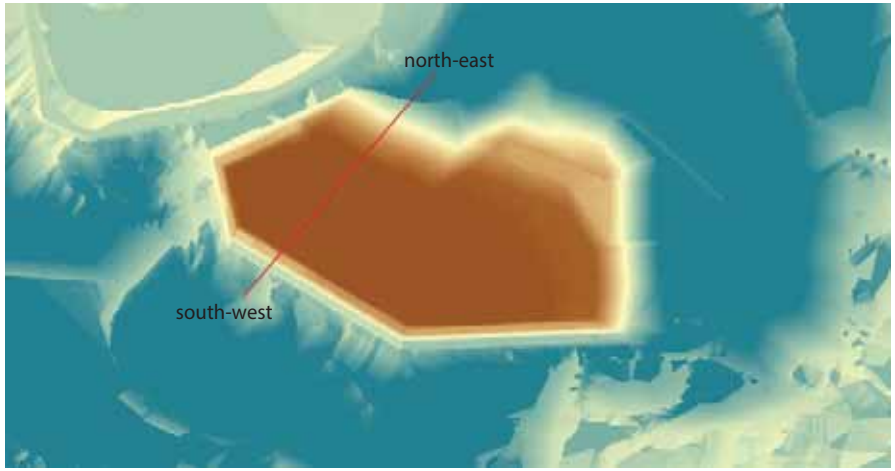
This useable area gradually reduces over the 300 year period where groundwater modelling (AGE 2016) predicts that the water level in the evaporative basin will slowly recover, resulting in a long-term useable area with a slope less than or equal to 10 degrees under the proposed modification of an additional 150ha compared with the current project approval.

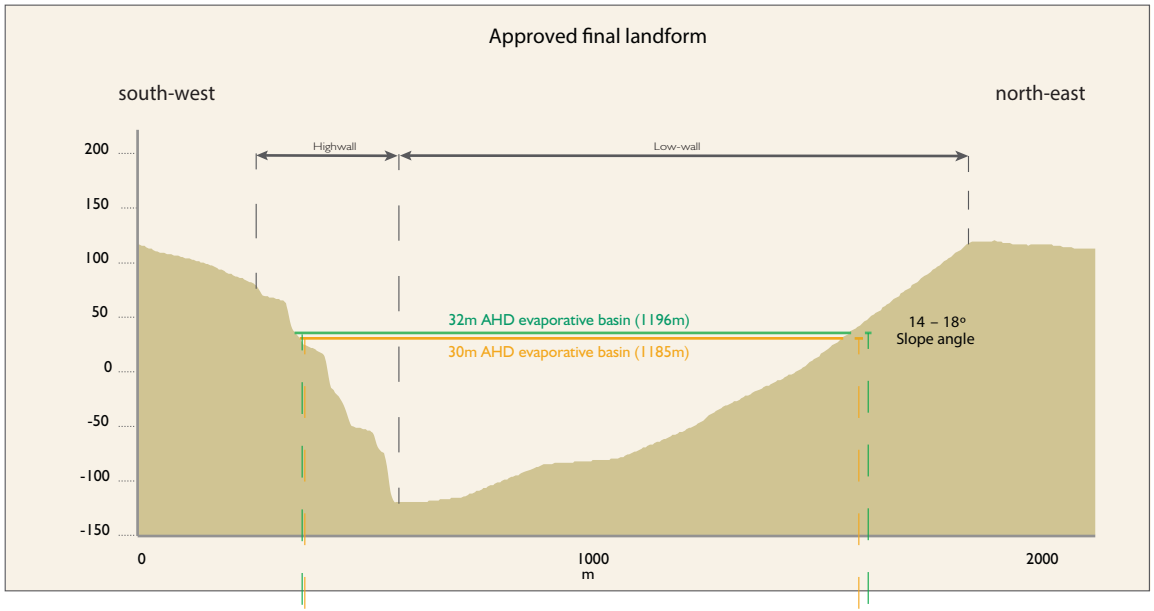
13.4 Management and monitoring

Rehabilitation and final landform development is undertaken in accordance with the HVO South MOP and the HVO South Rehabilitation and Landscape Management Plan; the latter prepared in consultation with the former Department of Water and Energy (now Department of Primary Industries - Water (DPI Water)), Department of Primary Industries and Singleton Council and approved by the Director-General (now Secretary). These plans will continue to be used for the proposed modification.

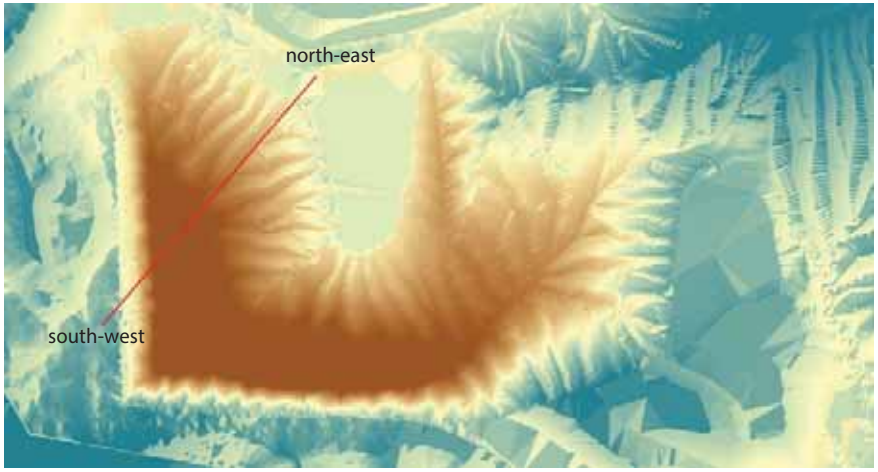
A final void management plan and mine closure plan will also be prepared in consultation with the relevant agencies at least five years prior to the completion of mining, as required by Conditions 37 and 38 Schedule 3 of the existing project approval (PA 06_0261), respectively.

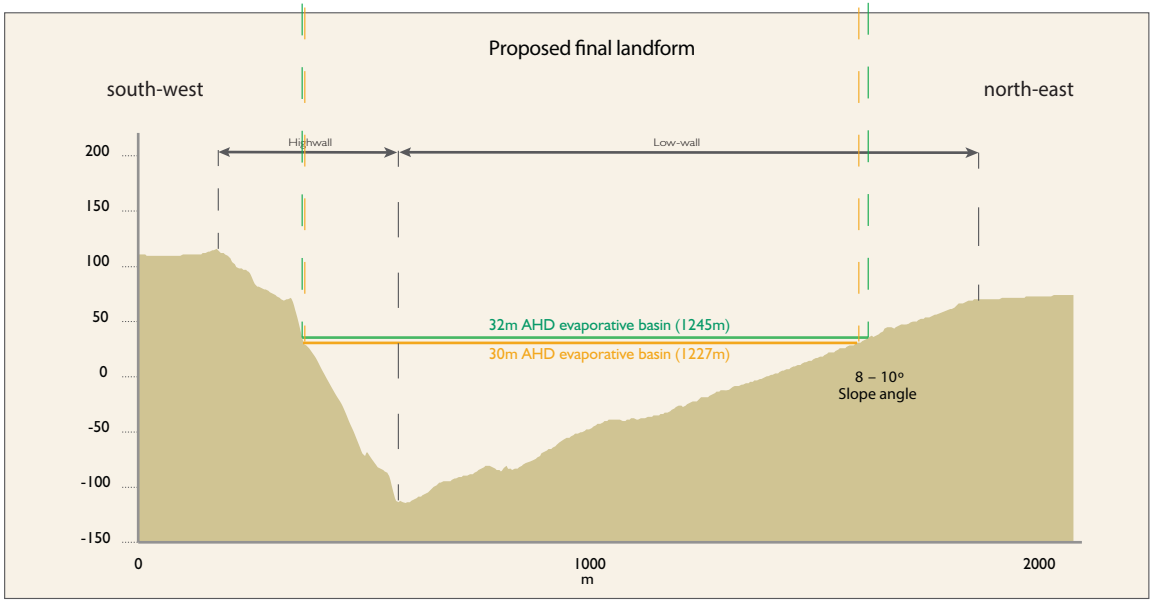
Approved final landform





Proposed final landform





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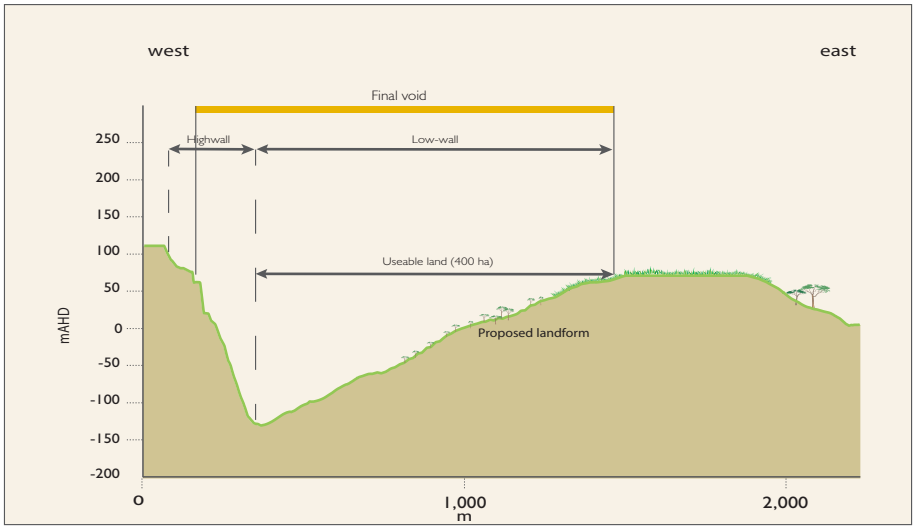
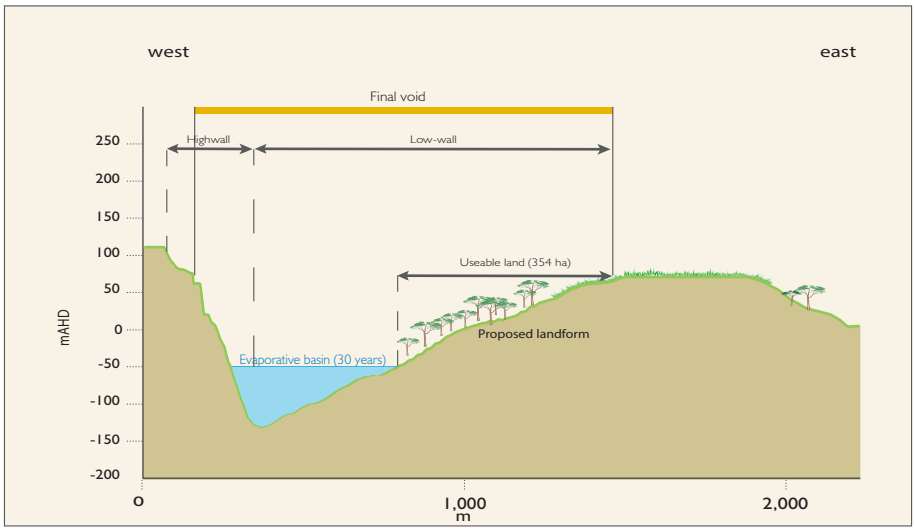
Indicative final void slope comparison
HVO South Modification 5
Environmental Assessment
Figure 13.4

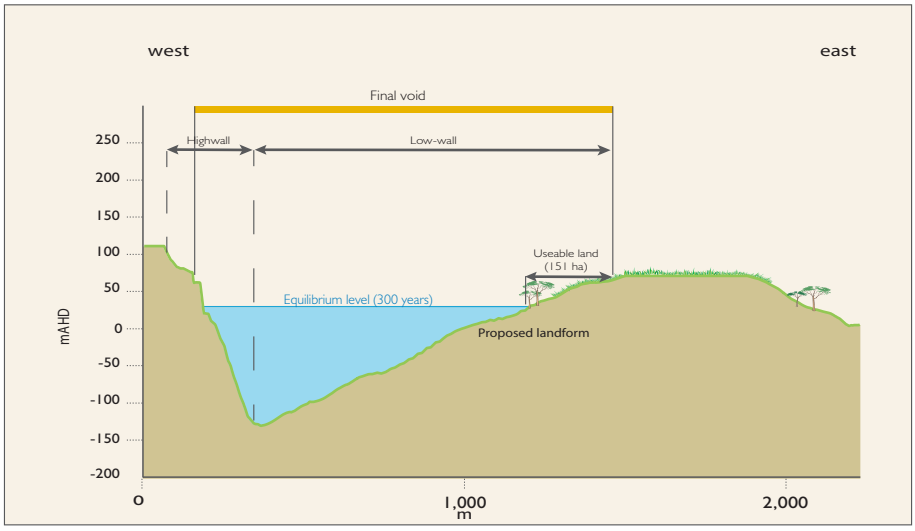
Year 0



Year 30



Year 300



Source: RTCA (2016)

Proposed indicative final landform - useable land

HVO South Modification 5
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Figure 13.5

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13.5 Conclusions

The overburden emplacement strategy and final landform have been revised to accommodate an additional volume of overburden material to access the deeper coal seams. The change in overburden emplacement strategy has provided an opportunity to develop a more natural landscape into the post mining landform design using micro-relief design techniques.

The indicative final landscape across HVO South is planned to be an undulating, free-draining landform with a post mining land capability which supports land for predominately cattle grazing and native habitat. The proposed landform aims to reflect the natural features and complement the previously created landforms. This is consistent with the requirements of the Synoptic Plan which aims to integrate biodiversity enhancement with sustainable agricultural practices.

The change in mine plan to access the deeper coal seams also results in changes in the size and location of the final void and associated evaporative basin.

The single final void under the existing approval has been consolidated over the years from five separate final voids.

The development of the final void for the proposed modification, its alignment with final landform objectives and its role in post-mining water management (preventing saline water leaving the site) were important considerations in the development of the proposed mine plan.

The optimised final void has been designed, where reasonable and feasible, to be consistent with government guidelines and contemporary development consent conditions.

The optimised final void results in an evaporative basin located further from the Hunter River compared to its approved location. The final void will remain as a groundwater sink in perpetuity which prevents the release of stored water into the Hunter River and Wollombi Brook. An indirect benefit of the groundwater sink is that there will be a reduction in saline water from the Permian strata flowing into the Hunter River and Wollombi Brook under natural gaining conditions. The long-term equilibrium water level of the proposed evaporative basin is 30mAHD, which is over 40m below the crest of the void, or spill level. The proposed modification's long-term equilibrium level also provides for a reduction in evaporative basin surface area from 403ha under the approved landform to 372ha.

The proposed indicative final landform has also been shaped to minimise the surface water catchment draining to the void, resulting in a surface water catchment area under the proposed modification smaller than under the current approval.

The slope of the final void has been substantially reduced from 14 to 18 degrees to 8 to 10 degrees, enabling greater land use optionality. This design consideration allows for an increase of 150ha of useable land with a slope of 8 to 10 degrees compared to the approved landform.

Rehabilitation and final landform development will continue to be undertaken in accordance with the HVO South MOP and the HVO South Rehabilitation and Landscape Management Plan. A final void management plan and mine closure plan will also be prepared in consultation with the relevant agencies at least five years prior to the completion of mining, as required by Conditions 37 and 38 Schedule 3 of the existing project approval (PA 06_0261), respectively.

14 Heritage

14.1 Introduction

This chapter describes the existing Aboriginal cultural heritage and historic heritage environments, including previous assessments and existing management measures implemented at HVO South.

As the proposed modification does not change the approved disturbance footprint, the results of previous heritage assessments remain applicable and no further detailed assessment is required.

14.2 Existing environment

14.2.1 Aboriginal cultural heritage

i Review of previous assessments

The management of Aboriginal cultural heritage associated with the proposed modification has been previously assessed and approved under the existing project approval (PA 06_0261). The proposed modification is entirely within the currently approved disturbance footprint. In accordance with Condition 40 of the existing project approval (PA 06_0261) an Aboriginal Cultural Heritage Management Plan (ACHMP) was prepared in consultation with OEH (formerly NSW EPA) and to the satisfaction of the Director-General (now Secretary) of DP&E that incorporates the area of the proposed modification.

The Aboriginal cultural heritage management methodology for the ERM (2008) EA involved:

- a review of previous assessments;
- development of a Terms of Reference with the Aboriginal community for additional assessments;
- conduct of these additional assessments;
- assessment of potential impacts; and
- a review of existing management measures to identify additional measures required as a result of the impacts proposed within the development application.

These management measures were subsequently incorporated within the ACHMP, which was approved on 24 February 2010.

Numerous Aboriginal cultural heritage investigations had been previously conducted over the proposed modification area prior to and for the ERM (2008) EA.

Since 2008, additional Aboriginal cultural heritage assessments and Aboriginal cultural heritage management compliance inspections have been conducted within the approved disturbance footprint under the terms of the ACHMP for approved disturbance areas and surrounding lands. They include cultural heritage assessment surveys for water management and power-line infrastructure at Barellan (McCardle CHM, 2009), Archerfield Woodlands (Scarp Archaeology, 2010/11), HVO South-East study area (Scarp Archaeology, 2010/11) and the Cheshunt Mine proximal area (Scarp Archaeology, 2011). These investigations and management activities have been conducted in accordance with the provisions of the ACHMP.

ii Aboriginal Cultural Heritage Management Plan commitments

Condition 40 within Schedule 3 of the existing project approval (PA 06_0261) required the preparation (in consultation with the Aboriginal community through the auspices of the Coal & Allied Upper Hunter Valley Aboriginal Cultural Heritage Working Group - CHWG) and implementation of an ACHMP. The ACHMP sets out the principles and processes under which Aboriginal cultural heritage will be managed on lands within the approved disturbance footprint. The provisions of this ACHMP apply to all extant and new Aboriginal archaeological and cultural heritage objects, sites and areas identified and recorded within the approved disturbance footprint. The ACHMP applies to all lands within this area and operates for the life of the mining activity and subsequent post-mining remediation works within the area subject to the ACHMP.

This ACHMP is publically available on Rio Tinto Coal Australia's website (refer to http://www.comalco.com/documents/HVO_PA_06_0261_Aboriginal_Cultural_Heritage_MP.pdf) and includes specific provisions for:

- Cultural Heritage Zoning Scheme and Ground Disturbance Permit system;
- care and control of collected Aboriginal cultural materials;
- cultural heritage management inductions;
- processes following the discovery of human skeletal remains;
- assessment of areas previously unassessed for Aboriginal cultural heritage;
- verification, management and mitigation measures for each particular site type;
- ACHMP compliance inspections; and
- Aboriginal community consultation and engagement.

While various cultural heritage investigations have been undertaken across the entire area at various times, the proponent is of the view that there are some areas within the ACHMP area that require a range of supplementary investigations and assessment before any development disturbance could be countenanced. These investigations are required for the reasons given below.

- Although investigations undertaken prior to 2006 were of a quality consistent with standard practice during this period, when measured against current best practice they are not sufficiently comprehensive in their coverage.
- Older Aboriginal cultural heritage site locational data was collected prior to well-developed methodologies involving the use of Global Positioning Systems (GPS) and GIS, which creates several issues arising that have significant implications in reconciling data included in various maps and in various tables in previous reports, and between these data and that held in relevant Aboriginal Heritage Information Management System (AHIMS) databases.
- There is a need to provide an opportunity for relevant Registered Aboriginal Parties to examine various lands within and adjacent to the development area and any cultural heritage sites identified to inform consultation and decision making for the management of these sites.

- A narrow definition of Aboriginal cultural heritage was adopted in previous studies which had a distinct material dimension. Additional investigations will afford the opportunity to ensure that a more inclusive view of the cultural heritage values of the area can be generated.

With these points in mind, and the agreed ACHMP for the approved disturbance area in place, any portions of this area required for future development and not yet subject to comprehensive pedestrian assessment will be surveyed, and any Aboriginal cultural heritage sites recorded managed in accordance with the provisions of the ACHMP.

iii Recorded Aboriginal cultural heritage sites

The management and mitigation strategies for the Aboriginal cultural heritage sites within the approved disturbance area are outlined within the approved ACHMP. Detailed measures for each specific site type have been agreed with the Aboriginal community and applied when disturbance of Aboriginal cultural heritage sites is unavoidable.

Any newly identified Aboriginal cultural heritage sites recorded as a result of any future assessments will be protected with an initial 20m buffer (where physically possible to do so) around the site until Coal & Allied and the Aboriginal stakeholders through the CHWG, have agreed on the site type, extent and the management measure/s most appropriate to manage the site as detailed within the ACHMP. Once the site type, extent and the management measure/s have been determined, all newly identified Aboriginal cultural heritage sites will be physically protected by the implementation of the fencing and barricading procedures specified in the ACHMP. An OEH AHIMS site card will be completed and submitted to OEH for each newly identified Aboriginal cultural heritage site or aggregation of sites.

14.2.2 Historic heritage

The management of historic heritage associated with the proposed modification activities has been assessed and approved under the existing project approval (PA 06_0261). The historic heritage study methodology for the ERM (2008) EA involved:

- a review of assessments previously undertaken within and surrounding the project area;
- database searches of all relevant local, regional, state and national heritage registers;
- documentation of sites identified during surveys and site inspections; and
- a review of existing management measures to identify additional measures required as a result of the potential impacts from the project.

This heritage study assessment and research confirmed that historic heritage features do exist within and surrounding the project area. However, all identified historic heritage features are outside of the approved disturbance area and will not be affected by the project.

The heritage study concluded that the identified historic heritage features will remain unaffected by the project through the implementation of existing management measures.

14.3 Impact assessment

14.3.1 Aboriginal cultural heritage

The proposed modification does not change the approved disturbance footprint which is encompassed by the ACHMP. It is considered that the impacts on Aboriginal cultural heritage sites, objects and values potentially posed by the proposed modification have already been assessed and management, mitigation and additional investigation strategies settled with the Aboriginal community and endorsed by the regulator.

The proposed modification will have no additional impact on Aboriginal cultural heritage sites than the existing approved activities. The approved ACHMP will remain the key instrument by which Aboriginal cultural heritage will be managed within the project area.

14.3.2 Historic heritage

The proposed modification does not change the approved disturbance footprint. It is considered that the impacts on historic heritage sites, items and features potentially posed by the proposed modification have already been assessed and management strategies are in place and endorsed by the regulator. The proposed modification will have no additional impact on historic heritage features than those already approved.

14.4 Management and monitoring

14.4.1 Aboriginal cultural heritage

Aboriginal cultural heritage management is, and will continue to be, undertaken in accordance with the approved ACHMP, the Coal & Allied Cultural Heritage Management System (CHMS) and relevant legislative requirements. As previously stated, the ACHMP was prepared in consultation with OEH (formerly EPA) and to the satisfaction of the Director-General (now Secretary) of DP&E.

Specific management principles have been developed in a manner consistent with the existing project approval (PA 06_0261) with respect to Aboriginal cultural heritage for those areas within the project area in accordance with Rio Tinto Coal Australia's cultural heritage management standards and policies, and in consultation with the Aboriginal community through the auspices of the CHWG.

14.4.2 Historic heritage

Historic heritage management is, and will continue to be, undertaken in accordance with the requirements of the existing project approval (PA 06_0261). No additional measures are required due to the proposed modification.

14.5 Conclusions

The proposed modification does not change the State-approved disturbance footprint. Therefore, the proposed modification will have no additional impacts on Aboriginal cultural heritage or historic heritage other than those approved for the existing operations. Management of cultural heritage will continue to be implemented in conformance with the ACHMP and Coal & Allied CHMS.

15 Socio-economic

15.1 Introduction

This chapter describes the existing socio-economic environment and considers the key changes that are likely to result, either directly or indirectly, from the proposed modification.

The proposed modification seeks to optimise the existing operations by mining deeper and at a higher maximum extraction rate. No changes to the disturbance footprint, levels of direct employment or the project approval period are proposed. Therefore, the potential socio-economic impacts relate to changes in indirect employment, economic benefits from increased production, and social amenity.

The assessment of the socio-economic impacts of the proposed modification was undertaken with reference to previous assessments undertaken for the ERM (2008) EA and the latest Australian Bureau of Statistics (ABS) census data from 2011.

15.2 Existing environment

15.2.1 Community profile

HVO South is situated in the Singleton LGA, approximately 200km north-west of Sydney and 80km west of Newcastle (the largest city in the region). The Singleton LGA covers an area of approximately 4,893km^2 and includes the town of Singleton, the villages of Jerrys Plains, Maison Dieu and Warkworth and smaller surrounding communities.

The population of Singleton LGA in 2011 was 22,694. Between 2006 and 2011, population growth in Singleton LGA was 3.5 per cent compared to growth in NSW of 5.6 per cent. Singleton LGA has a slightly higher proportion of males (51 per cent) and Indigenous persons (3.7 per cent) in the region when compared to NSW (49 per cent and 2.5 per cent, respectively). There are more young people aged 5 to 14 years, 15 to 24 years, and working adults aged 25 to 54 years residing in the Singleton LGA relative to the NSW average. Since 2006, Singleton LGA has experienced a 20 per cent decline in the 5 to 14 year age group and increases in the 20 to 29 year age group. This is likely through in-migration associated with the mining workforce.

The Hunter Region is currently underpinned by the key industries of coal mining; agriculture (particularly dairy, beef cattle, vegetable growing and pasture production) and associated service industries; horse breeding; power generation; tourism; viticulture and wine making; and defence. Mining is the dominant industry of employment, representing up to 22 per cent of the workforce in Singleton LGA. Personal and business incomes in Singleton LGA increased between 2006 and 2011, at a greater rate than for NSW as a whole, in conjunction with mining investment. While not evident in these 2011 figures, the slowing of the coal mining sector is starting to impact the regional economy and the labour market. Recent job losses have also occurred in the wider industry, with approximately 2,200 direct mining jobs lost in the Hunter Valley since 2013, and the expected loss of approximately 1,000 jobs in the Hunter Valley and surrounding regions in 2016.

Education attainment levels are generally below the NSW average. Data from the 2011 Census (ABS) shows that Year 12 completion rates increased but remained well below the state average, with the gap between the area and the state widening between 2006 and 2011. Year 12 completion rates among younger residents (aged 18 to 24) declined slightly related to the availability of work and other training options in the mining industry. Education continues to be identified by HVRF (2013) as a critical part of the future sustainability of the area, particularly given the growth in knowledge-based employment nationally and the likelihood of declining mining industry employment over the long-term.

There is a predominance of separate houses, as opposed to semi-detached and unit housing within Singleton LGA. There is also a higher proportion of dwellings being purchased and a lower proportion being rented compared to NSW as a whole. The proportion of occupied private dwellings generally reflects the NSW average. Median mortgage repayments were higher than the NSW average. Between 2006 and 2011, mortgage repayments also increased more rapidly than across NSW. Over the last five years, the regional residential housing market has outperformed NSW benchmarks and those for comparable regions in Sydney and Wollongong. Rental price growth for three-bedroom houses slowed markedly in 2015. At the same time, indications are that vacancy rates have increased. Anecdotally, this trend has accelerated with the slowing of the mining industry and a large number of dwellings are for sale or are available for rent.

There has been substantial infrastructure investment with most major projects associated with mining and related rail and port infrastructure, particularly the Hunter Valley Coal Chain (HVRF 2013). While the bulk of this expenditure flows out the region, the stimulatory effect on local employment and business is evident, reflecting a robust regional economy to 2015. The $1.7 billion 40km long Hunter Expressway between Newcastle and the Upper Hunter opened in March 2013 and provides improved access between these areas. More recently, the Hexham Train Support Facility near the Port of Newcastle opened in October 2015 to provide support to the coal supply chain and alleviate capacity pressures.

15.2.2 Community engagement and investment

The Coal & Allied Community Relations programme manages and supports relationships with a range of stakeholder groups across HVO and MTW, including: community groups; near neighbours; Aboriginal community and groups; government (particularly local government); education sector; industry and business associations; non-government organisations including research institutions, strategic community partners; and, to some extent, media and local suppliers.

Current community activities and programmes are summarised below.

- Consultation and engagement: near neighbour engagement programme (including one-on-one and group events); council engagement; business community and industry forum engagement; schools engagement; community events; Aboriginal community engagement; HVO Community Consultative Committee.

- Community development: initiatives include the Community Development Fund (CDF) and the Site Donations Committee. The CDF was initiated in 1999. In 2014, Coal & Allied announced the continuation of the CDF. Current community contribution commitments for the period between January 2015 and December 2017 are approximately $4 million.

- Communications: key communications are undertaken and maintained through the Coal & Allied' Information Line; website and email; newspaper advertorials, factsheets and media; site tours/open days; internal communication, input into external monitoring and compliance activities; regular CCC meetings and other forums/groups.

15.2.3 Existing socio-economic benefits

The socio-economic assessment for the ERM (2008) Environmental Assessment undertaken for the existing project approval concluded that the project will ensure that mining operations continue until at least 2028 and that the additional resource will ultimately provide a benefit to the local and regional community by:

- ensuring ongoing employment in the mining sector across HVO;
- increasing employment by 795 individuals through direct, indirect and induced employment effects;
- existing community engagement and investment would continue;
- additional sales revenue and revenue; and
- significant flow-on effects into the regional, state and national economy.

Further, the assessment found that the direct economic benefits of HVO South and the flow-on effects into the local, regional and national economies are significant with approximately 21 per cent of all revenue to be paid in the form of taxes and royalties. Therefore, the continued operation of the mine is considered to be important to the ongoing economic development of the region.

15.3 Impact assessment

15.3.1 Social amenity

HVO South's existing social amenity impacts will continue under the proposed modification. Assessments of the proposed modification's amenity impacts (such as noise, vibration, air quality, and visual) are described in the corresponding chapters of this document.

In summary:

- noise and vibration:
    - The proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from neighbouring mine operations.
    - The proposed modification is predicted to have significant impact on one property (remaining residence in Warkworth village, ie location 77) with noise levels greater than 5dB above PSNL. This residence is currently entitled to mitigation within the project approval (PA 06_0261) and entitled to voluntary acquisition due to impacts from other neighbouring mining operations (ie Wambo Mine and Warkworth Mine).

- The proposed modification is predicted to have moderate impacts on twelve additional properties with noise levels 3-5dB above PSNL (contributing more than 1dB to the total industrial noise level). Eight of these properties are west of the proposed modification on Jerrys Plains Road and the remaining four are east in Maison Dieu. According to VLAMP these properties would be entitled to treatment measures such as upgraded façade elements like windows, door, roof insulation to further increase the ability of the building facade to reduce noise levels. It should be noted that of the eight properties on Jerrys Plains Road, six would be afforded acquisition rights and the remaining two would be afforded mitigation rights due to the United Wambo Project, should it be approved.

- The proposed modification is predicted to have negligible impacts on four additional properties with noise levels 0-2dB above PSNL. Three of these properties are west of the proposed modification and one to the east. Noise exceedances would not be discernible by the average listener and, therefore, would not warrant receiver based treatments or controls.

- No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

  The parcel of vacant land already afforded voluntary acquisition rights upon request within the project approval (PA 06_0261) (refer to Section 7.2.1) does not meet the vacant land criteria specified within VLAMP as construction of a dwelling is not permissible under existing planning controls. The VLAMP is unclear on its application to vacant land parcels with existing voluntary acquisition rights where construction of a dwelling is not permissible under existing planning controls and the extinguishment of those voluntary acquisition rights based on the most recent technical assessments.

- The Mining SEPP (clause 12AB(3)) non-discretionary standard for acceptable night-time (ie amenity) criterion of 40dB $LA_{eq,9hour}$ is met at all but one assessment location. This location (location 77) is in Warkworth village and already entitled to voluntary acquisition due to operations at Wambo Mine (refer to Condition 3 of Schedule 3 of the project approval (PA 06_0261)). HVO South's contribution at this location is predicted to be between one and four per cent of all expected noise levels.

- The Mining SEPP (clauses 12AB(5) and (6)) non-discretionary standards for acceptable air-blast overpressure and ground vibration, respectively, are predicted to be satisfied at all privately owned residences.

- air quality:

  - The proposed modification satisfies the Mining SEPP non-discretionary standards for privately dwellings not already entitled to acquisition from neighbouring mine operations; and

  - Under the VLAMP, no additional private dwellings are impacted that are not already afforded acquisition rights from neighbouring mine operations as the VLAMP significant impact criteria correspond with the Mining SEPP (clause 12AB(4)) non-discretionary standard with respect to cumulative air quality at private dwellings.

- It should be noted that the proposed modification is predicted to exceed the VLAMP and Mining SEPP PM_{10}, annual average cumulative criteria of 30ug/m^3 at four properties with three within Warkworth village and one south-west of Camberwell village. Two of these three Warkworth properties are non-residences (102 - Warkworth Hall and 264 - St Phillip's Church) and the third Warkworth property (77) is entitled to acquisition upon request from Wambo Mine and Warkworth Mine as noted in Appendix 3 of the project approval (PA 06_0261). The property south-west of Camberwell village (471) is entitled to acquisition upon request from Ashton Coal's South East Open Cut project.

- No additional vacant land parcels are subject to voluntary acquisition under the VLAMP.

- visual:

  - Over the first six years of the modification, moderate impacts are predicted during establishment activities for sensitive receivers to the east in Maison Dieu and Long Point; however, once these activities are completed by the end of Stage 2 or approximately Year 2022, final rehabilitation activities will commence and reduce visual impacts. Overall, the proposed modification will result in a moderate/low visual impact at all viewpoints.

    It should be noted that in the longer term, existing visual amenity impacts are anticipated to be reduced through the incorporation of a more natural landform with micro-relief design incorporated into the post mining landform design.

15.3.2 Socio-economic benefits

The existing socio-economic benefits of HVO South will continue under the proposed modification including:

- ongoing direct and indirect employment and expenditure on local suppliers;

- continued community engagement and investment through the HVO CCC and programmes such as the Coal & Allied Community Development Fund, sponsorships and donations, with current community contributions commitments being approximately $4 million for the period between January 2015 and December 2017; and

- additional direct economic benefits and flow-on economic effects of HVO South with 21 per cent of revenue to be paid in the form of $160 million taxes and $243 million royalties. This proportion is consistent with the ERM (2008) EA.

15.3.3 Community consultation feedback

Throughout the development of the HVO South Modification 5 Environmental Assessment, the proponent undertook consultation with a range of community stakeholders. The engagement programme included:

- one on one discussions with 25 near neighbours;

- presentations to the HVOCCC;

- presentations to Singleton Council;

- development of an interactive, multimedia application (flyover, viewpoints etc) to illustrate the anticipated visual amenity impact of the proposed modification at different stages and final landform;

- community BBQ and information sessions; and

- near neighbour letters and fact sheets distributed to 110 near neighbours.

As outlined in Chapter 5, community feedback primarily focused on concerns relating to amenity, particularly noise, dust and associated impacts on water quality and visual amenity, the type and regularity of engagement with HVO, rehabilitation and final mine design. Near neighbours had a variety of experiences relating to perceived impacts associated with the existing operations and the proposed modification. Key questions related to how HVO will manage noise and dust impacts associated with increasing the height of the emplacement, rehabilitation and opportunities for the use of different trees for screening and post mining land use.

15.4 Management and monitoring

The proponent will continue to implement current management programmes that contribute to the social and economic aspects of the local community. These include community development and consultation programmes as described above and in particular the CDF and Site Donations Committee, the Coal and Allied Local Procurement Policy and ongoing local employment.

Although the technical assessment outcomes of the proposed modification predict a low to moderate impact on amenity (noise, air quality and visual) for local communities, feedback received through community consultation has identified a perceived impact on amenity. This was particularly pertinent for residents of private dwellings with predicted impacts for noise and air quality that were negligible and, accordingly, do not require mitigation in accordance with NSW Government policy (refer to Section 4.3.4.iii). In response to this stakeholder feedback, HVO will establish a Near Neighbour Amenity Resource which will fund works and services to improve amenity for near neighbours. The scope of the programme will be developed in consultation with local stakeholders and will be in addition to the technical mitigation and management measures outlined elsewhere in this EA.

The community will continue to be consulted throughout the life of the project. Feedback received regarding frequency and method of engagement will be used to further improve and update HVO's community engagement programme in 2017.

15.5 Conclusions

HVO contributes significantly to both the local and regional economies. The proposed modification seeks to optimise the existing operations which will enable the mine’s socio-economic benefits to be maintained. This includes sustaining mine employment at current levels and additional direct economic benefits and flow-on economic effects including $243 million in royalties and $160 million in taxes (discounted at 7 per cent).

It does not result in social impacts arising from workforce influx, population change and associated impacts on infrastructure.

The noise and air quality assessments identified that the proposed modification satisfies the non-discretionary standards for privately owned residences not already entitled to acquisition from surrounding mine operations. No additional privately owned parcels of vacant land are predicted to exceed criteria and entitled to acquisition under the proposed modification. The visual assessment of the proposed modification did not identify significant additional impacts on surrounding residences although the proponent recognises there will be a change, particularly for residents in Maison Dieu and, accordingly, has designed the emplacement to minimise these impacts. In recognition of the change to be experienced by near neighbours, HVO will also establish a Near Neighbour Amenity Resource to fund discretionary mitigation works and services to improve amenity for near neighbours.

16 Statement of commitments

16.1 Introduction

This chapter provides commitments made to negate or minimise potential environmental impacts arising from the proposed modification.

Environmental management will continue in accordance with the processes and procedures outlined in Section 3.1.4. Section 16.2 reproduces the Statement of Commitments from Appendix C of the project approval (PA 06_0261), as modified, with commitments specific to the proposed modification shown in green.

These revisions relate exclusively to changes resulting from the proposed modification, including removing those commitments that are now redundant or inconsistent with measures prescribed in approved management plans and contemporising naming conventions where relevant.

16.2 Updated statement of commitments

General

Coal & Allied will:

- carry out the proposal generally in accordance with the systems, plans and mitigation measures identified throughout this Environmental Assessment Report;
- bring any matters that arise and require further assessment by the Secretary to the Secretary's attention and will comply with all requirements received; and
- obtain and maintain all permits, licences and approvals required throughout the life of the project that are not incorporated into the Part 3A Project Approval. This Statement of Commitments does not replace any obligations Coal & Allied has under these statutory requirements.

All works will be undertaken in accordance with the relevant Australian Standards where these standards do not conflict with specific legislative or safety requirements.

Standards may include but not be restricted to the latest versions of:

- *AS 2601-2001: The Demolition of Structures; and*
- *AS1940 - The Storage and Handling of Flammable and Combustible Liquids.*

Environmental Management Systems

The EMS has been developed and implemented in accordance with ISO14001.

This EMS will continue to be applied to the activities undertaken as part of the HVO South Coal Project.

Management Measures

Community Consultation

The existing consultation programmes will continue to be undertaken to ensure any specific outcomes from the environmental assessment are included into the relevant programmes as required. The community consultation specific to the proposal will continue throughout the project, from submission through to government decision and implementation of commitments. Ongoing communication techniques utilised by Coal & Allied (Table 6.1) will be implemented as appropriate.

Noise

In addition to the mitigation measures undertaken at HVO for noise, the following controls specific to the proposal will be implemented:

- equipment operation within South Lemington Pit 1 and associated truck movements will cease during night time operations if monitoring identifies unacceptable noise impacts will result from south westerly winds (occurring at or above 2.1 m/s). At lower wind speeds, real-time noise and/or weather monitoring will be used to guide modifications to operations as required.

- noise limits that will apply to the proposal are detailed in Table 7.1.

~~**Table 22.1 Noise Limits Applicable to Proposal, dB(A)**~~

~~New ID*~~	~~Old ID (project approval)~~	~~Location~~	~~Day Limits~~	~~Evening Limits~~	~~Night Limits~~	
			~~$L_{Aeq(15\ min)}$~~	~~$L_{Aeq(15\ min)}$~~	~~$L_{Aeq(15\ min)}$~~	~~$L_{1(1min)}$~~
~~311~~	~~3~~	~~Elisnore~~	~~38~~	~~38~~	~~38~~	~~45~~
	~~38~~	~~Muller~~	~~38~~	~~38~~	~~38~~	~~48~~
~~160~~	~~5~~	~~Bowman~~	~~39~~	~~39~~	~~41~~	~~46~~
	~~7~~	~~Stapleton1~~	~~N/A~~	~~N/A~~	~~N/A~~	~~45~~
	~~8~~	~~Holz (Oaklands)2~~	~~N/A~~	~~N/A~~	~~N/A~~	~~45~~
	~~10~~	~~Moses (Wandewoi)1~~	~~N/A~~	~~N/A~~	~~N/A~~	~~45~~
~~379~~	~~13~~	~~Jerry Plains Centre~~	~~38~~	~~38~~	~~38~~	~~45~~
	~~16~~	~~Algie~~	~~39~~	~~39~~	~~42~~	~~46~~
	~~17~~	~~Algie~~	~~39~~	~~39~~	~~40~~	~~46~~
	~~19~~	~~Birralee Feeds Pty Ltd~~	~~38~~	~~38~~	~~38~~	~~45~~
	~~23~~	~~Hawkes1 (Springwood)~~	~~N/A~~	~~N/A~~	~~N/A~~	~~46~~
~~124~~	~~24~~	~~Clifton & Edwards~~	~~39~~	~~39~~	~~39~~	~~46~~
~~308~~	~~31~~	~~Copper (Kilburnie)~~	~~39~~	~~39~~	~~39~~	~~49~~
	~~32~~	~~Algie (Curlewis)~~	~~39~~	~~39~~	~~42~~	~~46~~
	~~33~~	~~Edward & Haynes2~~	~~N/A~~	~~N/A~~	~~N/A~~	~~46~~
~~121~~	~~34~~	~~Ernst~~	~~39~~	~~39~~	~~40~~	~~46~~
~~309~~	~~36~~	~~Garland~~	~~48~~	~~48~~	~~48~~	~~45~~
	~~38~~	~~Henderson1~~	~~N/A~~	~~N/A~~	~~N/A~~	~~46~~
	~~43~~	~~Kannar2~~	~~N/A~~	~~N/A~~	~~N/A~~	~~46~~
~~77~~	~~45~~	~~Kelly~~[~~a~~]	~~N/A~~	~~N/A~~	~~N/A~~	~~46~~

~~**Table 22.1 Noise Limits Applicable to Proposal, dB(A)**~~

~~New ID*~~	~~Old ID (project approval)~~	~~Location~~	~~Day Limits~~	~~Evening Limits~~	~~Night Limits~~	
			~~$L_{Aeq(15\ min)}$~~	~~$L_{Aeq(15\ min)}$~~	~~$L_{Aeq(15\ min)}$~~	~~$L_{1(1min)}$~~
~~256~~	~~47~~	~~Moxey~~	~~39~~	~~39~~	~~41~~	~~46~~
~~161~~	~~61~~	~~Shearer~~	~~39~~	~~39~~	~~41~~	~~46~~

~~** Coal & Allied has updated the individual IDs for assessment locations for their operations in the Hunter Valley.*~~

~~*1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.*~~

~~*2. These residences are owned by mining companies other than CNA.*~~

~~*General:*~~

- ~~*Daytime (between 7am and 6pm); evening (between 6pm and 10pm); and night time (between 10pm and 7am).*~~
- ~~*The noise emission limits above apply for winds up to 3 m/s (at a height of 10 m) and temperature gradients up to 4 degrees Celsius per 100 m.*~~
- ~~*If there is a valid private amenity agreement with any property owners these criteria may be exceeded.*~~
- ~~*Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.*~~
- ~~*Location No. is consistent with the HVO West Pit consent (DA 450-10-2003).*~~

Table 7.1 Noise impact assessment criteria

Locality	Descriptor	New ID	PA ID	Noise limits, dB			
				Day/Evening/Night $L_{Aeq,15minutes}$			Night $L_{A1,1minute}$
				Day	Evening	Night	
-	Hunter Valley Gliding Club (when in use) [2,3]	-	-	55 (when in use)			-
Warkworth							
	Kelly	77[1]	45	43	43	43	45
All other privately-owned residence in Warkworth village	-	-	-	43	43	43	45
Warkworth Hall[4]	-	102	-	65 (when in use)			-
St Phillips Church[4]	-	264	-	40 (internal, when in use)			-
Maison Dieu	Shearers Lane	160[1], 161, 162, 163, 256, 258, 260, 261	5, 61, n/a, n/a, 47, n/a, n/a, n/a	41	41	41	45
Maison Dieu	-	121[1], 123	34, 50	40	40	40	45
	Within 250m of 24	120, 122, 124[1]	n/a, 56, 24	39	39	39	45
Maison Dieu	Within 1km of Shearers Lane, not otherwise listed in this table	244, 245, 246, 247	n/a	37	37	37	45
Maison Dieu (north)	-	471 and 472	n/a	41	41	41	45
Jerrys Plains	Smith	309	36	36	36	36	45
All other privately owned residences				35	35	35	45

Notes: 1. PA 06_0261 nominates at Table 4 land subject to additional mitigation upon request and includes location 77, 121, 124 and 160.

2. Noise impacts at HVGC are to be assessed in the immediate vicinity of its residential facilities and/or clubhouse. Noise impact

assessment limits are only applicable during times of use that have been notified by Hunter Valley Gliding Club (HVGC) to the proponent.

3. As required by Conditions 47 to 49 of Schedule 3 of the project approval (PA 06_0261), Coal & Allied has an agreement in place with the HVGC and prepared an Amenity Management Plan in consultation with the HVGC.

4. Noise criteria were not specifically included in the PA and hence are derived as per the INP amenity criteria (ie $L_{Aeq,period}$) for a commercial receiver and place of worship for the hall and St Phillip's Church, respectively. In reality, the resulting noise level will be the lowest criteria achievable by the proposal in this locality (eg if the 40 dB internal criteria for the church is achieved, this will be the noise level exposure of the hall also, given their proximity to one another).

Blast and Vibration

~~In addition to the mitigation measures undertaken at HVO for blast and vibration management, blasts will be designed to minimise impacts on neighbouring mine ventilation structures and minimise the potential for fracture development along pit walls to assist with pit wall stability:~~

- ~~blast vibration will be managed through design and modelling;~~
- ~~bench heights will be managed to not significantly exceed 15 m;~~
- ~~no throw blasts will take place adjacent to final walls;~~
- ~~high density explosives will be toe loaded;~~
- ~~blast monitoring and post blast analysis where required;~~
- ~~presplit blasting will be implemented on final walls where this indicates improved wall conditions; and~~
- ~~visual monitoring by way of regular highwall and pit inspections will be undertaken.~~

The HVO BMP will be updated to include the following blast scheduling procedures:

- 4 – 7 days in advance of blasting – scheduling undertaken in consideration of forecast meteorological conditions (use of publically available forecast information);
- 1 – 3 days in advance of blasting – site-specific blast plume predictions and updated weather forecast information is used to refine the blast schedule, taking account of a range of factors such as shot size and location, requirement for closure of public roads, and risk-assessed likelihood of dust / fume associated with the blast;
- morning of the planned blast – site-specific blast plume predictions are used to determine the optimum time for firing; and
- approaching blast detonation – review of the blasting permissions page for the appropriate pit area which considers wind speed and wind direction relative to sensitive receptors and public roads.

Air Quality

In addition to the mitigation measures undertaken at HVO for air quality management, efficient mine planning and operations will ensure:

- the mine plan is regularly reviewed with a view to controlling dust emissions and keeping emissions to the lowest levels practicable;
- exposed areas are kept to the minimum practicable; and

- haul roads are kept to the shortest routes practicable and material handling is kept to the minimum levels practicable.

Groundwater

In addition to the mitigation measures undertaken at HVO for groundwater management, the following controls specific to the proposal will be implemented:

Groundwater Flow To and From Rivers:

- development of protocols for monitoring and reporting of DPI Water stream gauge results to clearly record any reductions in flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the site. In addition, consideration will be given to tying in specific Coal & Allied water level recordings with current DPI Water gauging locations;

- monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit; and

- measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and

- offset seepage to pits in accordance with regulatory requirements.

Regional Groundwater Drawdown:

- the HVO River Red Gum Rehabilitat*ion* and Restoration Strategy and Coal & Allied EMS procedure for Flora and Fauna will be updated to reflect changes resulting from the proposal. This will include monitoring the health of the River Red Gums located on the Hunter River and Wollombi Brook alluvium as identified in Chapter 11 (Figure 11.2) of the ERM (2008) EA. The monitoring programme will include details on frequency of monitoring, reporting and corrective actions; and

- up to three monitoring wells will be installed in the proximity of the cluster of registered Coal & Allied bores located to the east of the LCPP (Figure 25 Annex J of the ERM (2008) EA). Data will be used to compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented.

Alluvial Buffer Zone:

- a buffer zone of 100m will be retained from the Cheshunt Pit highwall to the edge of alluvium of the Hunter River;

- a buffer zone of 150m will be retained from the South Lemington Pit 2 highwall to the edge of alluvium of the Wollombi Brook;

- bores will be installed to further delineate the saturated zone between the Hunter River and the Cheshunt Pit before mining commences within this area; and

- the groundwater component of the HVO Water Management Manual will include procedures for monitoring potential impacts, including accurately measuring seepage to pits throughout mining and assessment of proximity to alluvials as mining approaches.

~~*Deep Cheshunt Pit*~~ *Final Void:*

- the ~~Deep Cheshunt Pit~~ final void will be designed to intercept leachate from overburden emplacements and minimise discharge of saline groundwater. ~~Deep Cheshunt Pit~~ Final void design will be reviewed at least three years prior to anticipated mine closure;

- ~~the Deep Cheshunt Pit Final Void Management Plan will include future use options including investigation of feasibility to use the Deep Cheshunt Pit final void as a water storage that could be used as a buffer in times of flood flows in the Hunter River and as a supplementary water supply at times of scarce water supply. This would include additional investigations to refine predictions of final void water chemistry;~~

- a post closure monitoring programme will be developed as part of the ~~Deep Cheshunt Pit~~ Final Void Management Plan for water quality monitoring of the final void; and

- the mine plan will be further reviewed with a view to minimise the area of the ~~Deep Cheshunt Pit~~ final void as much as practicable.

Surface Water

In addition to the mitigation measures undertaken at HVO for surface water management, the following controls specific to the proposal will be implemented.

Water Supply:

- modify Water Access Licences, review conditions and report on water use in the AEMR;

- monitor and record abstraction quantities;

- increase pump capacity from Dam 20S (or alternative storage) to the LCPP and undertake minor improvements to the existing HVO South water system in conjunction with the design of the LCPP to minimise need to pump from Hunter River Water Discharge; and

- review current discharge conditions in respect of the proposal and incorporate where applicable into the Water Management Manual.

Flood Mitigation:

- construct South Lemington Pit 2 Levee (SLP2) as a permanent levee and ensure the outer face of the levee will withstand 100-year ARI flood flow velocities; and

- assess Hobden Gully levee (CL1) prior to mine closure to determine if protection of the Deep Cheshunt Pit final void is required.

~~*Erosion and Sediment Control:*~~

- ~~erosion and sediment control structures will remain in place to divert water away from the Deep Cheshunt Pit final void unless required for use as flood flow storage.~~

Monitoring and Inspections:

- prior to LCPP and infrastructure construction works review the Surface Water Monitoring Programme, establish additional representative monitoring sites where required and undertake monitoring; and

- annual monitoring of water level and water quality in the ~~Deep Cheshunt Pit~~ final void after mining operations have ceased as part of the post closure monitoring programme. Monitoring will continue in accordance with regulatory requirements.

~~*Management Plans:*~~

- ~~the existing WMP would be reviewed and revised to incorporate the proposed modification including water management protocols and response procedures for the WMS that would be adhered to throughout the operation of the proposed modification;~~

- ~~the site water balance model would continue to be review and progressively refined on a regular basis; and~~

- ~~the Erosion and Sediment Control Plan would be reviewed and updated for the proposed modification.~~

Ecology

In addition to the mitigation measures undertaken at HVO for management of flora and fauna, the following controls specific to the proposal will be implemented:

- the River Red Gum Rehabilitation and Restoration Strategy prepared by Coal & Allied will be updated to include the stands along the Hunter River and Wollombi Brook, will include collection and storage of seed from existing stands, and will ensure the health of these River Red Gums is periodically monitored;

- studies will be undertaken to investigate the preferred water source of River Red Gums and develop appropriate management measures;

- rehabilitation planning will identify opportunities to create similar ecological characteristics (such as habitat types) of proposed extension areas; and

- the Warkworth and Wambo Green Offset areas and the Hunter Valley Synoptic Plan will be considered with rehabilitation planning to enhance linkage where practical.

Aboriginal Heritage

In addition to the mitigation measures undertaken at HVO for management of Aboriginal heritage, the following controls specific to the proposal will be implemented as agreed with the Aboriginal Working Group.

Management Measures for ACHMP HVO South Stage 1 include:

- all management measures will be undertaken in accordance with the Aboriginal Heritage Assessment as outlined in the ACHMP;
- if at a later date it is found necessary to undertake an action that would impact sites described within the Aboriginal cultural heritage assessment, additional and specific management recommendations may be implemented in consultation with the Working Group;
- provision is to be made for the management of collected cultural heritage material;
- provision will be made in the ACHMP for the Working Group to undertake an independent compliance audit of the management programme on a six monthly basis. In the event that any non-compliant activities are identified at any time, an additional compliance audit may be undertaken as part of the investigation process;
- where any mitigation is required it will be undertaken by representatives of the Working Group and suitably qualified technical advisers;
- implement a management programme providing for the controlled collection of the following sites where site avoidance is not possible. Until management measures (which may involve the collection of cultural material) have been implemented, mine-related impacts to the sites will be prevented:
    - Riverview South West Mining Extension Area Sites 1-24;
    - South Lemington Pit 1 Mining Extension Area Sites 59-79;
    - Proposed rail spur and loop easement Sites 80-83;
    - LCPP Sites 101 and 105-106;
- the alignment of the proposed rail spur and loop have been amended to avoid impacts to Sites 26-44, 47-58 and 107-109;
- restricted access zones will be defined for Sites 26-44, 47-58, 84-100, 102-104 and 107-109. The boundaries (Figure 12.3) are indicative only; and
- land management activities on the Archerfield property will avoid any impacts to Site 25.

Management measures to be implemented in accordance with the agreed ACHMP for HVO South Stage 2.

Historic Heritage

In addition to the mitigation measures undertaken at HVO for management of historic heritage, the following action specific to the proposal will be implemented:

- a targeted field assessment will be undertaken by an historic heritage professional where required to supplement existing information to report on the relative significance of the additional sites identified on Coal & Allied land including a derelict bridge structure over an unnamed ephemeral creek and the cockatoo fence and recommend additional management measures.

Visual

In addition to the mitigation measures undertaken at HVO for management of visual amenity, the following action specific to the proposal will be implemented:

- a review of the extension areas that adjoin Jerrys Plains Road and the proposed rail spur and loop easement will be undertaken prior to construction of the rail spur and loop, to determine if additional screening is required.

Traffic and Transport

In addition to the mitigation measures undertaken at HVO for management of traffic and transport, the following action specific to the proposal will be implemented:

- ensure the relocation of Comleroi Road and construction of the rail loop are undertaken in accordance with the relevant regulatory requirements;
- obtain the appropriate approvals, including those required for heavy equipment transfer; and
- ensure relevant stakeholders are consulted as required.

Waste Management

There are no suggested controls for waste management specific to the proposal. It is anticipated the mitigation measures currently implemented at HVO will be sufficient to manage the increase in waste resulting from the proposal.

Land Management

There are no suggested controls for land management that are specific to the proposal. The current mitigation measures implemented at HVO are anticipated to be sufficient to manage any potential impacts from the proposal on land use.

Mine Landscape Planning

In addition to the mitigation measures undertaken at HVO for management of landscape planning, the following actions specific to the proposal will be implemented:

- Remnant vegetation located within the Project Application area and outside proposed disturbance areas will be protected and enhanced to improve the ecological value and biodiversity. In particular, the specific management practices will include:
    - monitoring of remnant vegetation areas in accordance with existing procedures to provide evidence of success of management practices;
    - undertaking bushfire management, weed and pest control in accordance with recommended practices;
    - utilising local native species for seed stock where practical;
    - utilising existing farm dams and retention or establishment of native vegetation around dams to provide habitat; and
    - habitat creation and enhancement for common and threatened species.

- A Final Void Management Plan will be prepared for the ~~Deep Cheshunt Pit~~ final void at least five years prior to completion of mining and will include:
  - identification of possible beneficial uses for the void;
  - consideration of technologies which will assist to enhance the range of possible uses;
  - review of modelling and predictions of long-term hydrological behaviour and water quality responses, including final void water quality and level;
  - long-term integrity of void slopes;
  - waste characterisation and containment as pertains to runoff into final voids;
  - ~~coal seam capping; and~~
  - long-term management, monitoring and mitigation measures.
- Mining in South Lemington Pits will be incorporated into a revised MOP for HVO South, which will supersede all previous MOPs for this area. The management commitments for South Lemington Pit 1 will include highwall stability monitoring, water storage management, minimisation of visual impacts and management of dust emissions and erosion.

The process for designing the landforms across HVO and undertaking progressive rehabilitation with the aim of achieving a final landscape vision will be undertaken in accordance with the HVO Conceptual Landscape and Rehabilitation Management Strategy.

17 Modification justification and conclusion

17.1 Introduction

This chapter considers the suitability of the site, assesses the proposed modification against the objects of the EP&A Act (including ESD principles), and draws conclusions based on the EA.

17.2 Suitability of the site

HVO South is an existing open cut coal mine operating under a variety of approvals including the project approval (PA 06_0261) as modified, MOP, EPL 640 and mining authorities. Due to the long history of operations at HVO, the regional and local social, physical and economic environments are well understood and the site has well established environmental management systems.

The proposed modification will enable the implementation of an efficient and flexible mine plan, providing access to an additional state resource. Approved infrastructure will be used to efficiently extract, process and transport the resource.

The proposed modification will not change the State-approved footprint of disturbance, mining method, employee numbers, integrated tailings and water management across HVO or extend the project approval period.

The potential environmental and social impacts arising from the proposed modification will be largely consistent with approved operations. The design of the proposed modification therefore achieves its objective of development of an economic mine plan that minimises adverse potential environmental and social impacts. It is, therefore, concluded that the site is suitable for the purposes of the proposed modification.

17.3 Objects of the Environmental Planning and Assessment Act 1979

The objects of the EP&A Act are specified in Section 5 of the EP&A Act. An assessment of the proposed modification against the objects is provided below.

(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.

HVO South contains a substantial coal resource supported by existing extensive physical and human infrastructure. The proposed modification will facilitate proper development and the orderly use of this resource, thus promoting social and economic welfare. It will also not compromise the conservation of natural resources. The proposed conceptual final landform and land use were devised with the intention of creating a stable, free draining landform consistent with a post mining land capability which integrates biodiversity enhancement with agricultural practices. The landform aims to reflect the natural features and complement the previously created landforms.

(a)(ii) To encourage the promotion and co-ordination of the orderly and economic use and development of land.

The proposed modification is for the continued development of a natural mineral resource on land within a State-approved disturbance footprint of an existing mine. It will constitute an orderly and economic use of land and the resources contained within it.

(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.

This object is not applicable to the proposed modification.

(a)(iv) To encourage the provision of land for public purposes.

All the elements of the proposed modification will be constructed on privately owned land within the State-approved disturbance footprint of an existing mine.

(a)(v) To encourage the provision and co-ordination of community services and facilities.

The proposed modification enables jobs to be maintained; it does not seek to increase HVO South's workforce nor extend the project approval period. Accordingly, there is unlikely to be any demand for additional community services. Ongoing operations will enable continued support of the community through initiatives such as the Coal & Allied CDF. Should the proposed modification be approved additional royalties generated by the continued operation of HVO South (estimated to be around $243 million in net present value (NPV) terms) will go to State revenue to provide for community services and facilities.

(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.

All the elements of the proposed modification will be constructed within the State-approved disturbance footprint of an existing mine. The proposed modification will not require clearing of additional land that would impact on the conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats. The existing environmental management measures will continue to be implemented for the proposed modification and the requirements of the project approval (PA 06_0261) complied with.

(a)(vii) To encourage ecologically sustainable development.

The Commonwealth Government's (1992) *National Strategy for Ecologically Sustainable Development* defines ESD as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

The proposed modification will enhance community resources by providing additional public revenues through royalties and taxes. In this way it will contribute to improvements in the local, State and National economies and contribute to an overall increase in quality of life. Also, the proposed modification will continue to conserve community resources indirectly through effective impact mitigation.

The proposed modification has provided the opportunity to improve the mine plan design resulting in:

- no extension to approved mining disturbance areas and utilisation of the approved disturbance footprint by accessing the deeper coal seams;
- micro-relief being incorporated into overburden emplacement area design with consideration given to sensitive residences to the west (Jerrys Plains), east (Maison Dieu and Long Point) and north-east (Camberwell village) as well as the Hunter Valley Glider Club;
- mining strip alignment to minimise potential noise emissions received at Jerrys Plains;
- an increased distance between the Hunter River and the proposed evaporative basin within the final void;
- the minimisation of surface water catchment area draining to the final void; and
- a reduction in the low-wall slope to enable greater land use optionality within the final void.

The proposed modification will make a negligible contribution to global greenhouse gases (Scope 1 and 2). Less efficient energy production from low quality coal and/or less efficient mining would involve a higher contribution.

The principles of ESD are outlined in Section 6 of the POEO Act and Schedule 2 of the NSW Environmental Planning and Assessment Regulation 2000. The consistency of the proposed modification with each of these principles is discussed below.

Precautionary Principle: in practice this means that development should not cause serious or irreversible environmental impact. Such impacts can be avoided through the understanding of potential environmental impacts by undertaking a full environmental assessment, and incorporating effective mitigation or compensation measures into development proposals.

Avoidance was applied as a guiding principle for the proposed modification's development wherever possible. As detailed in Chapter 3, a number of design options were considered for the proposed modification, with the preferred option chosen to provide an appropriate balance between environmental, social and economic impacts and development of an efficient and flexible mine plan.

The mine has been operating for many years meaning that the surrounding physical environment is well understood and extensive baseline data has been collected. The environmental assessment of the proposed modification and the supporting technical studies were prepared by industry leading specialists and based on conservative assumptions ensuring that potential worst case impacts are determined. These assumptions are discussed in the respective technical studies. Monitoring at HVO South has verified that actual impacts are within the conservative predictions of previous assessments. The principles of ESD require such impacts to be balanced against humanity's needs, including for energy and material well-being.

The proponent has committed to measures to prevent or minimise potential adverse environmental impacts from the proposed modification. A range of environmental management plans are implemented at HVO South which have been prepared in consultation with relevant government agencies and are regularly reviewed and revised as required. These plans include contingencies to manage any unpredicted impact and their consequence. Any residual impacts will be balanced against the provision of a cost effective and efficient means of energy generation which provides for humanity's current and future needs.

For these reasons, the proposed modification is consistent with the precautionary principle.

Social equity including intergenerational equity: the proposed modification contributes to social equity by providing a viable operation that will allow for continued direct and indirect employment.

The proposed modification will enable the additional extraction of approximately 56.8Mt of ROM coal over the remaining project approval period within the existing State-approved disturbance footprint. It will be efficiently extracted, processed and transported to market.

The extraction, processing and transportation of the resource can be efficiently achieved because of the hundreds of millions of dollars invested in the operation and its existing access to product transport and distribution infrastructure such as road, rail and port.

It will result in the efficient development of a geological resource into physical and human capital through investment in infrastructure and workforce training, and, indirectly, through contributions to governments which will enable greater investments in public infrastructure and services.

The assessment of worst case potential residual noise and air quality impacts determined that acquisition criteria will not be exceeded at privately owned residences not already within either HVO South's or a neighbouring mine's existing acquisition zone. No privately owned parcels of vacant land are predicted to exceed criteria and afforded acquisition rights in accordance with the VLAMP for the proposed modification.

The visual impacts of the proposed modification were also assessed. The proposed modification has been assessed as having moderate short to medium term impacts through the longer exposure to establishment activities of some areas within Cheshunt overburden emplacement areas for sensitive receivers east at Maison Dieu (VP1 and VP2). Sensitive receivers further away from the proposed modification in Long Point, Jerrys Plains and Camberwell village were considered to experience moderate/low impacts during these initial final landform height establishment activities. Due to the design considerations having regard for visual amenity through emplacing overburden setback from the existing rehabilitated face of the Cheshunt emplacement visual impacts have been reduced. Existing views of the Wollemi National Park (and associated escarpments from the east will remain as the proposed modification will emplace overburden within the existing disturbance footprint with the majority of height establishment activities within the northern areas of Cheshunt emplacement area rather than to the south.

Further, although the overburden emplacement will be higher in places, the final landform has been designed to look more consistent with natural landforms in the area. That is the final landform has been designed with slopes, undulations, grassland and vegetation that better replicates and assimilates with the natural landscape in the area so that in the longer term sensitive receivers in Maison Dieu and Long Point would have moderate/low impacts from the proposed modification.

In addition to the above, feedback received through community consultation has identified a perceived amenity impact irrespective of the technical assessment outcomes which predict a low to moderate impact on amenity (noise, air quality and visual). In response to this stakeholder feedback, HVO will establish a Near Neighbour Amenity Resource which will fund works and services to improve amenity for near neighbours. The scope of the programme will be developed in consultation with local stakeholders and will be in addition to the technical mitigation and management measures outlined elsewhere in this EA.

Taking all the above matters into account, it is considered that the proposed modification will generally promote social equity including intergenerational equity.

Conservation of biological diversity and maintenance of ecological integrity: the proposed modification is within the State-approved disturbance footprint of an existing mine and will not require clearing of additional land. The mine's existing offset strategy fully meets contemporary government policies and provides a significant ecological benefit in the long-term and, accordingly, will provide for the conservation of biological diversity and maintenance of ecological integrity.

Improved valuation and pricing of environmental resources: the proposed modification will enable the mine to remain economically viable supporting the maintenance of existing jobs. The additional benefits, discounted at 7 per cent, include $243 million in royalties and $160 million in taxes. Therefore, it is considered that the proposed modification assists in the valuation and pricing of environmental resources.

The general conclusion is that the proposed modification is consistent with ESD and its principles.

(a)(viii) To encourage the provision and maintenance of affordable housing.

The proposed modification will allow for the continuation of existing employment and not change employment levels or the approval period that would impact on housing demand. Therefore, this object is not applicable to the proposed modification.

(b) To promote the sharing of the responsibility for environmental planning between the different levels of government in the State.

All relevant State and local government agencies have been consulted during the preparation of the EA. Further consultation will occur during the response to submissions following exhibition and pre-determination phases.

(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.

Stakeholder consultation was undertaken for the proposed modification with feedback received through the consultation process considered in the preparation of the EA (refer to Chapter 5). Public involvement and participation will also be provided through the public exhibition process of this EA where the public will be invited to make submissions on the proposed modification.

17.4 Mining SEPP non-discretionary standards

Clause 12AB of the Mining SEPP sets out a number of non-discretionary development standards in relation to carrying out of development for the purposes of mining. The clause states that if a proposed development for the purposes of mining satisfies a development standard set out in this clause, the consent authority cannot require more onerous standards for those matters but does not prevent the consent authority granting consent even though any such standard is not complied with.

The proposed modification satisfies the non-discretionary standards for privately owned residences not already entitled to acquisition from surrounding mine operations. There are no additional exceedances of cumulative noise levels and air quality due to the proposed modification and airblast overpressure, ground vibration and aquifer interference meet appropriate criteria as summarised in Chapter 4 and detailed in the relevant technical chapters of this EA.

17.5 Conclusion

It is considered that the proposed modification is justified, for the following reasons:

- it will enable the implementation of an efficient and flexible mine plan;
- it will add to the important regional and local economic and social benefits from the mine's operation;
- the site is suitable for the proposed modification given that it is an existing mining operation and there will be no change to the approved disturbance footprint;
- it meets the Mining SEPP's non-discretionary standards for noise and air quality amenity at all privately owned residences not already entitled to acquisition from surrounding mine operations;
- potential environmental and social impacts are largely consistent with those approved under the project approval (PA 06_0261) such that the existing management controls implemented by HVO South require only minor amendments; and
- it is aligned with the principles of ecologically sustainable development, consistent with the contemporary legislative requirements and meets all relevant government policies.

Abbreviations

ABS	Australian Bureau of Statistics
ACARP	Australian Coal Association Research Programme
ACHMP	Aboriginal cultural heritage management plan
ACDF	Aboriginal Community Development Fund
AEP	annual exceedance probability
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHIMS	Aboriginal Heritage Information Management System
AIP	NSW Aquifer Interference Policy
AIS	agricultural impact statement
ANZECC	Australian and New Zealand Environment Conservation Council
ARI	Annual recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AWBM	Australian Water Balance Model
BAM	beta attenuation monitors
BMP	blast management plan
BoM	Bureau of Meteorology
BSAL	biophysical strategic agricultural land
CDF	Community Development Fund
CHMS	Cultural Heritage Management System
CHWG	Cultural Heritage Working Group
CO	carbon monoxide
CRD	Cumulative Rainfall Departure
DECC	Department of Environment and Climate Change
DLWC	NSW Department of Land & Water Conservation
DoE	Commonwealth Department of Environment
DP&E	NSW Department of Planning and Environment
DPI Water	NSW Department of Primary Industries - Water
DRE	Division of Resources and Energy
DSITI	Queensland Department of Science, Information Technology and Innovation
EC	electrical conductivity
EMM	EMM Consulting Pty Limited
EPA	Environment Protection Authority
EPL	environmental protection licence
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
ESD	ecologically sustainable development
GDEs	groundwater dependent ecosystems

GPS	global positioning system
HRSTS	Hunter River Salinity Trading Scheme
HVAS	high volume air sampler
HVO	Hunter Valley Operations
km	kilometre
LCPP	Lemington Coal Preparation Plant
LEP	local environmental plan
LGA	local government area
LP	loading points
Major Development SEPP	State Environmental Planning Policy (Major Development 2005)
ML	Mining Lease
MTW	Mount Thorley Warkworth
MOP	HVO South Mining Operations Plan
Mining Act	*Mining Act 1992*
Mining SEPP	State Environmental Planning Policy (Mining, Petroleum and Extractive Industries 2007
Mtpa	million tonnes per annum
NEPC	National Environment Protection Council
NES	national environmental significance
NEPM 2003	National Environment Protection Measure 2003
NGA	National Greenhouse Accounts
NPV	net present value
NSW	New South Wales
Nox	nitrogen
NO_2	nitrogen dioxide
OLC	overland conveyor
PVZ	Primary View Zone
Part 3A Repeal Act	*Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011* Repeal Act
PoEO Act	NSW *Protection of the Environment Operations Act 1997*
PSNL	Project specific noise level
PRP	Pollution reduction program
RNP	*Road Noise Policy*
ROM	run of mine
RING	Rail Infrastructure Noise Guidelines
SEPP	State Environmental Planning Policy
SEPP33	State Environmental Planning Policy No.33 – Offensive and Hazardous Development
S&RD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State significant development
SRLUP	strategic regional land use plan

TAS	Todoroski Air Sciences
TAPM	The Air Pollution Model
TDS	total dissolved solids
TEOMs	tapered element oscillating microbalances
TSP	total suspended particulates
TSS	total suspended solids
VMP	vibrating wire piezometer
WAL	water access licence
Water Act	*Water Act 1912*
WM Act	*Water Management Act 2000*
WMP	Water Management Plan
WMS	water management system
WQO	water quality objective
WRM	WRM Water and Environment Pty Ltd

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