WAMBO COAL MINE
South Bates Longwall Extension
(DA 305-7-2003 MOD 17)

Environmental Assessment Report
Section 75W of the *Environmental Planning and Assessment Act 1979*

1. BACKGROUND

The Wambo Coal Mine is located in the Hunter Valley about 15 kilometres (km) west of Singleton, near the village of Warkworth. The mine is bounded by several coal mining operations to the north and east, agricultural activities associated with Wambo Creek and Wollombi Brook to the south and Wollemi National Park to the southwest (see **Figure 1**).

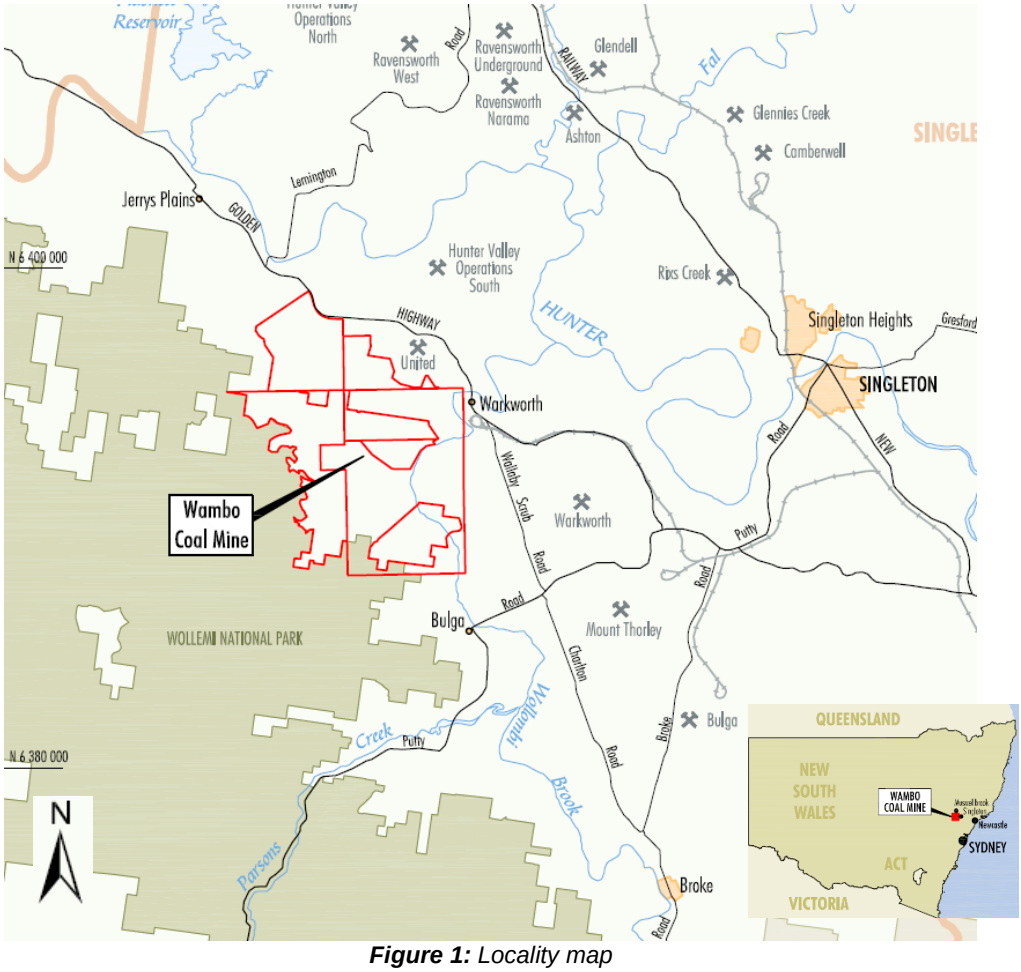
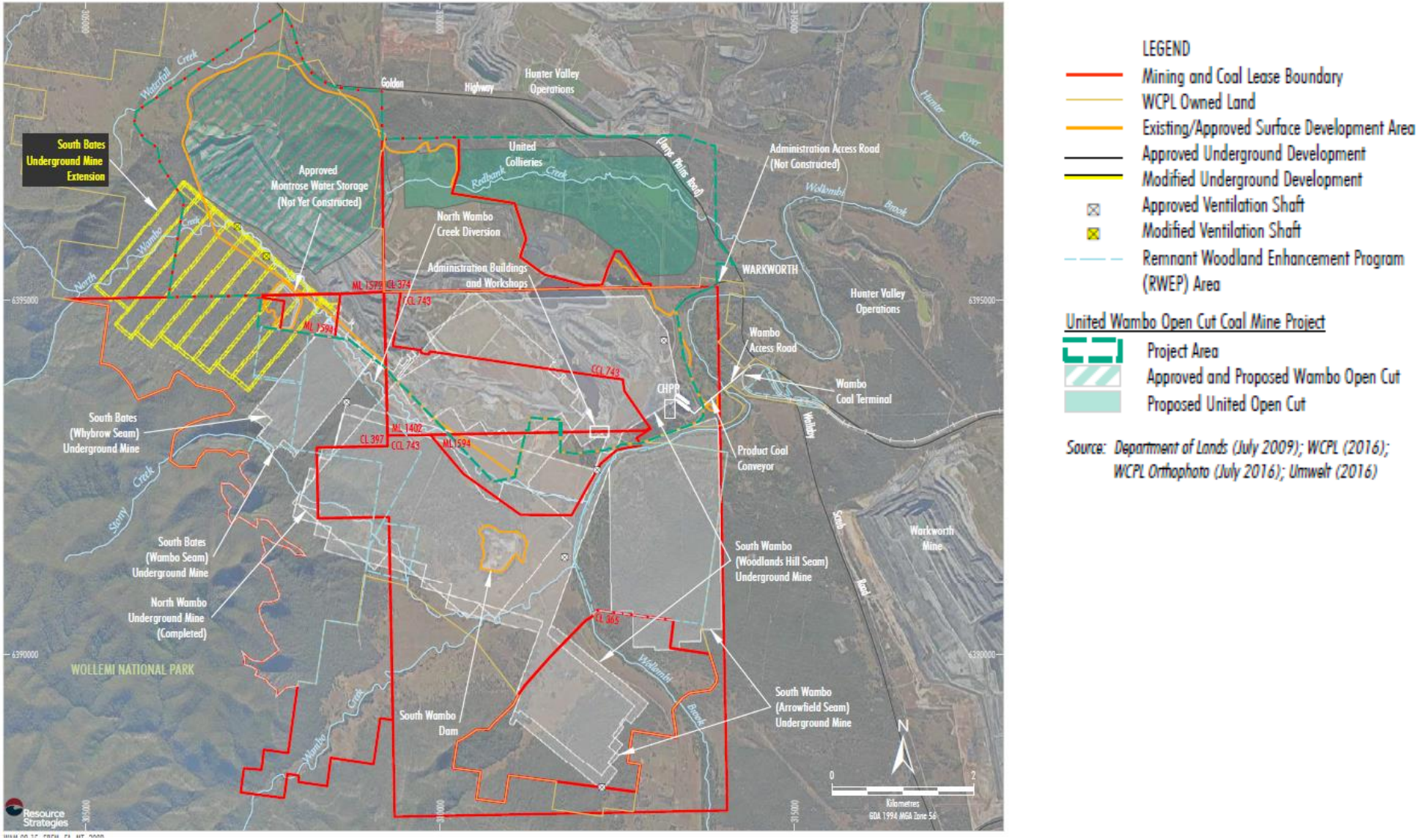


Figure 1: *Locality map*

The mine originally commenced operations in 1969 and is currently operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy. The operations currently involve the Wambo open cut, multi-seam longwall mining in the South Bates Underground Mine (Whybrow Seam) (Longwalls 11 to 13), progressing to the Wambo Seam (Longwalls 14 - 16) and South Wambo Underground Mine (see **Figure 2**).



LEGEND

- Mining and Coal Lease Boundary
- WCPL Owned Land
- Existing/Approved Surface Development Area
- Approved Underground Development
- Modified Underground Development
- Approved Ventilation Shaft
- Modified Ventilation Shaft
- Remnant Woodland Enhancement Program (RWEP) Area

United Wambo Open Cut Coal Mine Project

- Project Area
- Approved and Proposed Wambo Open Cut
- Proposed United Open Cut

Source: *Department of Lands (July 2009); WCPL (2016); WCPL Orthophoto (July 2016); Umwelt (2016)*

Figure 2: *Existing and proposed layout of Wambo Coal Mine*

Current operations at the mine are controlled by two Ministerial development consents: one for the open cut, underground mining operations and coal handling and processing plant (CHPP) (DA 305-7-2003, granted on 4 February 2004), and one for the associated rail operations (DA 177-8-2004, granted on 16 December 2004). Under these consents, WCPL is authorised to:

- extract up to 14.7 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal, comprising:
  - up to 8 Mtpa of ROM coal from its open cut mining operations; and
  - up to 9.75 Mtpa of ROM coal from its underground mining operations;
- process this ROM coal at its on-site coal handling and processing plant; and
- transport up to 15 Mtpa of product coal from the mine via rail.

Table 1 provides a summary of the existing approved mining areas at the Wambo Coal Mine.

Table 1: *Approved mining areas at the Wambo Coal Mine*

Mining area	***Coal seam/s***	***Operational status***
North Wambo Underground	Wambo Seam	Completed
South Bates Underground	Wambo and Whybrow Seams	Currently active, anticipated to commence mining of the Wambo seam in June 2017.
South Wambo Underground	Arrowfield Seam and Woodlands Hill Seams	Commencement on completion of South Bates Underground.
Open Cut	Whybrow, Redbank Creek, Wambo and Whynot Seams	Currently active, however approved open cut mining operations expire in 2020, subject to approval of the United Wambo Open Cut Mine proposal.

A separate development application (SSD 7142) has been submitted by United Collieries Pty Ltd for the United Wambo Open Cut Coal Mine Project. This project involves a joint venture project between United Collieries and WCPL to integrate the existing Wambo open cut with a proposed open cut mine at the adjacent United Mine site (see **Figure 2**).

The United Wambo project would involve extraction of an additional 150 million tonnes (Mt) of ROM coal over approximately 23 years and proposes a number of changes to the layout of existing public infrastructure, including relocation of both a 2 km section of the Golden Highway and sections of 66 kV and 330 kV powerlines. Modification applications have also been lodged in conjunction with SSD 7142 to extend the life of both the Wambo train loading facility under DA 177-8-2004 (MOD 3) and the open cut operations under DA 305-7-2003 (MOD 16). The United Wambo project is not seeking to modify underground mining operations at Wambo Coal Mine authorised under DA 305-7-2003. Generally, WCPL has assumed approval of the United Wambo project for the purposes of this modification to enable assessment of potential worst-case (i.e. cumulative) scenarios.

2. PROPOSED MODIFICATION

After mining of the Whybrow Seam, WCPL has identified an additional coal resource adjacent to the existing South Bates Mine. WCPL proposes to modify DA 305-7-2003 to develop 9 additional longwalls (LWs 17 - 25) in the Whybrow Seam, recovering an additional 18 Mt of ROM coal, within existing approved annual limits (see **Figure 2**). Processing of this coal is expected to generate 3.7 Mt of coarse rejects and 2.1 Mt of tailings, to be managed within existing tailings storage facilities.

The viability of mining this resource relies on using the mining fleet, infrastructure and workforce already in place at the South Bates Mine. In order to utilise the existing South Bates infrastructure, WCPL proposes to change the current mine scheduling. This would involve delaying mining in the South Wambo Underground Mine until mining of the proposed longwalls at South Bates is completed (see **Table 1**). For this reason, WCPL also proposes to extend the consent's life by 7 years until 2039. This is consistent with the extension sought for the United Wambo project (under MOD 16).

The majority of the proposed longwalls are within WCPL's existing mining tenements (CL 397, ML 1572 and ML 1594). Sections of proposed LWs 23 - 25 are located within an exploration tenement (A 444) but outside of existing mining leases (see **Figure 2**). WCPL requires a new mining lease over this area prior to commencing mining within it.

The modification would require construction and operation of two additional ventilation shafts to support underground mining, one upcast with a fan, the other downcast and not requiring a fan. An existing ventilation fan located in the open cut would be retained to service the proposed longwalls via the access portal. New surface infrastructure to support the ventilation shafts would be required, including roads, fencing, electrical and water management infrastructure.

WCPL anticipates that one or two gas drainage boreholes may be necessary for each gateroad, either side of each longwall. A new centralised gas flaring plant is proposed within the approved surface development area, located next to the upcast ventilation shaft.

WCPL also proposes minor extensions and upgrades to surface facilities within the existing surface development area, including conveyor belts/drives, electrical and communication infrastructure, water and flood management infrastructure, service pipelines and bores.

A comparison of the approved and proposed operations is set out in **Table 2**. A detailed description of the modification is provided in WCPL's Environmental Assessment (EA, see **Appendix A**).

Table 2: *Comparison of approved and proposed operations*

Component	***Approved***	***Proposed***
Life of Mine	• Until 1 March 2032	• Until 31 December 2039 (extension of 7 years)
Open Cut Mining	• Open cut mining operations expire 2020. Mining at a rate of up to 8 Mtpa	• No change
Underground Mining	• Underground mining of up to 9.75 Mtpa of ROM coal from the Whybrow, Wambo, Arrowfield and Woodlands Hill Seams	• Underground mining of up to 9.75 Mtpa • Extension to current South Bates Underground Mine, additional 9 longwalls targeting the Whybrow Seam
Total ROM Coal Production Rate	• Up to 14.7 Mtpa of ROM coal	• No change
Total ROM Coal Mined	• 241.3 Mt	• 259.3 Mt • Additional 18 Mt of ROM coal recovered through 9 additional longwalls
Coal Washing	• CHPP capable of processing approximately 1,800 tonnes per hour	• No change
Product Coal	• Up to 11.3 Mtpa of thermal coal, predominantly for export	• No change
CHPP Coal Reject Management	• Course rejects and tailings would be incorporated, encapsulated and/or capped within open cut voids in accordance with existing management practices	• No change
Total CHPP Coal Rejects	• Approximately 36.6 Mt of coarse rejects and approximately 22.4 Mt of tailings	• An additional 3.7 Mt of coarse rejects and 2.1 Mt of tailings
Surface Facilities	• Construction of surface facilities within the approved surface development area	• Construction of additional surface infrastructure within approved surface development area
Total Waste Rock	• 640 million bank cubic metres	• No change
Waste Rock Management	• Waste rock deposited in open cut voids and in waste rock emplacements adjacent to open cut operations	• No change
Water supply	• Make-up water demand to be met from runoff recovered from tailings storage areas, operational areas, dewatering and licensed extraction from Wollombi Brook and Hunter River	• No change

3. STATUTORY CONTEXT

3.1 Section 75W

DA 305-7-2003 was granted in 2004, under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In accordance with clause 8J(8) of the *Environmental Planning and Assessment Regulation 2000* and the transitional arrangements under Schedule 6A of the EP&A Act, the modification is to be determined under the former section 75W of the EP&A Act.

The Department is satisfied that the proposal can be characterised as a modification to the existing development consent. The additional coal to be recovered is a small fraction of the mine's annual rate of production and planned total production, the disturbance footprint occurs within close proximity to and is a natural progression of other approved underground mining domains, and the proposal could be achieved with limited environmental impact (see **Section 5**). Given these considerations, the Department is satisfied that the proposed modification is within the scope of section 75W and may be determined accordingly.

3.2 Approval Authority

The Minister for Planning is the approval authority for the application. However, the Planning Assessment Commission must determine the application under the Minister's delegations of 14 September 2011 and 11 October 2017, as more than 25 public submissions objected to the proposal.

3.3 Environmental Planning Instruments

A number of environmental planning instruments apply to the modification, including:

- SEPP *(Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP);
- SEPP *(Infrastructure) 2007* (the Infrastructure SEPP);
- SEPP *(State and Regional Development) 2011;*
- SEPP No. 33 – *Hazardous and Offensive Development*;
- SEPP No. 44 – *Koala Habitat Protection*;
- SEPP No. 55 – *Remediation of Land*; and
- *Singleton Local Environmental Plan 2013*.

The Department has assessed the modification against the relevant provisions of these instruments and reviewed WCPL's consideration of these matters in its EA. Based on this assessment, the Department is satisfied that the proposed modification can be carried out in a manner that is consistent with the aims, objectives and provisions of these planning instruments.

3.4 Site Verification Certificate

WCPL has confirmed that the closest Biophysical Strategic Agricultural Land (BSAL) is 2 km to the north of the proposed modification. The proposed modification area is not located within any mapped Viticulture Critical Industry Cluster. A site verification certificate issued on 23 November 2016 verified that the small area of the proposed modification which is outside WCPL's existing mining tenements does not contain BSAL.

3.5 Other Approvals

WCPL would require a mining lease under the *Mining Act 1992* prior to any mining within the small area subject to the proposed modification that is outside of WCPL's existing mining tenements. This area is currently covered by an exploration licence for coal (A 444). A variation would also be required to the Environmental Protection Licence (EPL). An Aboriginal Heritage Impact Permit (AHIP) for disturbance outside the area covered by the existing permit would also be required.

3.6 Commonwealth Approval

The Wambo Coal Project was determined to be a 'controlled action' in 2003 and subsequently approved in November 2004 (EPBC 2003/1138). On 22 December 2016, a delegate of the Commonwealth Minister for the Environment determined that parts of the proposed modification (EPBC 2016/7816) are a 'controlled action' under section 75 of the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The action proposed by WCPL was determined as likely to have a significant impact on matters protected under the EPBC Act (ie Matters of National Environmental Significance (MNES)), being:

- listed threatened species and communities (under sections 18 & 18A of the Act), including the Regent Honeyeater, Swift Parrot and *Central Hunter Valley Eucalypt Forest and Woodland Ecological Community*; and
- a water resource in relation to large coal mining development (under sections 24D & 24E of the Act).

Subsequently, environmental assessment requirements were issued by the Commonwealth Department of Environment and Energy (DoEE). On 16 February 2017, the Department provided these to WCPL as supplementary Secretary's environmental assessment requirements.

As the State's environmental assessment process for State Significant Development under the EP&A Act is an accredited process under the Commonwealth's Bilateral Agreement with NSW, the Department has assessed the likely impacts to MNES as a result of the proposed modification on behalf of the Commonwealth. The Department's assessment of the project's potential impacts on water resources and biodiversity is provided in **Sections 5.2 and 5.3**, and MNES are further addressed in **Appendix F**. Following the NSW determination of the project by the Commission, the Department will make a recommendation to the Commonwealth Minister for the Environment in relation to the acceptability of the impacts to MNES for separate determination by the Commonwealth under the EPBC Act.

As required under the Bilateral Agreement, the project was referred jointly by the Department and DoEE to the Commonwealth's *Independent Expert Scientific Committee on Coal Seam Gas and Large Mining Development* (IESC) for advice on surface and groundwater impacts, as well as potential impacts on downstream watercourses and receiving environments. The advice provided by the IESC has been summarised in **Section 4.2** and considered in **Section 5.2**. It has also informed the conclusions presented in **Section 7** and the recommended conditions of consent in **Appendix G.**

4. CONSULTATION

The Department exhibited the modification application from 30 March until 2 May 2017 and made the accompanying EA publicly available on its website and at the Department's Information Centre, Singleton Shire Council's administrative centre and the office of the Nature Conservation Council.

In response to this exhibition, the Department received 49 submissions, comprising:

- 9 from public authorities, including NSW Government agencies;
- 26 public and special interest group submissions objecting to the project; and
- 14 public and special interest group submissions in support of the project.

Copies of these submissions and a copy of WCPL's Response to Submissions (RTS) are included in **Appendix B** and **Appendix C**, respectively. Two public submitters also provided supplementary submissions following the exhibition period and these have also been addressed in WCPL's RTS. A summary of the residual issues raised in these submissions is provided below (see **Appendix D** for agency comments on the RTS).

4.1 Agency Submissions

The **Division of Crown Lands and Water** of the Department of Industry (CLWD), previously the Water Division of the Department of Primary Industry (DPI Water) raised a number of concerns regarding the proposed modification. Its primary concern related to potential for hydraulic connectivity between mined longwall voids and the surface and subsequent impacts on potentially occurring Groundwater Dependent Ecosystems (GDEs) around North Wambo Creek. CLWD also requested further information in relation to the numerical groundwater model used to assess the impacts of the proposal and made several recommendations for improvements to the groundwater and surface water monitoring requirements. These concerns are discussed in further detail in **Section 5.2**.

CLWD also recommended monitoring sites above LWs 11 - 16 in the approved South Bates Mine to increase understanding of vertical aquifer depressurisation in a multi-seam situation (ie a different scenario to the proposed modification, which is single seam only). CLWD also made recommendations relating to WCPL's existing Surface Water Management Plan. At the time CLWD provided these comments, the Department was reviewing the mine's Surface Water Management Plan and an Extraction Plan for longwalls in the approved South Bates Mine in consultation with CLWD. The Department considers that these recommendations are more appropriately addressed in the review of these management plans as they are outside the scope of the proposed modification.

The **Office of Environment and Heritage** (OEH) was satisfied with WCPL's assessment of impacts to Aboriginal cultural heritage. OEH noted that, due to the limited impacts of the proposed modification, further investigation of the six rock shelters and four open context sites was unwarranted. OEH also supported WCPL's proposed inclusion of the identified Aboriginal sites into the mine's existing management framework and recommended a number of standard Aboriginal cultural heritage conditions. The Department notes that these conditions are already included in the existing consent. Therefore, the Department considers that no additional changes are necessary.

OEH noted that the predicted ponding in watercourses is minor and contained within the site's boundaries. OEH was satisfied there would be no additional impact on flooding.

OEH was also satisfied that the surface clearing for ventilation shafts and gas drainage facilities would not impact any threatened flora or fauna species. Nonetheless mine subsidence may adversely impact other native vegetation. OEH recommended that the consent's existing biodiversity performance measures, including offsets for impacts that cannot be remediated, be applied to the proposed modification.

OEH does not accept any subsidence impacts in the Wollemi National Park. WCPL's consent contains existing performance measures requiring negligible subsidence impacts within the national park. OEH supports the proposed visual monitoring of the cliff lines of the Wollemi Escarpment and recommends that National Park and Wildlife Service (NPWS) staff are involved in this monitoring.

Subsidence impacts on the Wollemi Escarpment and the Wollemi National Park are discussed in **Section 5.1.**

The **Heritage Council of NSW** (Heritage Council) was satisfied with the EA's Statement of Heritage Impacts, which concluded that subsidence impacts would affect the Whynot homestead but not impact the Wambo Homestead.

Distortion or collapse of the Whynot Homestead buildings is a possible result of mine subsidence. However, this homestead has limited local heritage significance and does not share any association or significance with the Wambo Homestead. The Heritage Council recommended archival recording of the Whynot Homestead and Outbuildings prior to mining operations that may affect it and visual monitoring during undermining in order to seek to prevent collapse.

WCPL considered that archival recording was not required due to the limited significance of the Whynot Homestead. Nevertheless, WCPL accepted the Heritage Council's recommendations.

The Department's Division **of Resources and Geoscience** (DRG) provided a resource assessment and noted no issues over resource sterilisation. DRG advised that WCPL would need to submit a mining lease application over the affected part of exploration licence A444 and complete Native Title extinguishment processes.

DRG also noted that the modification would provide economic benefits to the local region and state.

The **Environment Protection Authority** (EPA) provided several comments on noise, air quality, gas drainage and flares, surface water management and waste.

The EPA confirmed that noise from equipment used during ventilation shaft construction would not be significant in the context of the mine's other operational noise. No increase in noise limits is sought by WCPL and the EPA recommends continued application of the consent's existing noise limits.

WCPL has committed to undertake an acoustical design review before installing the fan on the upcast ventilation shaft, to ensure compliance with noise criteria at nearby privately-owned receivers. The EPA supports this commitment and requested that this review should be made an additional requirement of the site's Noise Management Plan. The Department notes that the existing Noise Management Plan condition requires a description of measures to ensure best management practice and considers that WCPL's commitment to undertake this review is a best management practice. WCPL would be required to review and update its management plans within three months of an approval, therefore the Department is satisfied that the Noise Management Plan would be revised to reflect this commitment.

The EPA recommended that the EA's Air Quality Assessment be revised to include consideration of the EPA's recently revised air quality criteria. The Department notes that the modification was submitted on 25 November 2016, while the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants 2016* were gazetted on 20 January 2017. Under the Department's transitional arrangements, projects (including modifications) submitted prior to the gazetted date are not required to reassess air quality impacts under the revised policy.

The EPA agreed that air quality impacts from the modification are unlikely to differ from those currently approved and that, in large measure, no further conditions to manage air quality impacts are required. However, the EPA requested that the consent's existing Air Quality Monitoring Strategy be revised to include continuous PM_{10} monitoring at upwind and downwind locations approved by the EPA, and that the monitoring must be in accordance with the *Approved Methods for Sampling and Analysis of Air Pollutants in NSW*. Existing conditions already require WCPL to monitor PM_{10} against the air quality criteria. Existing conditions also require WCPL to consult with the EPA in developing the Air Quality Management Plan, which must be revised within three months of any approval of the modification. This revision would allow WCPL to consult with the EPA on monitoring locations and to review the plan against the Approved *Methods for Sampling and Analysis of Air Pollutants in NSW.*

The EPA also noted that if flaring of methane drained from the longwall panels is necessary, licensing under an EPL would be required and recommended conditions to manage flare emissions. The Department supports this proposal and recommends that WCPL must reduce visible emissions as far as reasonable and feasible. Overall, the Department is satisfied that the EPA's comments on air quality have been adequately addressed and/or conditioned.

The EPA raised some concerns over the electrical conductivity (EC) impact assessment criteria used in the EA in regard to water quality impacts and recommended that a site-specific trigger value, derived in accordance with the ANZECC Guidelines, is used in impact assessment criteria. Impacts on surface water quality are discussed further in **Section 5.2.4**.

The EPA also raised concerns over interactions between the modification and the proposed United Wambo project and water storage and discharge from the site. WCPL notes that the proposed modification would not alter the location, timing, design or operation of sediment dams or the location of other surface water storages. WCPL has an existing site Erosion and Sediment Control Plan which outlines design guidelines for on-site water storages. The site water balance provided in the EA is a cumulative assessment accounting for both this modification and the proposed United Wambo project. While the inclusion of the United Wambo project provides a worst-case scenario, that project is not yet approved and therefore is not a key consideration in respect of water management for this modification. The Department will carefully consider any water management concerns in the separate assessment of the United Wambo project.

The Department notes that existing conditions require that WCPL recalculates the site water balance each year. The Department is satisfied that the existing conditions and management plans adequately address water storage at the Wambo site.

The **Dams Safety Committee** (DSC) advised that the proposed longwalls would underlie WCPL's Montrose mine water dam. Once DSC receives a design report for the dam it would determine a notification area around the proposed dam. For WCPL to mine within this notification area an application must be submitted to the DSC seeking endorsement prior to works beginning. DSC noted that WCPL has previously undertaken this process for other dams on the site.

The Department understands the Montrose Dam would not be constructed until after completion of the proposed longwalls, although the proposed dam location would be impacted by subsidence. The Department notes that WCPL is yet to finalise the dam's design and would include consideration of subsidence impacts in the design. Subsidence impacts predicted for the dam location are discussed further in **Section 5.1.4**.

The **Rural Fire Service** (RFS) did not raise any concerns relating to bushfire risks associated with the modification.

Subsidence Advisory NSW (SA NSW) raised no objections to the proposed modification and commented that WCPL should ensure it is aware of the proposed changes to the *Mine Subsidence Compensation Act 1961*.

Roads and Maritime Services (RMS) commented that the proposed modification would have no significant impact on the State road network.

The Department did not receive a submission from **Singleton Shire Council**.

4.2 Independent Expert Scientific Committee

The Commonwealth IESC provided scientific advice on the modification to both the Department and DoEE (see **Appendix E**). The IESC identified several areas where it considered that additional information should be provided by WCPL. This primarily related to impacts from groundwater drawdown and changes to surface water flows in North Wambo Creek and the potential impacts on private groundwater users and water availability for ecosystems. The IESC also raised concerns over water quality and subsidence impacts on the geomorphology and hydrology of North Wambo Creek.

The IESC considered that, while the impacts of the proposed project are likely to be limited in scale (given its relatively small size compared with adjacent mining operations), the modification would contribute to the cumulative impacts of mining across the region. Despite the relatively small scale of predicted impacts, the IESC considered that monitoring, mitigation and management strategies had not been adequately addressed. The IESC also advised that the existing management plans should be updated and provided several recommendations in this respect.

The Department notes that a number of these recommendations relate to the most recent modification to this consent (MOD 12), approved in December 2016. WCPL has submitted revised management plans to reflect this modification. WCPL is consulting with CLWD regarding its revised Water Management Plan and the Department has advised WCPL to consider the IESC's recommendations in the update of these plans.

The Department requested that WCPL provide a response to the IESC's concerns, which was submitted on 12 September 2017. This response largely addressed the IESC's concerns. Residual matters are discussed further in **Section 5.2**.

4.3 Public Submissions

4.3.1 Objections

The Department received 26 objections from members of the public and special interest groups. Of these objections, nine were from the nearby towns of Bulga, Jerry's Plains, Camberwell or Singleton, nine were from across the broader Hunter region (mainly from the Central Coast) and eight were from outside the Hunter region, including Gloucester, Sydney and Thirlmere (see **Figure 3**).

Key issues raised by objectors are presented in **Figure 4** and were primarily concerned with:

- existing surface water impacts and perceived poor mine management at Wambo;
- proximity of the proposed longwalls to the Wollemi National Park;
- subsidence impacts particularly on water courses and cliffs in the national park;
- greenhouse gases and climate change;
- cumulative impacts of coal mining in the area around Singleton; and
- the application being considered as a modification, the requirement for a new mining lease, and the delay in mining of South Wambo Underground.

Greenhouse Gases and Climate Change

A high number of submitters were opposed to approving further production of thermal coal in NSW in light of global warming and perceptions of man-made climate change. Many drew upon Australia's recent signing of the *Paris Agreement*, which set out a global action plan between 195 countries to limit global warming and avoid climate change. The Department notes that the proposed modification would not significantly change the Wambo Coal Mine's already approved air quality impacts (see **Section 5.4**).

Cumulative Impacts

Eighteen submitters raised concerns over cumulative impacts associated with the proposed modification. Cumulative noise, air quality, subsidence and water impacts were identified as specific concerns. There was also general dissatisfaction with the overall assessment of cumulative impacts. Given that the proposed modification largely relates to underground mining, with limited surface impacts, the Department is satisfied that the noise and air quality assessments in the EA were appropriate. Nevertheless, these matters have been further discussed in **Section 5.4**. The Department's assessment of subsidence and water impacts is discussed in **Sections 5.1** and **5.2** respectively**.**

Peabody Energy Australia's Financial State

Submitters noted that WCPL's American parent company, Peabody Energy, recently filed for bankruptcy protection in the USA and raised concerns over the company's financial capacity to meet its obligations under the development consent, particularly in relation to rehabilitation (see below). The Department notes that Peabody Energy filed petitions for bankruptcy protection for the majority of its United States entities on 13 April 2016 and that Peabody Energy relisted on the New York Stock Exchange on 4 April 2017.

Peabody Energy has previously advised that none of its Australian entities were included in the 2016 bankruptcy application and that its Australian operations have access to separate funding arrangements which enable it to continue operations at Wambo. Further detailed information on the filings was provided in WCPL's RTS for the previous MOD 12.

Impacts to Aboriginal Heritage

Many submitters raised concerns over the EA's Aboriginal cultural heritage assessment, noting that it did not survey 34 hectares (ha) of land within the proposed modification area.

The Department notes that this area was not surveyed due to logistical constraints. WCPL states in the EA that it would be surveyed prior to extraction of the proposed longwalls. The Department accepts this approach and considers that the existing conditions of consent adequately cover the management of Aboriginal cultural heritage, including previously undiscovered items. Aboriginal heritage is discussed further in **Section 5.4**.

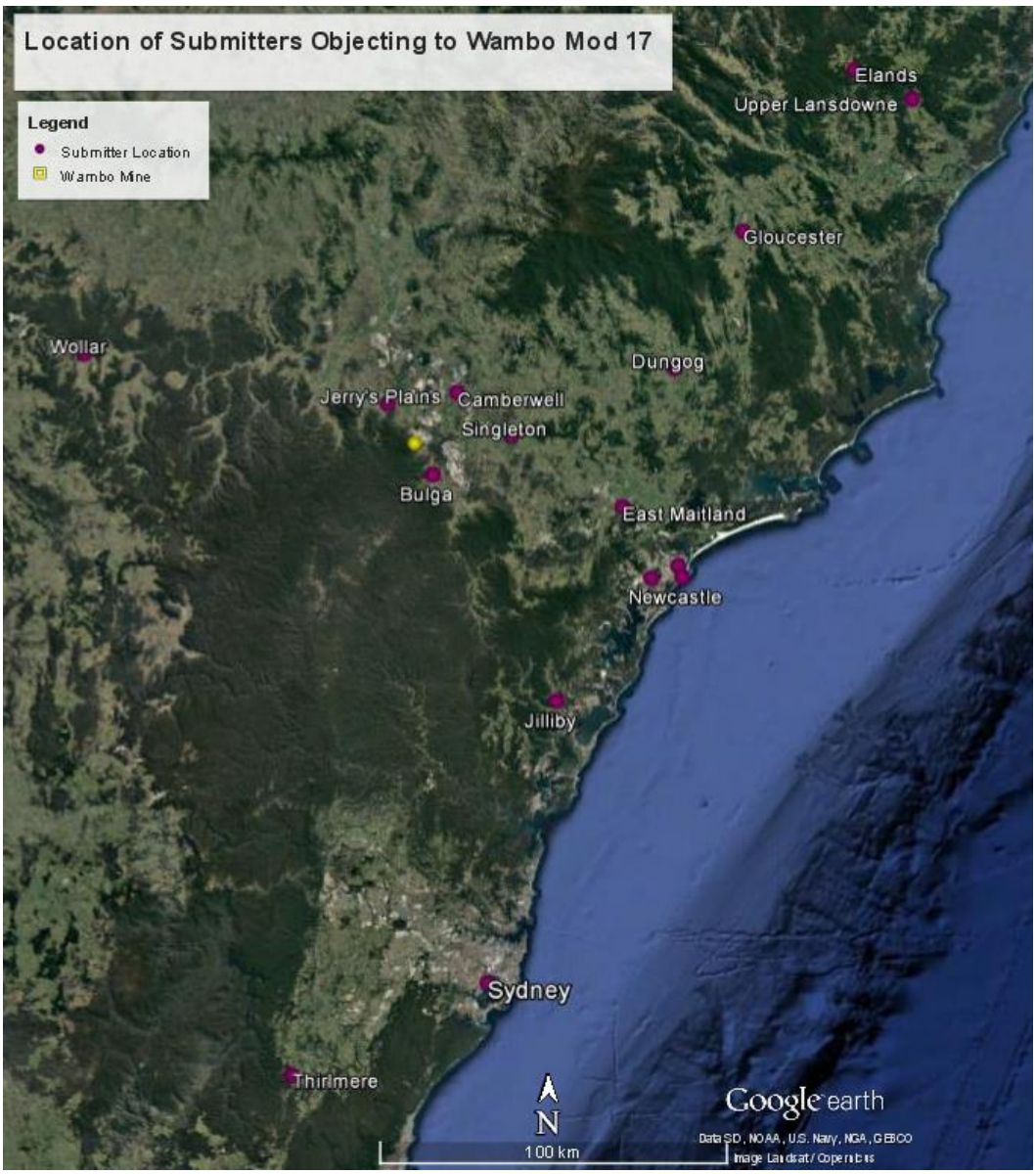


Figure 3: *Locations of submitters objecting to proposed modification*

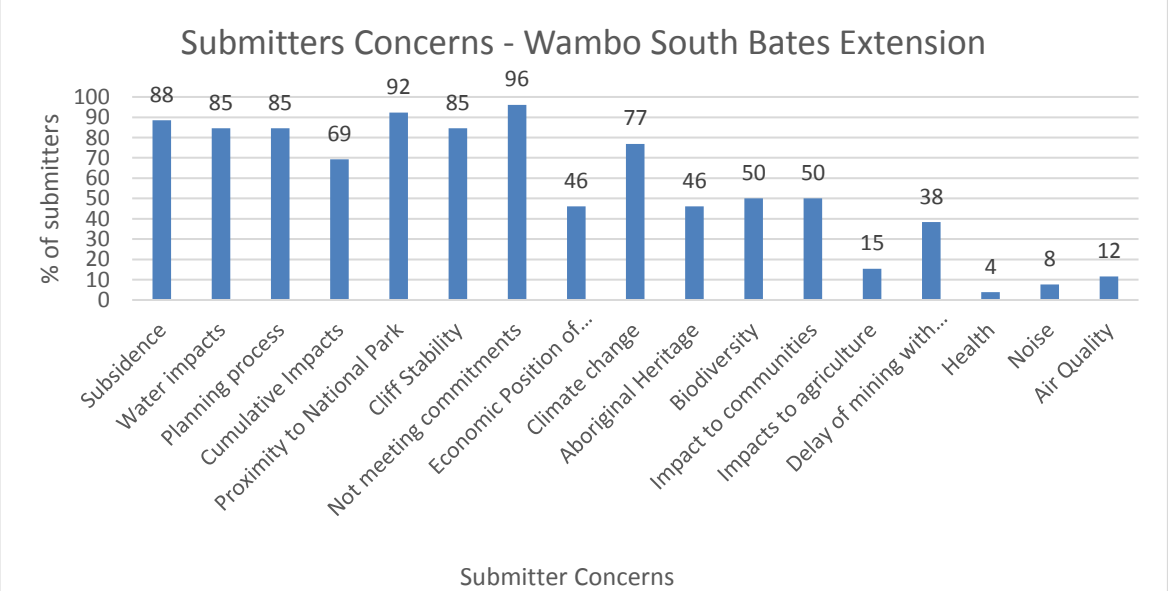


Figure 4: *Number of times issues were raised in submissions*

Compliance with Commitments/Conditions
Most submissions raised the issue of existing subsidence impacts on Wambo Creek, and noted that repair works had not been undertaken to rectify existing damage to the creek bed. Many submitters considered that this showed that WCPL would not fulfil its rehabilitation or mine closure commitments. These submitters lacked confidence in the mine's management to achieve successful environmental outcomes for the existing operation and (by extension) the proposed modification.

Compliance matters are dealt with separately under the EP&A Act and have been previously investigated by the Department's Compliance Branch. Rehabilitation and mine closure commitments are monitored by both the Compliance Branch and DRG.

The Department or consent authority is not required by the EP&A Act to consider the financial viability of any applicant in determining a development application. This is because, the development consent relates to 'land', rather than a 'person'. The current application must be assessed in this manner.

However, the *Mining Act 1992* requires that applicants for mining leases must satisfy a 'fit and proper person' test. Further, there are mechanisms in place to ensure that the site is effectively rehabilitated. DRG holds substantial security deposits for the rehabilitation of every operating mine in NSW, including Wambo. The security deposit is designed to cover the full cost of undertaking rehabilitation, and may be 'called in' by DRG in the event that a leaseholder fails to meet rehabilitation requirements set by the *Mining Act 1992* within the relevant mining lease.

WCPL has lodged a security deposit for the Wambo Coal Mine which addresses all mining operations covered by its current Mining Operations Plan. This deposit would be regularly reviewed over the life of the project and would be revised to reflect changes resulting from the project/modification as well as progressive rehabilitation.

Modification Under Section 75W
Over 75% of submitters considered that the Department should assess the modification as a new development application under Part 4 of the EP&A Act, as an area of the modification is outside WCPL's existing mining leases and a new mining lease would be required.

WCPL has a coal exploration licence (A 444) to explore for coal over the small area outside its existing mining leases. It is important to note that a development consent under the EP&A Act must be in place before a mining lease can be granted. The Department notes that Section 75W requires consideration of the proposed modification against the development currently approved (ie as previously modified), rather than the development as originally approved. It is the Department's role to carefully consider any modification application on its merits, within the limits imposed by statute and case law.

As discussed in **Section 3.1**, the Department is satisfied that the proposal can be characterised as a modification to the existing development consent. The additional coal to be recovered is a small fraction of the mine's annual and overall production, the proposed disturbance footprint is adjacent to the existing development and is a natural continuation to approved underground mining domains, and the proposal could be undertaken with limited environmental impacts.

4.3.2 Support
Fourteen submissions in support of the application were received from the community and a local business. These submissions emphasised the mine's role in providing local employment and indirect benefits to local service providers and noted that approval of the proposal would provide job certainty and ongoing contributions to the local economy.

5. ASSESSMENT
In assessing the merits of the proposal, the Department has considered WCPL's EA, submissions received from the community, agencies and the IESC, and WCPL's RTS. The Department considers the key assessment issue to be the proposal's subsidence impacts and related potential impacts to surface water, groundwater and biodiversity values. Consideration of these key impacts is provided in **Sections 5.1 – 5.3**, with other impacts considered in **Section 5.4**.

5.1 Subsidence
5.1.1 Introduction
Underground mining commenced at Wambo in 1969 in the former Homestead and Wollemi Mines, both of which used bord and pillar and longwall mining methods to extract coal from the Whybrow

Seam. Under DA 305-7-2003, granted in 2004, WCPL is permitted to develop multi-seam mining operations in the Whybrow, Wambo, Arrowfield and Bowfield Coal Seams.

The proposed modification would involve an extension of the existing South Bates Underground Mine, with nine additional longwall panels proposed in the Whybrow Seam. The proposed longwalls are located between the Wambo Open Cut in the north-east, the South Bates Underground Mine to the south-east and the Wollemi National Park to the south-west (see **Figure 5**). This area has not been previously mined.

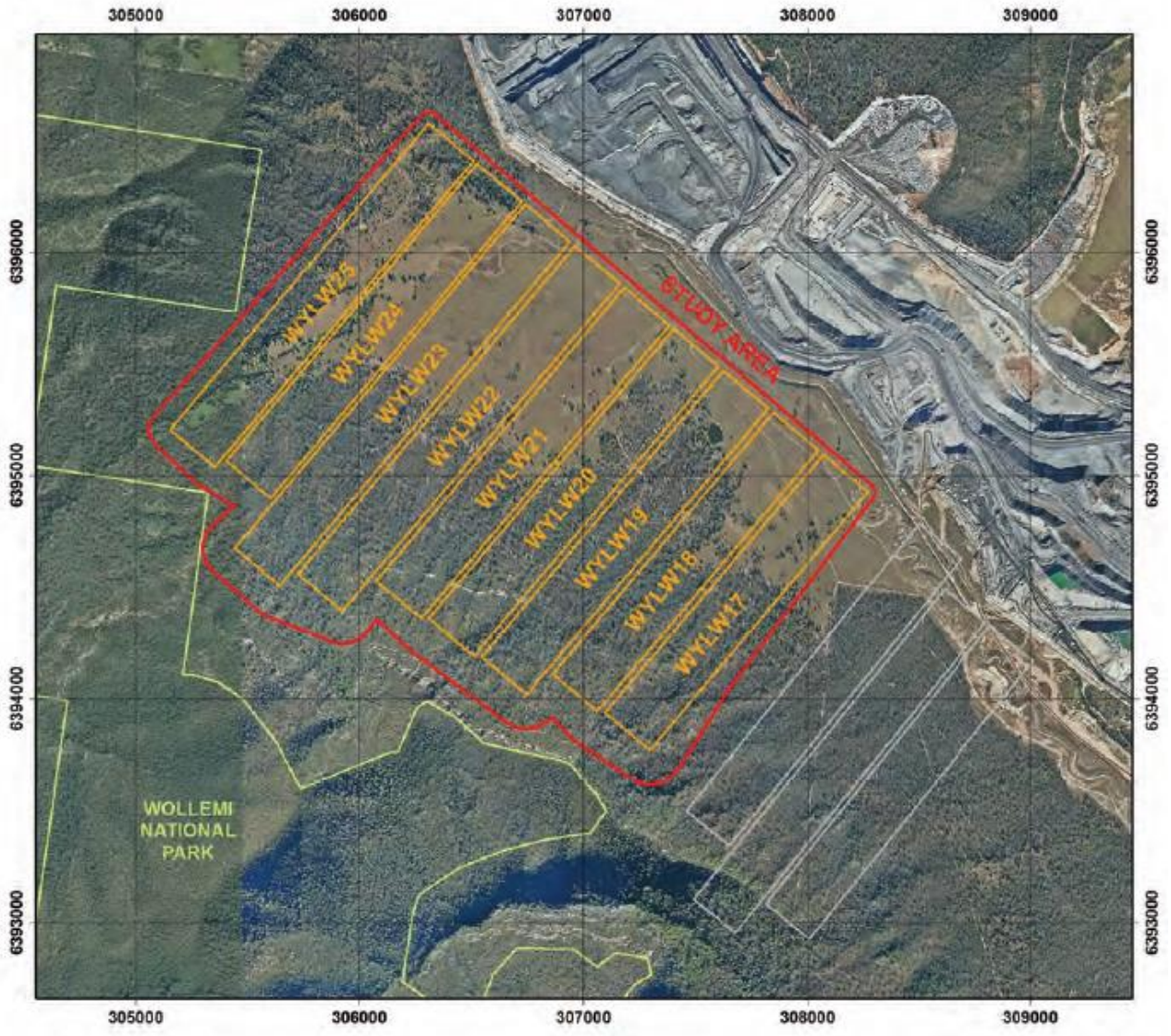


Figure 5: *Proposed South Bates Extension (longwalls outlined in orange), extent of conventional subsidence from proposed longwalls (red outline) and existing South Bates Underground Mine (outlined in white)*

WCPL proposes to commence mining these longwalls in the south-west, progressing to the north-east towards the open cut. The shallowest depth of cover is 50 metres (m) above the north-east ends of LWs 19 and 20, with the deepest cover of 330 m above LW18 in the south west. The geometry of the proposed longwalls is summarised in **Table 3** below.

The modification would cause surface and sub-surface subsidence impacts, including cumulative subsidence impacts, which could affect a range of built and natural features. The EA includes a detailed subsidence assessment undertaken by Mine Subsidence Engineering Consultants (MSEC). The subsidence impact zone associated with the modification was determined as being the greater of the 20 millimetre (mm) predicted subsidence contour and a 26.5 degree angle of draw from the proposed longwalls. The subsidence assessment used empirical data from the current mining operations.

In accordance with the Department's standard practice for managing mine subsidence, the mine is subject to existing consent conditions which stipulate key subsidence performance measures and require the development of detailed Extraction Plans to govern the mining of approved longwall panels. The Extraction Plan is required to be approved by the Secretary before carrying out any second workings (such as longwall panel extraction).

Table 3: *Geometry of proposed longwalls*

Longwall	***Overall void length (m) (Including installation heading)***	***Overall void width (m) (Including first workings)***	***Overall tailgate chain pillar width (m)***
LW17	1510	261	-
LW18	1530	261	31
LW19	1675	261	30
LW20	1700	261	31
LW21	1720	261	26
LW22	1920	261	30
LW23	2015	261	29
LW24	1740	261	21
LW25	1795	261	21

5.1.2 Subsidence Predictions and Effects

Subsidence effects refer to deformation of the groundmass due to mining, including all mining-induced ground movements. 'Conventional subsidence' includes vertical displacement, tilt, and tensile and compressive strains. Additional 'non-conventional subsidence' components include those arising in steep or incised topography (valley closure and upsidence) and far-field horizontal movements.

MSEC's subsidence assessment states that subsidence effects would vary across the longwall areas due to variations in controlling factors such as cover depth and local geology. The maximum predicted conventional subsidence, tilt and curvature due to the proposed longwalls are summarised in **Table 4**.

The maximum predicted subsidence resulting from mining of the Whybrow Seam is 1,950 mm, representing 65% of the total proposed extraction height of 3 m. The maximum predicted subsidence impact would occur above the finishing ends of the longwalls, where the depth of cover is the shallowest.

Table 4 also shows the predicted total conventional subsidence effects over the proposed modification area compared to the corresponding predictions for the approved South Bates project. The maximum predicted total subsidence and tilt are less than predicted for the existing multi-seam South Bates mine.

Table 4: *Comparison of maximum predicted total subsidence parameters based on the approved and proposed layouts due to existing mining at South Bates and the proposed South Bates Extension*

Layout	***Maximum predicted total conventional subsidence (mm)***	***Maximum predicted total conventional tilt (mm/m)***	***Maximum predicted total conventional hogging curvature (km^{-1})***	***Maximum predicted total conventional sagging curvature (km^{-1})***
Approved South Bates Mine Whybrow Seam (LW11 - LW13) and Wambo Seam (LW14 - LW16)	4,150	100	>3.0	>3.0
Proposed South Bates Extension Whybrow Seam (LW17 - LW25)	1,950	90	>3.0	>3.0

An area of 508 ha that has not been previously affected by mining operations and not previously approved for mining impacts would be subject to conventional subsidence under the proposed modification.

It is also likely that some non-conventional ground movements would occur in the vicinity of the proposed longwalls, due to the shallow depths of cover and geological features. A series of faults cutting through the north-east ends of LWs 17 - 21 and the south-west end of LW17 has not been taken into account in the modelling. The faults could slightly increase subsidence adjacent to these

longwalls (LW 17 - 21) but no significant tilts, curvatures or strains are predicted. Whilst noting that such additional subsidence movements may occur, MSEC predicts that they are unlikely to cause any adverse impacts, and that any impacts which do occur would not be beyond the scope of those already approved under the current mining layout and could be effectively managed.

The ratio of the longwall width against the depth of mining determines whether the panel width is 'supercritical'[1]. The proposed longwalls range from supercritical widths at the north-eastern ends to subcritical at the south-western ends due to the increasing depth of cover. It is predicted that maximum subsidence would be achieved at the north-eastern ends. In the Hunter Coalfield, this is estimated to be 60 – 65 % of the extracted seam thickness, which in the present case ranges from less than 2.8 up to 3.0 m.

DRG considers that, given the geographical and geological constraints (e.g. the Wollemi Escarpment and local faulting), the proposed underground mine plan enables adequate recovery of coal resources. SA NSW made no comment on the proposed modification.

The development of the open cut to the north-east is likely to have relieved and redistributed much of the existing horizontal stress in the overburden, reducing potential far-field horizontal movements. MSEC notes that the predicted far-field movements are very small and could only be detected by precise surveys. WCPL notes that previous mining in the South Bates Underground Mine and Homestead Underground Mine has not resulted in significant far-field horizontal movements. The Department is satisfied that far-field horizontal movements and their effects on natural and built features are unlikely to be significant or to cause any adverse impacts.

Overall, the Department is satisfied that an appropriate subsidence prediction model has been used and notes that the model is calibrated to local conditions and therefore has allowances for local natural variations built in. The Department considers that MSEC's subsidence predictions are conservative.

5.1.3 Natural and Heritage Features and Potential Impacts

There are a number of significant natural and heritage features located above or in the vicinity of the proposed longwalls. Impacts on natural features are discussed below and in **Sections 5.2** – **5.3**.

Cliffs

The subsidence assessment categorised cliff features as either 'cliffs' or 'minor cliffs' according to the definitions provided in the Department's *Standard and Model Conditions for Underground Mining* (DPE 2012).

The cliffs were divided into three groups:

- cliffs associated with the Wollemi Escarpment;
- intermediate level cliffs below the Wollemi Escarpment; and
- low level cliffs.

The cliffs associated with the Wollemi Escarpment are located along the boundary of the Wollemi National Park (see **Figure 6**). These cliffs are discontinuous, separated by sections of minor cliffs and rocky outcrops. WCPL has designed the proposed longwalls so that the cliffs associated with the Wollemi Escarpment are located outside the 26.5º angel of draw (see **Figure 7**). Less than 20 mm vertical subsidence is predicted to occur at these cliffs, with no predicted significant conventional tilts, curvatures or strains. This is consistent with previous subsidence predictions for the cliffs in the Wollemi National Park in the approved South Bates Mine.

The intermediate level cliffs are predicted to experience up to 30 mm of vertical subsidence and could experience very low levels of tilts, curvatures or strains (see **Table 6**).

There is potential for the cliffs associated with the Wollemi Escarpment and intermediate level cliffs to experience far-field horizontal movements. Modelling predicts far-field horizontal movements (based on the 95 % confidence level) of 110 mm. WPCL notes that these movements tend to be bodily movements towards the extracted longwalls and consequently does not expect measurable strains to develop. The Department notes that the scale of these impacts is such that the cliffs associated with the Wollemi Escarpment and the intermediate level cliffs are unlikely to be adversely impacted by far-field horizontal movements even if the predictions were exceeded by a factor of two.

[1] The 'critical width' for a longwall void is the narrowest void width at which the overlying strata are not partially supported by the adjacent pillars and maximum subsidence therefore results. Increasing this width (ie a 'supercritical' void width) does not result in any increase in vertical subsidence. Void width less than critical is known as 'subcritical', with less than maximum subsidence resulting. Critical width is generally 1.4 times the depth of cover but may vary based on local conditions.

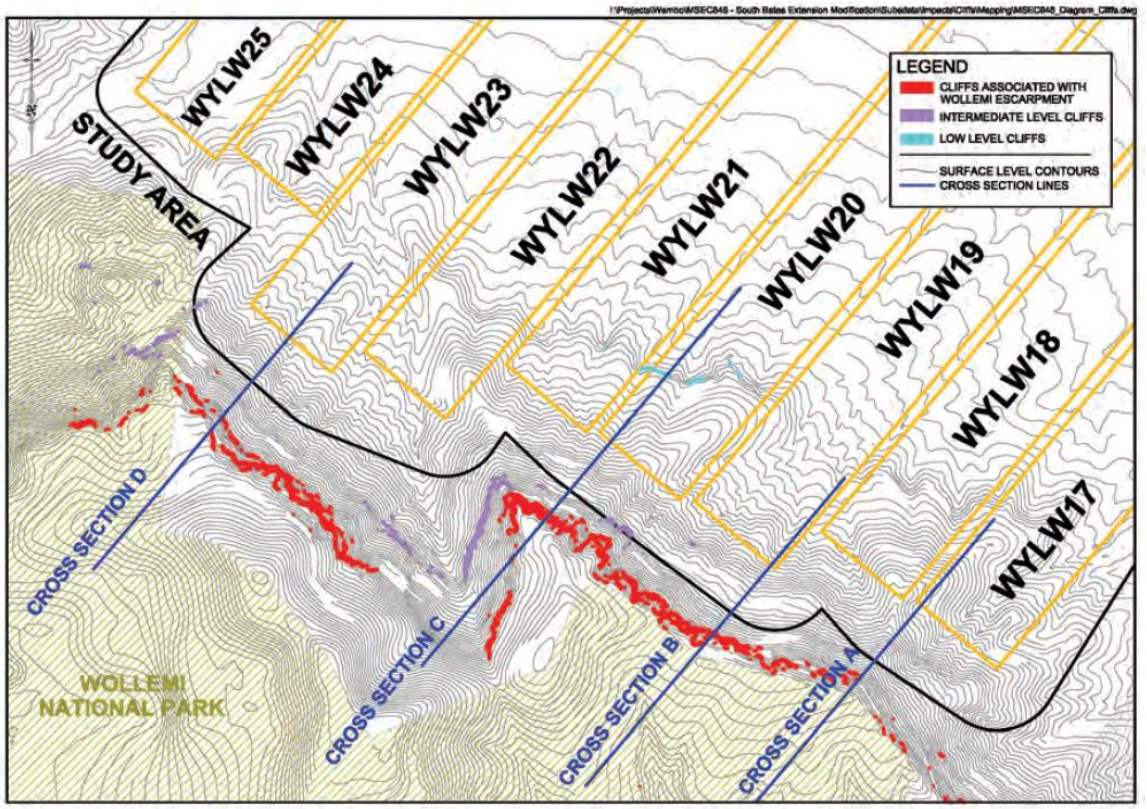


***Figure 6**: Commencing ends of proposed longwalls showing cliff categories*

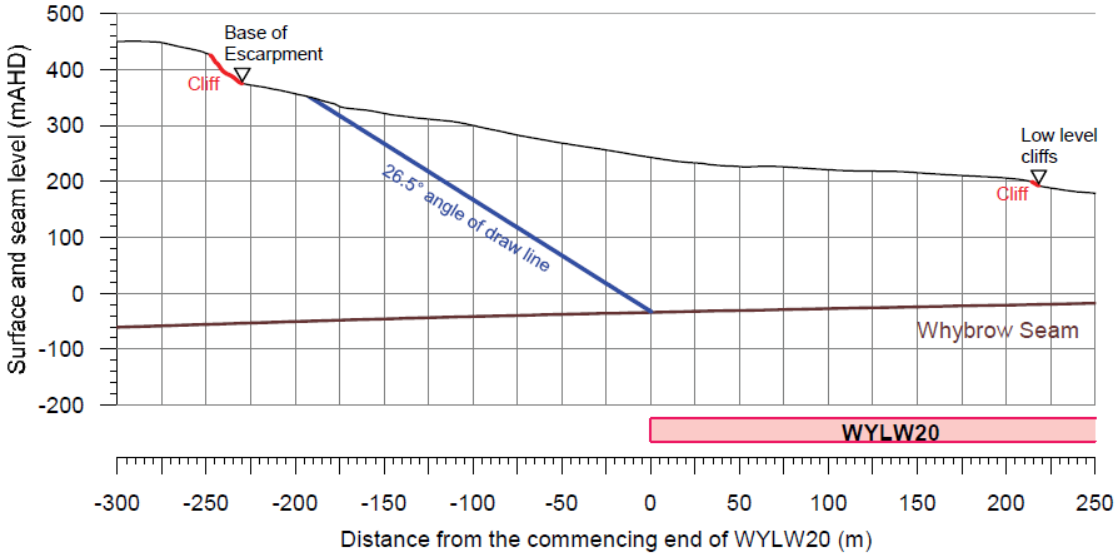


***Figure 7:** Cross section through commencing end of longwall 20 through the Wollemi Escarpment and low-level cliffs (see Figure 6 above for cross section 'C' location)*

***Table 6**: Maximum predicted subsidence impacts on cliffs and steep slopes*

Location	*Maximum predicted total subsidence (mm)*	*Maximum predicted total tilt (mm/m)*	*Maximum predicted total hogging curvature (km^{-1})*	*Maximum predicted total sagging curvature (km^{-1})*
Cliffs associated with the Wollemi Escarpment	<20	<0.5	<0.01	<0.01
Intermediate level cliffs	30	0.5	<0.01	<0.01
Low level cliffs	1,750	25	0.7	0.7
Steep slopes	1,950	30	1.0	1.0

The low-level cliffs are located directly above the south-western ends of the proposed longwalls, with a large section approximately 150 m in length above LWs 20 and 21 (see **Figures 6** and **7**). A maximum subsidence impact of 1,750 mm is predicted for these cliffs (see **Table 6**). WCPL predicts that 7 – 10% of the total low-level cliff length located directly above the longwalls could be impacted. This would result in rock falls along approximately 15 m or less than 1 % of the total length and face area of cliffs within the study area.

WCPL proposes periodic visual inspection of all cliff categories during and after extraction of the longwalls. The Department and OEH supports visual monitoring of the cliff lines, with OEH recommending that NPWS staff are involved in the visual monitoring.

The Department accepts that it is unlikely that cliffs associated with the Wollemi Escarpment or intermediate cliffs would experience any adverse impacts as a result of the proposed modification. Under existing conditions of consent, WCPL must prepare a Land Management Plan for the Secretary's approval as part of the Extraction Plan process. Any Extraction Plan for this area would consider potential impacts on these cliffs and would require approval prior to longwall extraction.

The level of impact to low-level cliffs directly above the proposed longwalls is predicted to be more than negligible and therefore the Department recommends an additional and specific performance measure for low-level cliffs of 'minor environmental consequences' (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face area of such features within the South Bates Extension) for the low-level cliffs as a condition of consent. This would be in addition to the visual monitoring proposed by WCPL. The Department's recommended conditions are discussed further in **Section 6**.

Other Rock Features

Isolated pagodas associated with the Wollemi Escarpment are located outside the proposed longwall area. MSEC predicts that pagodas would experience vertical subsidence of less than 20 mm and no measurable tilts, curvatures or strains as a result of the proposed modification. The Department is satisfied that this level of impact is unlikely to be significant and notes the pagodas would be further considered through the Land Management Plan required through the Extraction Plan process.

Steep Slopes

Steep slopes beneath the Wollemi Escarpment are located above the commencing ends of the proposed longwalls. Isolated steep slopes associated with the banks of streams are present above the proposed longwalls; however, the Department notes that these are generally stabilised by vegetation. **Table 6** summarises the predicted subsidence impacts on steep slopes.

Tilting of up to 30 mm/m is predicted, however this change is very small when compared to the natural surface grades. Therefore, WCPL considers it unlikely that any mining-induced tilting would adversely impact the stability of steep slopes. Curvature and ground strain could cause surface cracking and compression heaving to develop along areas of the steep slopes located directly above proposed longwalls. Tension cracks forming on these steep slopes could cause some soil erosion.

WCPL proposes to remediate any surface cracking by infilling, regrading and recompacting the surface. Additional erosion protection measures, such as planting of vegetation, may be required in order to stabilise some slopes in the longer term. The Department is satisfied that WCPL has appropriate management and remediation methods in place (as required under existing conditions of consent) which it would be required to implement as part of the Extraction Plan process.

Wollemi National Park

The Wollemi Escarpment, within the Wollemi National Park is a very significant natural feature located immediately to the south-west of the proposed longwalls. The Escarpment has been considered as a constraint in WCPL's longwall design. The Wollemi National Park boundary, at its closest point, is 120 m from the commencing end of LW 24 and the main gate of LW 25 (see **Figure 5**). The national park is predicted to experience less than 20 mm vertical subsidence and is not predicted to experience any significant conventional tilts, curvatures or strains and, therefore no significant impacts. Far-field horizontal movements of up to 130 mm could occur at the boundary of the national park. However, these effects are not predicted to be associated with any measurable strains and are therefore unlikely to adversely impact the national park.

Existing consent conditions already contain specific performance measures for Wollemi National Park ('negligible subsidence impacts' and 'negligible environmental consequences'). Conditions also require WCPL to define more detailed performance indicators for all relevant performance measures

as part of each Extraction Plan. Consent conditions also require WCPL to provide a suitable offset to compensate for any subsidence impact or environmental consequence in the event that any performance measure is exceeded, and it is not reasonable or feasible to remediate the impact or environmental consequence or such remediation measures have failed.

The Department considers that the existing conditions are adequate to avoid and to manage impacts (in the unpredicted and unlikely event that they occur) on the Wollemi National Park.

5.1.4 Built Features and Potential Impacts

There are no major farming operations above the proposed longwalls, however the north-eastern end has been cleared and is used for light grazing. Farm-related surface features located above the proposed longwalls include fences, drainage culverts, dams and sheds.

WCPL's open cut mining operations occur at the north-eastern end of the proposed longwalls. There are two groundwater bores above the proposed longwalls used by WCPL for monitoring. Existing conditions require a comprehensive groundwater monitoring network to be maintained.

Except for two surveys markers, there are no other public utilities within the proposed modification area. There are no public amenities or industrial, commercial or business establishments identified within the proposed modification area, other than WCPL's mining operations.

Impacts on Aboriginal and historic heritage features are discussed in **Section 5.4**.

Unsealed Tracks, Culverts and Fences

Several unsealed tracks, culverts and fences, located directly above the proposed longwalls would experience the full range of subsidence impacts. WCPL predicts some cracking and rippling of the unsealed tracks and tilting of drainage culverts and fences.

WCPL has existing management and mitigation measures in place for these types of features. This includes visual inspections and repairing tracks to maintain them in a safe and serviceable condition; regrading and replacement of culverts and replacement or re-tensioning of fences. These measures would be reviewed and revised (if necessary) as part of the Extraction Plan process for the proposed longwalls.

Farm Dams

There are 12 farm dams located above the proposed longwalls from the mid-lengths towards the finishing ends. All 12 dams are likely to experience subsidence impacts to some degree. Tilting is likely to impact the available freeboard in the dams. Modelling predicts freeboard reductions from less than 0.1 m up to 0.7 m. However, WCPL considers it is unlikely that the predicted tilts would adversely impact the storage capacities of the farm dams.

Surface cracking could occur which may impact the base material of the dams. WCPL proposes dewatering of large farm dams prior to undermining. Visual inspection of the dams is also proposed and any necessary remediation would involve excavation and re-establishment of the dam base. The Department notes that these measures have been employed at Wambo Coal Mine for many years and would be described further as part of the Extraction Plan process.

Sheds

Farm sheds located above LW25 would be subjected to significant subsidence effects including tilts of up to 60 mm/m and strain greater than 30 mm/m. These impacts could distort the timber frames. WCPL proposes to either remove the sheds prior to mining or to undertake visual monitoring during active subsidence. If the sheds became unstable, WCPL would stabilise them with bracing, or fence them off to prevent access.

The Department notes that these sheds are owned by WCPL and considers that the proposed mitigation is appropriate.

Survey Markers

Two State survey control markers (TS12077 and SS119671) are located above LW21 and LW24 would be impacted by subsidence. The NSW Spatial Services Division also noted concerns relating to a survey marker (PM183247) located just off the north-eastern end of proposed LW23 that was not identified by WCPL. Subsequently WCPL confirmed that PM183247 would also be subject to low levels of vertical and horizontal subsidence movement.

NSW Spatial Services advised it had no concerns in relation to survey mark SS119671, as it is un-coordinated and is not connected to any Deposited Plans, but noted concerns regarding subsidence of survey marks TS12077 and PM183247. The Department notes that, under the *Surveying and Spatial Information Act 2002*, survey marks cannot be displaced or damaged without a relevant authorisation.

WCPL proposes to manage mine subsidence on these survey marks through the Built Features Management Plan component of the necessary Extraction Plan prior to any secondary extraction that could result in subsidence of the marks. This would involve developing appropriate management strategies in consultation with NSW Spatial Services and lodging an application for the relevant authorisation from the Surveyor General.

The Department and NSW Spatial Services are satisfied with this approach. Consequently, WCPL would address the management of the survey marks through the Extraction Plan process.

WCPL's Mining Operations

WCPL's open cut is located to the north-east of the proposed longwalls. The IESC requested further discussion concerning the interaction between the underground and open cut operations and potential subsidence impacts. MSEC notes that extraction of the open cut has likely relieved and redistributed much of the horizontal *in-situ* stress in the overburden closest to the open cut, reducing potential for far-field horizontal movements around the open cut. Nevertheless, WCPL proposes to complete a geotechnical assessment of the highwall prior to extraction of the proposed longwalls. The Department notes this would form part of the Built Features Management Plan component of the Extraction Plan process.

Exploration drill holes above the proposed longwalls would be capped prior to coal extraction.

WCPL has approval to construct the Montrose Water Storage dam, located above proposed LWs 17 and 18. While this dam would not be constructed prior to extraction of the proposed longwalls, the proposed location would be impacted by vertical subsidence and fracturing of bedrock.

The DSC's recommendations are outlined in **Section 4.1.** WCPL notes that the final dam design would include consideration of potential subsidence impacts including a sufficiently thick base and revised dam wall heights. The final design would then be provided to DSC for endorsement.

5.1.5 Conclusion

The Department is satisfied that WCPL's subsidence assessment has used conservative assumptions, and that the resulting subsidence predictions provide a sound basis to assess the proposal's potential subsidence impacts and associated environmental consequences.

The Department notes that existing conditions of consent require WCPL to assess potential subsidence impacts on built features through the Extraction Plan process and manage them according to established performance measures. The Department is satisfied that existing conditions would appropriately manage subsidence impacts to built features.

The existing conditions include strict subsidence performance measures to protect all natural and built features in the underground mining area and require offsets to be provided should unforeseen impacts occur which cannot be successfully remediated. Preparation of a comprehensive Extraction Plan, in consultation with relevant agencies is also required. This must be approved prior to extraction of any longwall. The Extraction Plan must contain a detailed subsidence impact assessment and a detailed subsidence monitoring program covering all significant built and natural features. The existing framework of conditions to manage subsidence and its potential impacts has so far proven highly successful in managing and mitigating subsidence risks.

The Department has carefully considered potential impacts of subsidence on natural and built features and is satisfied that these impacts are not significantly greater than those already approved. The Department recommends additional performance measures for the low-level cliffs but considers that the remaining existing performance measures remain appropriate and would provide adequate protection to all significant surface features in the modification area.

5.2 Water Resources

The modification would cause surface and sub-surface subsidence impacts, including cumulative subsidence impacts, which could affect a range of surface water and groundwater features. WCPL

provided a detailed Groundwater Assessment and Surface Water Assessment to set out the potential impacts of the proposed modification.

5.2.1 Groundwater Resources

Local groundwater resources are characterised by two main aquifers, namely a highly productive alluvial aquifer system which interacts with the surrounding surface creeks, and a less productive, deeper and more saline Permian porous rock aquifer system.

Groundwater Modelling and Monitoring

The Department and CLWD are generally satisfied that the numerical groundwater model developed by HydroSimulations and used for the proposed modification is appropriate and fit for purpose. However, both the IESC and CLWD requested further clarification of aspects of the groundwater model.

The IESC questioned whether the numerical model should include separate layers for alluvium and regolith, to better represent changes in saturation of the alluvium over time. This concern was also raised during the IESC's assessment of MOD 12 and is discussed in detail in the Secretary's assessment report for that modification. In summary, 'layer 1' of the model is used for both the alluvium and regolith. However, the two geologies are assigned separate (ie different) recharge parameters, storage parameters and hydraulic conductivities. The Department continues to accept this as an appropriate approach and notes that neither CLWD, the PAC, nor the peer reviewer raised similar concerns during the assessment of MOD 12.

The IESC considered that geological faults were not adequately characterised or included in the numerical model and recommended that future investigations at the site consider analysing potential fault impacts on groundwater flow through a sensitivity analysis. Additionally, the IESC requested a sensitivity and uncertainty analysis of the model's hydraulic parameters including recharge, storativity and hydraulic conductivity.

WCPL considers that faults and dykes within the proposed modification area have been characterised through surface and in-seam drilling and mapping. HydroSimulations predicts that the faults may act as minor barriers to local groundwater flow but would have no discernible regional impact. However, for the purpose of the model, HydroSimulations has assumed coal seam continuity (ie the faults do not act as barriers). This conservatively predicts drawdown effects farther than would occur if the fault caused a dislocation of the coal seam. The Department notes a sensitivity analysis of hydraulic parameters for the proposed modification was provided in the EA (see **Appendix A**) and that have been accepted for several previous modifications.

Both the IESC and CLWD recommended that the numerical model should be independently reviewed, specific to the current version and calibration, noting that this is a requirement of the *NSW Aquifer Interference Policy* (AIP). The Department notes that the numerical model for the proposed modification was independently reviewed in March 2017. This review concluded the numerical model was appropriate and fit for purpose and that the sensitivity analysis was sufficiently intensive for key parameters.

Furthermore, the model was calibrated for MOD 12 in August 2015 and independently reviewed in March 2016. The MOD 12 model calibration and independent review were accepted by CLWD and the Department considers no further calibration of the model is necessary for this proposed modification. However, the numerical groundwater model would be subject to review and verification through the Extraction Plan process in consultation with CLWD.

The Department notes that WCPL has included the proposed United Wambo project in the groundwater modelling. While the inclusion of this proposed project reflects a worst-case scenario in terms of both local and cumulative impacts, the project is not yet approved and the Department notes that consideration must also be given to the reduced level of impact that would occur without the inclusion of the United Wambo project.

Assessment of Impacts

- *Alluvial Aquifers*

Figure 7 shows areas of mapped alluvium within the project area. Groundwater flow patterns within the shallow alluvial aquifers reflect topographic levels and the containment of alluvium within the principal drainage pathways. Monitoring data shows that the alluvial aquifers recharge from rainfall. The groundwater flow paths around the creeks are complex with creeks both 'losing' and 'gaining' groundwater from the alluvium along its length.

WCPL provided an assessment against the minimal impact considerations of the AIP for both highly productive and less productive groundwater systems. The Wollombi Brook alluvium and a small portion of Wambo Creek alluvium falls within the boundary of CLWD's 'highly productive' *Hunter Alluvial Water Source*, with all remaining alluvial and porous rock system aquifers being 'less productive'.

The 'highly productive' alluvium is likely to experience Level 1 impacts. A negligible decrease in stream leakage of 0.02 megalitres per day (ML/day) is predicted in Wollombi Brook and no increase in long-term salinity is predicted. Additionally, there would be no discernible effect on Wambo Creek. The Department is satisfied that the proposal is not expected to affect any private user of alluvial groundwater and there would be no additional drawdown in the Wollombi Brook alluvium.

In the 'less productive alluvium', similar Level 1 impacts are predicted for cumulative drawdowns, pressure head and water quality. A maximum cumulative drawdown of approximately 2 m is already approved to occur from the start of underground mining at North Wambo. This drawdown lies along the central axis of the North Wambo Creek alluvium and is partially a result of the adjacent open cut mining and fracturing of the land surface. No change in maximum drawdown in the alluvium as a result of the modification is predicted.

The alluvial groundwater along North Wambo Creek is not used for water supply as there is no privately-owned land on North Wambo Creek, the flow is ephemeral; there are no Water Access Licences (WALs) or extraction points and the Creek is diverted downstream. WCPL would complete any necessary mitigation and remediation required during or after subsidence.

Groundwater recovery levels (including the proposed United Wambo project) were modelled until 2241 (a 200 year recovery period). Modelling showed no discernible signs of residual drawdown in the alluvium and regolith. Residual drawdowns are still present in the overburden above the Whybrow Seam, and in the Whybrow, Wambo, Woodland Hills and Arrowfield coal seams. The Department notes that while groundwater levels after the 200 year recovery period remain below pre-mining levels, the modelling shows that they are recovering. The regional groundwater flow pattern remains towards local watercourses and the Hunter River.

It is generally accepted that upwards discharge of saline hard rock groundwater to the alluvium in the Hunter Valley would have been historically limited, due to the low vertical conductivity of the Permian strata. Nonetheless, over long periods of time (ie millennia) salinity can build up at the base of and around the edges of alluvial sediments. During and immediately after mining, this salinity build up is impeded as a result of mine-related groundwater drawdown. However, over the long term, ingress of water from the surface and from up-gradient Permain strata eventually fills the groundwater 'void' caused by mining. Increased fracturing may then allow larger quantities of this saline groundwater to eventually rise into the alluvium, displacing the better quality alluvial groundwater.

WCPL's modelling shows no potential for increased flux of saline water from the Permian strata to the alluvium for at least 100 years. On this basis, the Department is satisfied that there is a negligible interim risk to the water quality in the alluvial aquifer.
The Department is satisfied that the proposed modification would not increase previously approved impacts on the alluvial aquifers. Predicted impacts would remain within the AIP's Level 1 minimal impact considerations.

- *Permian Aquifers*

WCPL concludes that in the 'less productive' porous rock aquifer there would be Level 2 impacts to the water table (ie >2 m water table decline cumulatively at any water supply work) and water pressure, but that impacts to water quality would be Level 1.

As there is currently no Water Sharing Plan relevant to the porous rock aquifer and limited information available on the three privately-owned bores within it, it is difficult to determine the significance of these impacts. However, depending on the depth from which these bores pump, it is possible they may experience >2 m cumulative drawdown. A Level 2 impact is predicted at one privately owned bore with an additional 1.4 m drawdown expected. However, the Department notes that this drawdown results from existing approvals rather than the proposed modification in itself. The proposed modification (in itself) is not expected to affect any private groundwater users.

WCPL proposes to continue implementing its Surface and Groundwater Response Plan. In the event that a significant reduction in groundwater supply is observed in any privately-owned bore, compensation would be required under the existing Surface and Groundwater Response Plan, which

requires WCPL to mitigate all Level 2 impacts on existing water supply bores. Existing conditions also require this plan to be updated to reflect this modification, if it is approved.

The Upper Permian coal measures (which are generally saline aquifers) within and around the mine footprint are already largely desaturated due to intensive mining at North Wambo Underground, United Underground and South Bates Underground. Overall, historical and ongoing open cut and underground mining within the Wambo area and adjoining mining operations have created a regional zone of depressurisation within the coal measures.

The approved South Bates mine would cause depressurisation of the Permian strata. While the proposed modification would cause additional drawdown in the overburden and Whybrow Seam, the main impact from the proposed modification (outside the mine footprint) would be depressurisation within the Permian strata to the immediate south and west. This is not expected in the north or east due to the adjacent open cut and underground mines.

The proposed modification could reduce groundwater pressures up to 55 m in the overburden above the Whybrow Seam and in the Wambo Seam (below the Whybrow Seam). In the Whybrow Seam reductions in groundwater pressure of approximately 200 m are predicted. The Department notes these impacts are generally limited to the proposed modification footprint and does not consider them to be significant at the regional scale. These saline, hard rock aquifers are also not considered to have any significant utility for agricultural or other purposes.

As previously noted, the modification proposes to delay mining at South Wambo. The modelling shows higher groundwater pressures around the approved South Wambo Mine as a result of the proposed modification during this delay, including increases of up to 70 m in the Woodland Hill Seam. These delays are not considered significant in themselves.

Other potential impacts of the proposed modification on groundwater resources include sub-surface fracturing and shearing of strata above the proposed longwalls resulting in changes in rock mass permeability and storage capacity. This has the subsequent effect of drawing groundwater towards the underground mining area. It can also require dewatering of the overlying workings to mitigate inflow risk to the active underground mining area.

WCPL predicts the peak annual groundwater inflow for the proposed longwalls to be 376 ML/year. This is around a 60 ML/year increase over that currently approved for South Bates. A slight reduction in the annual groundwater inflow of 53 ML/year is expected at South Wambo as a result of the proposed modification.

Groundwater Dependent Ecosystems (GDEs)

The EA included an assessment of the potential impacts of the proposed modification on GDEs. The Parnell Spring is the closest high priority GDE, located approximately 11 km south-southwest of the proposed longwalls. Parnell Spring likely flows from the Triassic-age Narrabeen Formation, which experiences negligible drawdown from WCPL's operations.

Across the majority of the modification area, depth to groundwater exceeds 10 m. Most remnant woodland and forest vegetation is positioned on foot slopes and ridges, detached from groundwater sources. However, in isolated areas of North Wambo Creek the water table is within 2 m of the surface, with potential for vegetation to access groundwater in these areas.

An area of *Hunter Lowland Redgum Forest*, an Endangered Ecological Community (EEC), is located adjacent to the natural sections of North Wambo Creek above LW24 and LW25, albeit in a disturbed and fragmented condition. The EA considers that, where this vegetation occurs, it is mostly 5 to 10 m above the water table and is likely to depend entirely on surface flows. While it is possible that the vegetation may access groundwater, this vegetation is not markedly different from vegetation in nearby areas where the water table depth is greater.

CLWD's submission questioned the mapping of this community and recommended changes to the proposed longwall layout to avoid any risk of impact. Following consideration of WCPL's RTS, CLWD reiterated its recommendations for further investigations to determine the groundwater dependence of this EEC, but did not continue its proposal to reduce the number of longwall panels.

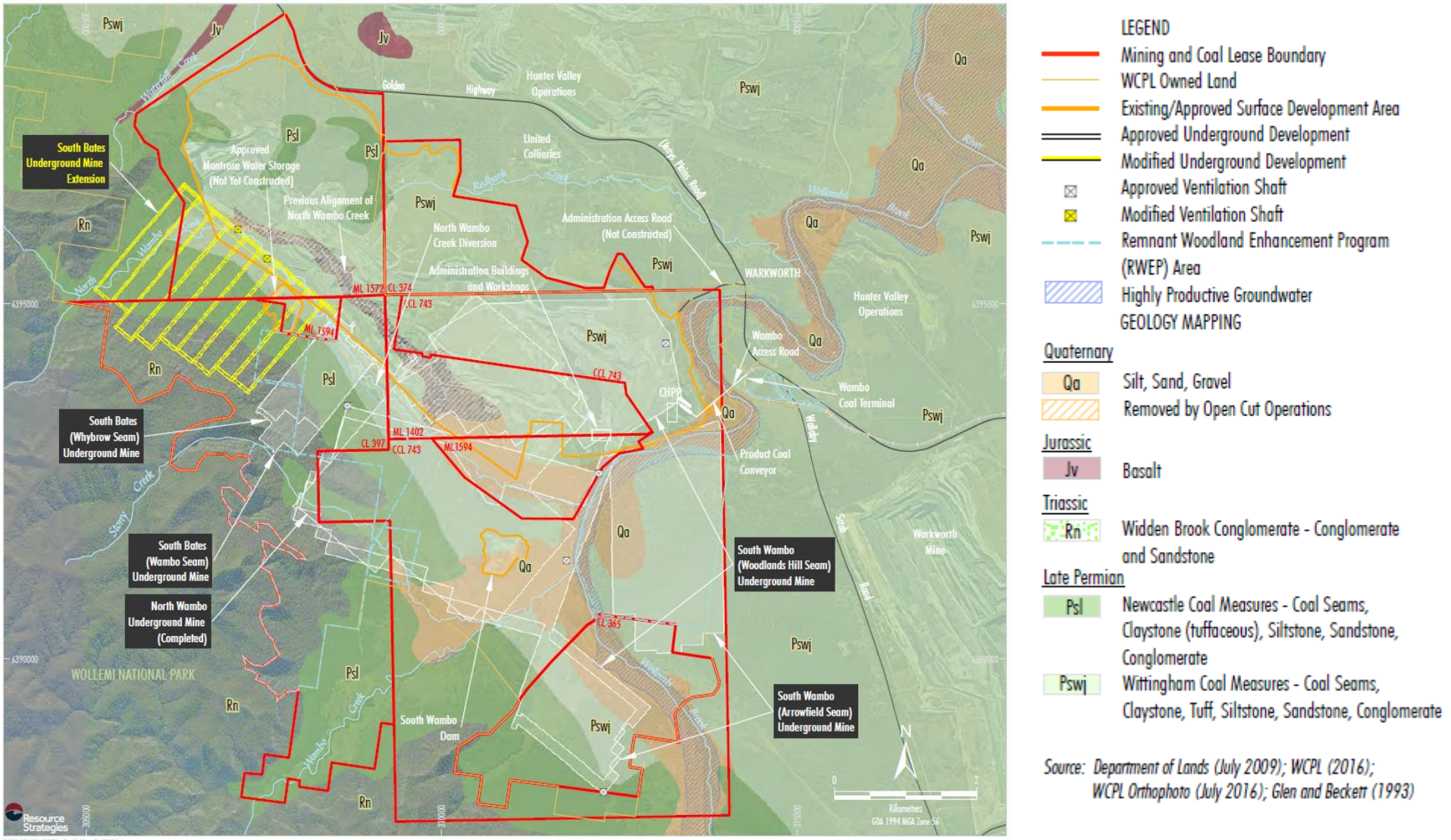


Figure 7: *Mapped alluvium in the vicinity of the proposed modification are*

CLWD noted WCPL's position that there are no GDEs on North Wambo Creek due to the depth to groundwater generally exceeding 10 m. However, CLWD questioned whether there was adequate information to conclude that the riparian *Hunter Lowland Redgum Forest* EEC is not a GDE or that the proposed modification would not have a significant impact on this community.

The IESC raised similar concerns over the *Central Hunter Valley Eucalypt Forest and Woodland* (CHVEFW) Critically Endangered Ecological Community (CEEC) and other potential riparian vegetation. The IESC did not consider that the EA adequately addressed vegetation that may periodically or opportunistically utilise groundwater. The IESC also recommended further investigations and monitoring be undertaken to address these concerns.

WCPL noted that a monitoring site (GW21), located adjacent to the proposed longwalls and within the CHVEFW, was drilled to a depth of over 35 m before reaching the water table. WCPL considers that it is improbable that CHVEFW could access groundwater at these depths, or would rely on this water in preference to the available water (ie soil moisture) within the unsaturated zone which would likely be more easily exploited by root systems. Soil moisture in the unsaturated zone is controlled by rainfall infiltration and not influenced by groundwater drawdowns.

The Department has noted the concerns raised by both CLWD and the IESC regarding adequate information and the need for futher investigation and monitoring. While the Department acknowledges WCPL has data on which it is forming its conclusions, the information is based (in part) on a single borehole and is therefore limited.

Given the condition of the *Hunter Lowland Redgum Forest* EEC above the proposed longwalls, the general depth of groundwater being greater than 10 m and the lack of permanent standing water, the Department does not consider any change in mine plan design to be warranted. It is also noted that this area of North Wambo Creek is not associated with any productive groundwater and is not used for water supply (see **Section 5.2.1**).

Due to the limited data the Department considers that further investigations and monitoring would lead to a better understanding of any groundwater dependency of these vegetation communities in the proposed modification area. The Department also considers it important to understand whether previous open cut and underground mining may have impacted on the groundwater dependency of these communities (ie were they once groundwater dependent, but are not now).

Consequently, to address CLWD's and the IESC's concerns and WCPL's claims, the Department has recommended a condition requiring WCPL to commission a Groundwater Dependent Ecosystem Study. This study must:

(a) be prepared by suitably qualified and experienced person/s whose appointment has been endorsed by the Secretary;
(b) be developed in consultation with CLWD;
(c) provide advice on the likely level of groundwater dependence of the vegetation in the South Bates Extension Area given current groundwater levels and expert knowledge of the vegetation communities in the region;
(d) in the event it is considered that vegetation communities in the vicinity of the South Bates Extension Area are groundwater dependent (either entirely or partially), provide advice on the likelihood that subsidence associated with the South Bates Extension Area could cause adverse impacts and how any such impacts would manifest;
(e) consider to what degree the cumulative impacts of adjacent mining operations may have already impacted groundwater dependent vegetation across the South Bates Extension Area;
(f) provide any recommendations regarding the revised Ground Water Monitoring Program required under condition 34B, and in particular provide any recommendations that would assist in assessing the potential fracture interconnections between surface water resources and hard rock aquifers that may impact on groundwater dependent vegetation; and
(g) include a management and/or remediation program that describes measures that could be implemented to ensure compliance with the performance measures in Table 14A for any groundwater dependent endangered ecological community.

In addition, the Department recommends that the consent's Groundwater Monitoring Program be revised to include the installation of:

(a) clustered monitoring bores for the South Bates Extension Area, located in proximity to the Hunter Lowland Redgum Forest along North Wambo Creek, and characterise the geological and hydrological systems in the vicinity of this vegetation community, including an assessment of the presence and extent of any shallow groundwater; and
(b) monitoring vibrating wire piezometers, located above the South Bates Extension Area, both within and beyond the areas with potential for surface cracking.

The Department considers the recommended additional investigations and data collection, outlined above, appropriately address CLWD's and the IESC's concerns. The proposed study and additional monitoring would enable the extent of the connection between the vegetation above the proposed longwalls and groundwater to be determined. These studies are required to be completed within 12 months of the approval of this modification and this information must be provided to the Department and CLWD for review and consideration prior to any Extraction Plan for the proposed longwalls.

Extraction plans are usually submitted for groups of two or three longwalls at a time. The longwalls in question are some of the last to be extracted providing opportunity for an adaptive mine plan design to be implemented, should the study demonstrate dependence between the vegetation and groundwater. The Department also notes the existing performance measures for threatened vegetation (minor cracking and ponding of the land surface or other impact) and the requirement for WCPL to provide offsets should the performance measures be exceeded and remediation not be possible.

Given these existing performance measures and additional investigations and monitoring proposed, the Department is satisfied that the impacts to GDEs (or potential GDEs) within the study area are unlikely to be significant.

Groundwater Licensing

The proposed modification would result in no change to the licensing requirements for the alluvial water sources. WCPL predicts a slight reduction on the approved take of 1,125 ML/year down to 1,072 ML/year as a result of the proposed modification. WCPL currently holds licensed entitlements of 1,647 ML/year for groundwater derived from the porous rock source.

CLWD requested that WCPL confirms that it has sufficient water licenses to ensure compliance with the *Water Management Act 2000*. WCPL considers that the 70 shares it holds in the *Lower Wollombi Brook Water Source* are sufficient to account for its predicted take from alluvial aquifers. Further groundwater entitlements are available for purchase on the open market should additional shares be required.

WCPL also holds an unregulated river access licence (350 shares) in the *Lower Wollombi Brook Water Source* (WAL 18437) and anticipates that this would cover any measured loss of surface flow in North Wambo Creek. WCPL proposes to make any necessary adjustments to its pumping from Wollombi Brook and/or the scale of its mining operations to ensure that it would maintain sufficient licence entitlement.

CLWD and the Department are satisfied that WCPL holds sufficient water licences. Furthermore, in the event that additional shares are needed, that existing conditions require WCPL to have sufficient water during each stage of the development and adjust the scale of mining operations to match its available water supply, if necessary.

5.2.2 Surface Water Resources

North Wambo Creek

North Wambo Creek is a fifth order ephemeral stream, with some standing pools along the lower reaches, draining to the Wollombi Brook in the south-east. A 2.7 km section of North Wambo Creek crosses above proposed LWs 23 - 25. In the upstream reach above LW25, the creek channel is well defined, while further downstream above LW23 and part of LW24 the channel becomes wide and grassy.

Riparian canopy cover decreases as the creek flows towards the finishing ends of the proposed longwalls. The banks and surrounding floodplain have been historically cleared, with some large trees and riparian shrubs present. Erosion occurs along the creek with steep sided, eroding and undercutting banks.

Other Natural Streams

There are two second order ephemeral drainage lines located above the proposed longwalls. Drainage 1 joins North Wambo Creek approximately 2 km above the Diversion. Drainage 2 runs in a north-easterly direction and joins North Wambo Creek Diversion further downstream.

North Wambo Creek Diversion

At the finishing end of LW22 North Wambo Creek joins the North Wambo Creek Diversion. This is a 9.2 km realignment of North Wambo Creek which accommodates progression of the Wambo open

cut. The North Wambo Creek Diversion is generally located outside of the proposed longwalls although a small section crosses above the finishing end of LW17.

The South Bates Underground mine is extracting LWs 11 – 13 beneath the North Wambo Creek Diversion and extracting LWs 14 – 16 adjacent to the Diversion.

Assessment of Impacts

WCPL has predicted subsidence effects for the watercourses above the proposed longwalls (see **Table 7**). Due to the longwall panels being located directly under the creeks and the shallower depth of cover there is potential for these creeks to be impacted by:

- ponding, flooding, erosion and scouring; and
- cracking in the creek beds and fracturing of bedrock.

Table 7: *Maximum predicted subsidence parameters for North Wambo Creek and Diversion due to proposed mining*

Watercourse	***Longwall***	***Maximum predicted total subsidence (mm)***	***Maximum predicted total tilt (mm/m)***	***Maximum predicted total hogging curvatures(km^{-1})***	***Maximum predicted total sagging curvature (km^{-1})***
North Wambo Creek	After LW21	<20	<0.5	<0.01	<0.01
	After LW22	50	4	0.8	<0.01
	After LW23	1,850	80	<0.3	<0.3
	After LW24	1,850	80	<0.3	<0.3
	After LW25	1,850	80	<0.3	<0.3
North Wambo Creek Diversion	After LW17	300	25	<0.3	<0.01
	After LW25	300	25	<0.3	<0.01

Ponding Impacts

WCPL predicts there would be changes to surface gradients and ponding along sections of North Wambo Creek, North Wambo Creek Diversion and Drainage 2 (see **Table 8**).

Table 8*: Predicted Ponding above proposed modification*

Longwalls located below predicted pools	***Watercourse***	***Number of pools predicted***	***Length of predicted pool (m)***	***Depth of Predicted pool (m)***
LW17	North Wambo Diversion	1	25	0.1
LW21	Drainage 2	1	175	1.3
LW22	Drainage 2	1	100	0.9
LW23	North Wambo Creek	2	125	0.3
			350	1.4
LW24	North Wambo Creek	1	300	1.3
LW25	North Wambo Creek	2	100	0.3
			150	0.6

WCPL notes that the extent of ponding above the proposed longwalls is dependent on the flow of the creek. As North Wambo Creek is ephemeral, it is expected that the pools would be dry for long periods.

WCPL has considered potential water loss from ponding by developing a daily water balance to model water inputs and outputs. The difference between the inflow and the flow downstream of the pools represents the overall loss of flow attributable to new pools along North Wambo Creek. This is similar to the modelling developed for the approved South Bates Mine (LWs 11 – 16). This modelling predicts an expected average net loss of about 33 ML/year, which equates to around 1.2% of average annual flow. The Department considers it unlikely that the reduction of total flow would be detectable from the natural variation in the flow regime in the Diversion.

The cumulative loss from pools considering the proposed modification and the approved South Bates longwalls (LWs 11 - 16) is expected to be about 55 ML/year or 2% of average annual flow. Generally,

there are 10 days per year where flow in the creek is 1 ML/day. The cumulative effect of the increased number and size of pools would reduce this to 1 day per year on average.

Figure 8 shows several areas of ponding above the finishing ends of the proposed longwalls. Above LW18 – 22, the predicted ponding is 'off-stream' across relatively flat land. As there would be variance in the actual water area of these predicted ponds due to the contributing catchments and rainfall, the actual extents and depths of ponding in these locations are expected to be less than the predicted topographical depressions**.** As there are no areas of ponding predicted outside the finishing ends of the longwalls (apart from the isolated areas along North Wambo Creek) it is considered that the area is not naturally susceptible to flooding. OEH considered the predicted ponding would be contained within the site boundaries and raised no concerns in regard to flooding. CLWD raised no concerns with potential flooding impacts.

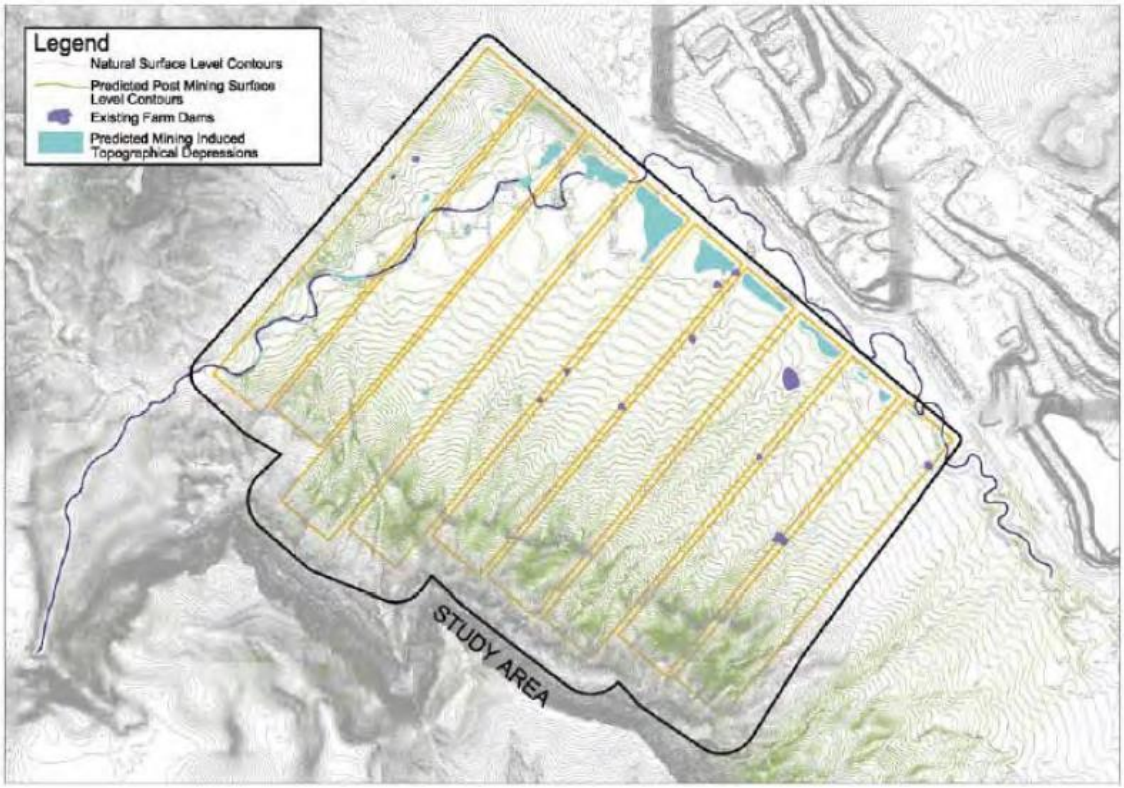


Figure 8: *Potential ponding areas above the proposed longwalls*

WCPL proposes that if adverse impacts were to develop as a result of localised ponding, they could be remediated by locally re-grading streambeds to re-establish natural gradients. The Department accepts this approach as reasonable and feasible and notes that such remediation works would be covered under relevant management plans of existing consent conditions.

Subsidence would increase the natural gradient of North Wambo Creek by up to 5.4% in isolated locations. This would increase the potential for localised erosion in North Wambo Creek, particularly the downstream section of the Creek where it is flatter and fine gravels occur. Where the North Wambo Creek Diversion crosses LW17, the predicted post-mining grades are very similar to the natural grades. However, there is a slight grade increase above the north-eastern corner of LW17.

The gradient of Drainage 2 is expected to increase and could be subject to erosion. There are no predicted reversals of grade along Drainage Line 1 due to it having higher natural gradients.

CLWD raised concerns about the potential for erosion and scour as a result of subsidence under North Wambo Creek and made several recommendations. In response to these concerns, the Department has recommended that:

Within 12 months of the approval of Modification 17, or as otherwise agreed with the Secretary, the Applicant must, in consultation with DPI-Water, revise the Surface Water Monitoring Program to:

(a) include installation of an up-stream flow gauge site on North Wambo Creek;
(b) complete a geomorphic context statement for North Wambo Creek; and
(c) undertake a pre-subsidence survey and energy profile analysis, and develop pre-subsidence channel profiles for both cross sectional and long profiles.

Above LW24 there are a series of braided ancestral channels south of the active North Wambo Creek channel. WCPL notes that, due to tilting, there is potential for North Wambo Creek above LW24 to divert into one of these ancestral channels which it considers would not necessarily have an adverse impact, as the ancestral channels appear to be stable and well vegetated. If the flow did divert into the ancestral channel, it would likely re-join the existing channel about 300 m downstream. WCPL has identified that this area would require monitoring so that any scour or flow Diversion can be identified and appropriate action taken.

The Department considers that WCPL has not fully assessed the potential impact of a diversion of flow into one of the ancestral channels and therefore monitoring and regrading of the active creek bed to prevent diversion of the flow should be implemented. The Department recommends that these remediation measures are outlined in both the Extraction Plan and the Rehabilitation Management Plan (condition 94C of Schedule 4), which should be revised within 3 months of this modification.

HydroSimulations assessed the potential change in groundwater baseflow to North Wambo Creek, its tributaries and the North Wambo Creek Diversion. Modelling predicts the medium-term effect (at about 2030) would be a reduction in groundwater baseflow to North Wambo Creek and its tributaries of around 5 ML/yr. Baseflow occurs as minor seepage into the creeks and the Diversion and would be lost by evaporation in these ephemeral watercourses in any case (except at times of flow). HydroSimulations does not expect that this baseflow provides a measurable contribution to downstream flow (for example in Wollombi Brook).

Surface Cracking Impacts

Subsidence would cause fracturing of the topmost bedrock to develop along sections of the stream directly above the proposed longwalls. This may affect stream flow through a loss of flow into surface cracks.

The creeks are ephemeral with surface water flows only occurring during short periods after rainfall events. WCPL predicts, that in times of heavy rainfall, the majority of runoff would flow over the natural surface soil and stream beds and would not be diverted into the dilated strata below. However, in times of low flow and prior to remediation, surface water flows could be diverted into the dilated strata. The potential for complete hydraulic connectivity is discussed in **Section 5.2.3**.

HydroSimulations modelled changes to the hydraulic properties of the overburden caused by caving and subsidence above the proposed longwalls. The modelling was validated against several measured NSW case studies. Fracturing from the mine directly to the land surface was assumed when the 95th percentile fracture height comes within 15 m of the land surface, the maximum anticipated depth of shallow cracking.

Figure 9 shows that fracturing to the surface is predicted above 40 – 50% of the area above the proposed longwalls (see **Section 5.2.3**). While surficial cracking of the alluvium associated with North Wambo Creek above LWs 23 - 25 is likely, this is considered to be a temporary effect as tensile cracks would open and close as the subsidence wave passes.

WCPL's expectation is that fractures in the underlying bedrock would gradually be filled with surface soil during flow events, especially during times of heavy rainfall. If the cracks did not fill naturally, WCPL would undertake remediation by infilling with surface soil or suitable materials, and if needed, by local regrading and compacting of the surface. It is expected that there would be no long-term adverse impacts on these streams after completion of surface remediation.

WCPL notes that surface cracking widths were observed during previous mining of North Wambo within the range of 10 to 50 mm, with maximum widths up to approximately 100 mm. WCPL expects cracking along North Wambo Creek and the drainage lines to be similar.

WCPL has previously implemented management strategies for undermined sections of the streams at Wambo Coal Mine. Under existing consent conditions, management strategies for the streams would be reviewed and, where required, revised to address the impacts of the proposed longwalls.

Conclusions

Overall, the proposed modification would result in new impacts to an area of North Wambo Creek and associated Drainage lines. However, the predicted impacts are of a similar size and scale to those already approved for other areas of the mine (ie the adjacent and approved South Bates project). WCPL proposes to continue management strategies developed and applied for sections of creeks and drainage lines previously undermined. As at present, it may be necessary, at the completion of mining, to remediate some sections of the ephemeral drainage lines, particularly where depths of cover are shallowest.

The Department would require impact assessment, monitoring, mitigation and remediation of affected watercourses to be addressed in the Extraction Plans submitted for the proposed longwalls. In addition, the Department supports CLWD's recommendations of for further monitoring and information gathering about GDEs.

Existing consent conditions regarding rehabilitation of watercourses were strengthened as part of the assessment of MOD 15 (approved in October 2015), this included an additional rehabilitation objective requiring WCPL to ensure that all watercourses subject to subsidence impacts are hydraulically and geomorphologically stable, with riparian vegetation that is the same or better than prior to mining. This rehabilitation objective would also apply to the proposed modification area.

The Department is satisfied that potential impacts to surface water bodies above the proposed modification area would not be significantly different to those already approved. Further, that any adverse impacts that may occur would be appropriately detected, managed and remediated under the existing conditions of consent.

The Department notes that the North Wambo Creek Diversion is already subject to ongoing monitoring and maintenance (under the existing conditions of consent) including additional tree and shrub planting and weed management, in order to meet the long-term management and rehabilitation objectives for the Diversion.

5.2.3 Hydraulic Connectivity

The EA addresses the potential for increased hydrological connectivity between the surface and the extracted longwall panels. The following four zones were adopted in predicting subsidence impacts for the proposed modification:

- *caved or collapsed zone*: comprises loose blocks of rock detached from the roof and occupying the cavity formed by mining (ie the goaf);
- *disturbed or fractured zone*: comprises *in-situ* material that has undergone significant deformation and is supported by the material in the caved zone. This zone has sagged downwards and consequently suffered significant bending, fracturing, joint opening and bed separation;
- *constrained zone*: comprises confined rock strata above the disturbed zone which have sagged slightly but, because they are constrained by the disturbed zone, have absorbed most of the strain energy without suffering significant fracturing or alteration to their original physical properties. Some bed separation or slippage can be present as well as some discontinuous vertical cracks, but not to a degree or nature which would result in connective cracking or significant increases in vertical permeability. Some increases in horizontal permeability can be found; and
- *surface zone*: comprises unconfined strata at the ground surface in which mining-induced strains may result in the formation of surface cracking or ground heaving.

It is generally accepted that the height of discontinuous fracturing can extend 1 to 1.5 times the void width above an extracted seam. The overall void widths for the proposed longwalls in the Whybrow Seam are 261 m. Therefore, disconnected fracturing could extend 260 m - 390 m above the Whybrow Seam.

As previously noted, the depth of cover ranges from 50 m above the finishing ends of LW 19 and 20 to 330 m above the commencing end of LW 18. Therefore, disconnected fracturing heights are likely to reach the surface over the majority of the proposed modification area. Fracturing to the surface does not always imply hydraulic connectivity between the surface and the mine, as the vertical fractures may be discontinuous due to the presence of strata layers with low permeability (see also **Sections 5.2.1** and **5.2.2**).

The plan view (left hand diagram) of **Figure 9** shows potential direct hydraulic connection (ie connected fracturing) to the surface to be modelled over 40 – 50% of the area directly above the longwall panels. This generally correlates to areas where the depth of cover is less than 100 m. As the Whybrow Seam dips to the south-west the depth of cover increases and the potential for hydraulic connection decreases. While WCPL's mine plan deliberately locates the main gateroads beneath much of the North Wambo Creek Diversion, the Diversion crosses over LW17 where the depth of cover is shallow (between 50-70 m). A longer section of North Wambo Creek crosses LWs 23 – 24 where the depth of cover is also shallow, leading to increased potential for direct hydraulic connection from the surface to the longwall void. It is the layout of LWs 23-25 beneath North Wambo Creek that is of greatest concern to CLWD.

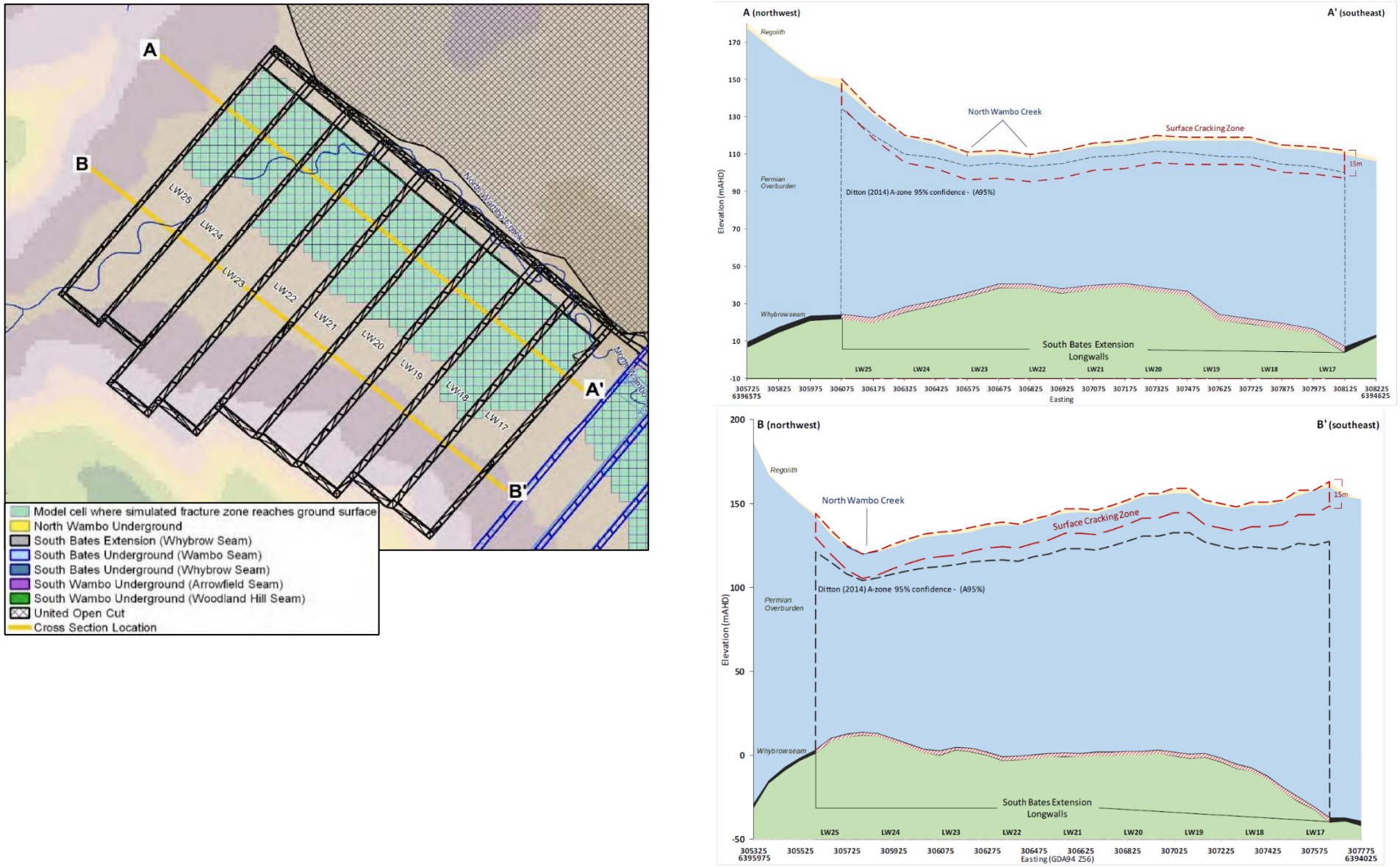


Figure 9: *Modelled surface fracturing above proposed longwalls*

Based on its monitoring results of previous mining at the site (ie the extraction of 21 longwalls with depths of cover ranging from 60 to 120 m), WCPL considers that it is unlikely that a direct hydraulic connection would occur. Direct hydraulic connection between the surface and the longwall voids has previously been observed at only one location, during extraction of longwalls 9 and 9A in the Homestead Mine beneath Stony and Wambo Creeks.

WCPL remediated the creek bed through grouting and installing a buried clay liner. A temporary reduction in surface flows occurred during remediation works, although there does not appear to be any flow loss since the remediation.

The Department and CLWD recognise there is a significant risk of a direct hydraulic connection at key locations above LW17 and LWs 23-25. WCPL notes that if a direct hydraulic connection did eventuate, the majority of the runoff would continue to flow over the natural creek bed during times of heavy rainfall and continue to flow downstream. However, during low flow, surface water would be diverted into dilated strata below the creek bed. This may result in some transfer of higher quality creek water through the cracks into the underlying regolith and fracture zone. These volumes would be small, and may provide some beneficial effect on the water quality in the regolith which is known to be saline at bore GW17.

MSEC considers that the main risk of direct hydraulic connection would be that some surface water flows in the creek could infiltrate through surface cracks and percolate into the workings. WCPL notes that the longwalls would be extracted in the up-dip direction of the seam, so increased water flows into the mine would flow away from the extraction face.

WCPL proposes to apply the remediation approach set out in the South Bates Extraction Plan (LWs 11 - 16) as approved by the Department on 6 May 2017. This same remediation works program has been previously applied by WCPL, to reduce the hydraulic conductivity of any cracks that may open at the surface. Cracks would be sealed using the following actions, to be commenced as soon as they appear:

- washing a slurry containing well-graded sandy silt into the cracks, using water from the mine workings; and
- infilling larger surface cracks with typical alluvial material with added bentonite or other clays as necessary.

In the event that inflow to the workings indicates that sealing is inadequate, the relevant surface pool would be drained by pumping to allow access for visual inspection and any required further remedial action, including possible cement-based grouting. The Department is satisfied with this approach and notes that it would be further considered in detail as part of the Extraction Plan process for the proposed longwalls.

WCPL must prepare a comprehensive Extraction Plan following consultation with relevant agencies and this must be approved prior to commencing extraction of the proposed longwalls. The Extraction Plan must include detailed consideration of the potential for hydraulic connectivity and the proposed monitoring, management and remediation measures. The Department also recommends strengthening the existing Ground Water Monitoring Program to require WCPL to:

> install and monitor vibrating wire piezometers, located above the South Bates Extension Area, both within and beyond the areas with potential for connective cracking.

As part of the Groundwater Dependent Ecosystem Study, WCPL should also be required to:

> provide any recommendations that would assist in assessing the potential fracture interconnections between surface water resources and hard rock aquifers that may impact on groundwater dependent vegetation.

These monitoring requirements reflect recommendations from CLWD and the IESC and would provide important data for inclusion in the relevant Extraction Plans. This data would inform any decision by the Department, following advice from CLWD, to limit undermining of North Wambo Creek or to require remediation measures and rehabilitation completion criteria.

CLWD proposed a series of additional amendments to existing and draft conditions during the Department's assessment process. These included that:

- the Groundwater Dependent Ecosystem Study be developed to its satisfaction and include determination of baseline data for a number of matters that are already addressed under the consent's Surface Water Monitoring Program;
- the full length of North Wambo Creek be subject to a performance measure of 'negligible' subsidence impacts and environmental consequences; and

- all Extraction Plans and Rehabilitation Management Plans be prepared to CLWD's satisfaction and include a series of measures and actions to monitor, manage, arrest, rehabilitate and prevent potential impacts on all streams (including North Wambo Creek) affected by the Wambo Coal Mine.

The Department considers that:

- the proposed Groundwater Dependent Ecosystem Study already addresses all matters previously requested by CLWD and the baseline data sought is already required in the existing Surface Water Monitoring Program, to add this requirement again would be unnecessary duplication;
- North Wambo Creek is an ephemeral stream that is highly disturbed, in part, as a result of approved mining. The monitoring and management of subsidence impacts or environmental consequences are already conditioned and have been strengthened further;
- the established standard conditions relating to Extraction Plans and Rehabilitation Management Plans achieve CLWD's objectives and are developed in consultation with relevant agencies; and
- further consultation between CLWD and WCPL in the development and refinement of management plans must occur, in conjunction with the assessment of the Groundwater Dependent Ecosystem Study and additional monitoring results, to the satisfaction of the Department's Secretary.

5.2.4 Water Quality

Both the IESC and the EPA requested further information to assess the potential impacts the modification could have on water quality. Specifically, the IESC questioned:

- potential leakage of saline or contaminated water from future void lakes (potentially induced through depressurisation resulting from the proposed modification);
- potential leakage of stored water in historic underground workings to the Hunter River, Wollombi Brook or alluvial systems;
- potential implications for water quality and biota in North Wambo Creek and predicted subsidence ponds should flow in the creek reduce;
- changes to water quality from diversion of flows to the subsurface, and potential re-emergence of this diverted water in North Wambo Creek, including changes to iron, salt and dissolved oxygen concentrations; and
- availability of salinity credits under the Hunter River Salinity Trading Scheme (HRSTS) and how WCPL would manage water on-site in the event that sufficient salinity credits cannot be obtained.

WCPL used numerical modelling to predict the potential for the proposed modification to cause leakage from the final voids planned for the proposed United Wambo project. The proposed modification would have no influence on the open cut mining operations or the locations of the final voids.

Modelling predicts that, groundwater levels in the proposed United Wambo project final voids and emplacement areas would recover by approximately 50 m after 200 years. Groundwater levels would remain below pre-mining levels and the final voids would continue to act as groundwater sinks. On this basis, WCPL considers there to be negligible risk of leakage of saline or potentially contaminated water from future void lakes that could affect groundwater users, and no further analysis is required. The Department acknowledges that this assessment provides potential worst-case, as the United Wambo project is not yet approved.

WCPL discharges water to Wollombi Brook under the HRSTS from a discharge point licensed under its EPL. WCPL currently holds 48 HRSTS credits and considers that an additional 63 credits would be required by 2025.

The HRSTS comprises 1,000 active salinity credits (each with a lifespan of 10 years) with credit expiry staged so that, every two years, 200 credits expire and 200 new credits are created and auctioned to replace those that have expired. WCPL considers it is reasonable to assume that it would hold 126 salinity credits by 2025 (by which time four credit auctions would have taken place). It has applied this assumption in the site water balance for this modification. If WCPL could not acquire sufficient salinity credits for a high rainfall scenario, several alternatives could be applied, including reducing production rates, storing water in the open cut pits and/or treating water prior to release are possible.

The EPA raised concerns over WCPL's surface water impact assessment criteria for electrical conductivity (EC) and Total Suspended Solids (TSS) provided by WCPL for North Wambo Creek monitoring sites (SW04 (upstream) and SW05 (downstream)). The IESC noted similar concerns.

The EPA considered that the EC impact assessment criteria for North Wambo Creek were inconsistent with the ANZECC Guidelines, and may not provide a sufficiently early indicator to determine if an impact is occurring and requires mitigation. The EPA recommended that impact assessment criteria derived in accordance with ANZECC Guidelines are used to determine site-specific trigger values.

WCPL responded that the water quality impact assessment criteria provided in the EA are consistent with the approved criteria for SW05 – North Wambo Creek Downstream and were established based on the 20th and 80th percentiles of monitoring results at that site. No surface water quality impact assessment criteria have been developed for SW04 – North Wambo Creek Upstream. WCPL notes that the difference in salinity between the upstream part of North Wambo Creek (SW04) and North Wambo Creek near Wollombi Brook (SW05) was also reported in 2003, prior to development of the North Wambo and South Bates Underground Mines and construction of the North Wambo Creek Diversion.

The EPA then advised that WCPL had not addressed all its concerns and that, where there is a likelihood that EC may exceed 400 µs/cm in sediment dams, dams should be sized and constructed better than the 'Blue Book' guideline to avoid discharge of saline water and ensure compliance with section 120 of the *Protection of the Environment Operations Act 1997 (*POEO Act) and clause 19 of the *Protection of the Environment Operations*. The EPA recommended water quality monitoring of all dam discharges for EC, TSS, turbidity, pH, total dissolved solids, total individual metals and total dissolved metals.

The Department considers that the long history of mining operations in the area and the ephemeral nature of North Wambo Creek could make determining appropriate site-specific trigger values challenging. Consent conditions requires WCPL to implement a Surface Water Monitoring Plan containing detailed baseline data on surface water flows and quality, surface water impact assessment criteria and monitoring of surface water flows and quality in North Wambo Creek. The Department notes that this monitoring plan would be reviewed within 3 months of approval of the proposed modification. Existing conditions also require monitoring of water quality discharged from licensed discharge points. However, to address the EPA's concerns the Department has recommended a program to monitor water quality in dam discharges from the site, in addition to the extra requirements for the Surface Water Monitoring Program discussed above.

Existing conditions of consent require WCPL to comply with section 120 of the POEO Act and the HRSTS. The Department considers that the above conditions satisfy the EPA's concerns. The Department also notes that WCPL would require a variation to its EPL which would allow the EPA to update its water quality monitoring requirements at that time.

5.2.4 Matters of National Environmental Significance

Following its review of WCPL's referral documentation, DoEE determined that it was likely that there would be significant impacts on a water resource in relation to large coal mining development. Specifically, DoEE determined that the proposed action would be likely to have significant impacts on ground and surface water in the vicinity of the proposed mine.

The Commonwealth's 'controlled action' is the proposed extension to the South Bates underground coal mining operations, together with related additional surface infrastructure and activities necessary to support the extension of underground mining.

In considering whether to approve the action, the Commonwealth Minister must consider advice received from the IESC. The IESC has adopted the approach of considering *all* potential impacts, rather than the increase in impacts over those currently approved.

Groundwater Resources

The IESC advised that, for groundwater related matters:

- groundwater modelling required further clarification and consideration. These issues have been addressed under *Groundwater Modelling and Monitoring* in **Section 5.2.1**;
- fracturing is predicted to reach the surface in some areas (see **Section 5.2.3**);
- the action would result in reductions of water pressure in the coal seams and in the overlying Triassic sandstones and potentially affect private water supply bores via drawdown (see **Section 5.2.1**);
- cumulative drawdown (in the hard rock aquifers) could propagate into the Wollemi National Park and the hydrological impacts of this drawdown should be assessed; and
- further consideration should be given to groundwater dependent ecosystems and potential impacts of soil cracking and ponding on flora and fauna habitat (see **Sections 5.2.1** and **5.3.5**).

The Department first notes that, prior to the commencement of any coal mining in the vicinity of Wambo Coal Mine, the potentiometric surface within the Permian aquifers most probably reflected the topography, with elevated water levels/pressures in areas distant from the major drainages and relatively lower levels in areas adjacent to the alluvial lands. However, past and current open cut and underground mining in and around the site has created a regional zone of depressurisation within the Permian coal measures.

Monitoring indicates that mining to date at Wambo Coal Mine has resulted in negligible drawdown in the overlying Triassic sandstones and other strata. The action would likely result in additional depressurisation. However, this is not expected to have any significant regional impact.

The value of a water resource is determined by its utility for third party uses, including environmental and other public benefit outcomes (as detailed in Section 5.2.1 of DoEE's *Significant Impact Guidelines – Water Resources* (2013)). There are 197 groundwater bores within a 5 km radius of the proposed modification, of which 39 are registered for irrigation, domestic and/or stock use and three are of unknown use.

The Department is satisfied that the impacts on these bores would be no greater than previously approved by both NSW and the Commonwealth. The Permian groundwater sources are generally low yielding and brackish to saline, and therefore generally have low resource potential (see **Section 5.2.1**). Potential drawdown impacts (including in relation to the more valuable alluvial water resources) have been discussed under *Alluvial Aquifers*, in **Section 5.2.1**.

Furthermore, in accordance with both the AIP and existing consent conditions, WCPL is required to 'make good' impacts on privately-owned water bores where there is > 2 m cumulative drawdown, or cumulative pressure head decline of > 40% where the 'post Water Sharing Plan' pressure head above the base of the water source is less than 5 m.

The surface of the Wollemi National Park comprises sandstones of the Narrabeen Group that unconformably overlie the Permian coal measures and form the Wollemi Escarpment to the south-west of the Wambo Coal Mine. WCPL predicts that some depressurisation of the Permian aquifer would extend beyond the boundary of the national park. However, no significant hydrological impacts are anticipated given that the depth to groundwater within the Wollemi National Park is greater than 100 m and the predicted cumulative drawdown is less than 2 metres.

The Department is satisfied that impacts to groundwater resources in the proposed modification area would be minimal and generally consistent with or less than impacts already approved by NSW. The Department considers that the impact to groundwater systems of the national park would be negligible. The IESC recommended further work to characterise vertical connectivity between the Permian strata and alluvial aquifers, particularly:

- monitoring and analysis of data from nested piezometers located within the alluvial and Permian aquifers and comparison of the hydrographs with surface water hydrographs and rainfall;
- monitoring of inflows to mine workings to identify changes in volumes and/or rates; and
- collection and analysis of surface and groundwater quality data and suitable stable isotope or tracer data that could provide independent estimates of vertical mixing over time.

Data available from previous underground mining operations at Wambo used to inform the groundwater assessment for the proposed modification includes:

- monitoring of groundwater levels and EC in alluvial bores above North Wambo Underground Mine;
- monitoring of groundwater pressure within Permian strata above and adjacent to North Wambo Underground Mine and South Bates Underground Mine;
- monitoring of inflows to mine workings (with no observed significant changes in volumes and/or rates associated with rainfall and/or extraction under alluvial areas); and
- water quality analysis of surface water in the North Wambo Creek Diversion and water accumulated in mine workings (which showed different chemical signatures).

A multi-level piezometer (N5) in the proposed modification area monitors the Permian groundwater system. N5 is close to shallow piezometers GW16 and GW17, which are monitored for water level and water quality. The Department is satisfied that WCPL has conservatively modelled the potential hydraulic connectivity enhanced by mining, with fracturing to surface assumed over the north-eastern ends of longwall panels. The Department supports the IESC and CLWD recommendations to install additional monitoring bores enabling more accurate characterisation of the hydraulic connectivity at site (see **Section 5.2.1** and **Section 5.2.3**).

Surface Water Resources

The IESC advised that, for surface water related matters:

- the EA's surface water modelling and assessment required further clarification and consideration regarding flow regimes and increased no flow days;
- there was limited discussion of fracturing in North Wambo Creek and Diversion (see *Surface Cracking* under **Section 5.2.2**);
- further information on salinity credits and water management is required (see **Section 5.2.4**);

- further consideration regarding aquatic biota is required (see *Aquatic Biota* under **Section 5.3.2**); and
- limited information on water quality was provided (see *Water Quality* under **Section 5.2.2**).

Surface Water Assessment and Modelling

The IESC asked for further consideration of the calibration, limitations and assumptions for the suite of models used in the EA's Surface Water Assessment. The IESC also requested further justification for the off-site creek flow data used and information on the location of the creek and similarity to creeks at Wambo.

Given the ephemeral nature of flow in the creeks in the proposed modification area and the relatively short duration of available records, available monitoring records at Wambo do not provide an adequate basis for characterising long-term average flow regimes. Consequently, an analogous catchment with comparable geology, landuse and climate was used in the model. For the purposes of the proposed modification (and consequently the action), the modelling is considered to be adequate to characterise the flow regime in North Wambo Creek and North Wambo Creek Diversion.

The Department notes that combined impacts to hydrology and water quality were assessed in the EA's Surface Water Assessment and is satisfied that the potential impacts to surface water have been appropriately considered (see **Section 5.2.3**). Furthermore, surface water monitoring at Wambo is comprehensively detailed in the management and monitoring programs required under existing conditions of consent which are available on WCPL's website. These would be reviewed and, if necessary, revised following any approval of the proposed modification.

The IESC also noted some limitations with the use of the Australian Water Balance Model (AWBM) for the analysis of flow regimes. The Department is satisfied with AWBM as it is a well-recognised, standard model developed specifically for assessment of runoff in Australian catchments.

In regards to water extraction and/or discharge, it is noted that the proposal does not include any material changes to the site's water management system, water supply or water demand. In addition, the mine's water balance was reviewed for the proposed United Wambo project, including the proposed modification. The updated water balance includes revision of groundwater inflows to the underground workings, changes to ROM coal production and scheduling changes for some mine water storages.

The mine's water management strategy is based on containment of mine water within water storage dams and re-use at the mine. This limits the potential for off-site release of salt and heavy metals. Any releases to Wollombi Brook would continue to be carried out in accordance with WCPL's EPL, within the limits imposed by the HRSTS. Furthermore, the existing conditions require the site water balance to be recalculated every year.

North Wambo Creek, North Wambo Creek Diversion and Other Streams

As discussed in **Section 5.2**, the IESC requested clarification of the potential impact the proposed modification may have on no flow days in North Wambo Creek and the potential reduction in baseflow.

The IESC noted that one strategy to avoid, mitigate or reduce impacts of longwall mining is to alter the mine layout, including narrower longwalls and wider inter-panel pillars. The IESC noted that consideration should be given to reducing longwall extents and altering configurations in the vicinity of North Wambo Creek to reduce subsidence impacts, particularly fracturing of the creek bed.

The Department is satisfied that the EA's assessment of potential impacts to surface water resources contain conservative estimates. Additional surface water conditions have been recommended (see **Section 5.2.2**). Existing conditions of consent include subsidence performance measures which are required to be met (and historically have been met), including a performance measure of negligible subsidence impacts on Wollombi Brook. These performance measures would continue to apply to the proposed action.

Monitoring and Management Strategies

The IESC noted that WCPL's website did not key feature management plans reflecting the most recent modification MOD 12. As a result, the IESC recommended that all management plans should be revised to reflect this modification and be uploaded to WCPL's website. The IESC was reviewing WCPL's EA as the Department was reviewing WCPL's revised Water and Biodiversity Management Plans and Extraction Plans resulting from the recently approved MOD 12. For this reason, the most up to date revisions of the management plans were not available on WCPL's website at the time of the IESC's

review. While the Department has completed its initial review of the Water Management Plan, it has not yet received comments on the plan from CLWD, which it requested in May.

The IESC also recommended a number of monitoring and management strategies which the Department has addressed in **Table 10**.

Table 10: *IESC recommendations on monitoring and management strategies and Departmental consideration*

IESC recommendation	***Department's consideration***
Groundwater:	
• Expand the current groundwater monitoring network to install bores that are able to detect and provide early warning of potential drawdown in private bores located to the north, northwest and west of the proposed project.	WCPL has committed to installing additional groundwater monitoring bores in the north and north-west. Accordingly, the Groundwater Monitoring Program would be revised to address the proposal and allow for collection of baseline data prior to commencing mining in the modification area.
• Commit to replace or repair any current monitoring bores which are damaged due to the proposed project such as through subsidence.	An extensive monitoring network is required through several existing conditions of consent and must be maintained during operations.
• Expand the current water quality monitoring program to include 6 monthly sampling in the Permian aquifer and 3 monthly sampling in the alluvial aquifer.	The Water Monitoring and Groundwater Monitoring Program conditions both require that water quality in the alluvial and overburden aquifers is monitored. These plans would be revised to reflect the modification.
• Groundwater sampling to include metals and other potential contaminants of concern.	The Groundwater Monitoring Program includes the requirement for detailed water quality sampling for metals and other contaminants.
• Provide the data used to calculate trigger values for both groundwater levels and quality to show that only pre-impact data has been used in the calculation of the trigger values.	Given the long history of mining in this area, it may not be possible to establish 'pre-impact' data to calculate trigger values. However, where possible, trigger values should be calculated using pre-impact data. Trigger values would require updating as part of the Extraction Plan process and during revision of management plans.
• Regularly review and update the numerical groundwater model to validate predictions and inform ongoing monitoring and management measures.	The performance of the numerical groundwater model's predictions is reviewed annually as part of the Annual Review. The Extraction Plan process also provides a further opportunity for review and update of groundwater model incorporating recent monitoring data.
Groundwater Dependent Ecosystems:	
• Develop a GDE monitoring strategy that monitors groundwater drawdown and subsidence impacts to GDEs and terrestrial vegetation overlying the proposed mine workings and in areas of predicted drawdown	To address potential impacts to GDEs the Department recommends that a Groundwater Dependent Ecosystem Study is completed Within 12 months of the approval of Modification 17 (see **Section 5.2.1**). Additionally, potential impacts on vegetation would be monitored and managed through the Extraction Plan process and performance measures under existing conditions of consent, this includes the requirement for a Biodiversity Management Plan.
• Stygofauna, should be monitored using similar sampling methods to those that have detected stygofauna in Wollombi Brook and its tributaries to enable a baseline to be assessed and performance indicators and management triggers to be determined	WCPL concludes that as previous monitoring has not identified Stygofauna downstream of the proposed modification area it is unlikely to occur in this location. Aquatic fauna monitoring, including macro-invertebrate monitoring, is currently conducted in accordance with the Flora and Fauna Monitoring Program.
• Assess if there is likely to be an impact to the CHVEFW CEEC at this location due to the cumulative impacts of subsidence from the proposed project and the construction of the Montrose dam.	The Montrose dam was approved for construction in 2013, and any impact to CHVEFW CEEC was assessed at the time of approval. See discussion of GDEs in **Section 5.2.1**.
Surface Water:	
• Revise the surface water quality monitoring frequency to ensure the natural variability of the system is captured allowing prompt identification and investigation of any trigger value exceedances.	Surface water sampling is currently conducted in accordance with the Surface Water Monitoring Program. Surface water quality trigger levels would also be developed through the Extraction Plan process, for the proposed modification area.

• Identify and monitor suitable reference sites to calculate trigger values which have not already been impacted by mining.	Given the long history of mining in this area, it may not be possible to establish 'pre-impact' data to calculate trigger values. However, where possible, trigger values should be calculated using pre-impact data. Trigger values would require updating as part of the Extraction Plan process and during revision of management plans.
• Update and amend Trigger Action Response Plans (TARPs) considering the appropriateness of trigger values and clearly define the trigger values associated with the TARPs.	The Extraction Plan process requires development of a Water Management Plan for the proposed modification area. The Surface and Ground Water Response Plan requires revision of TARPs based on updated trigger values for the proposed modification.
• Extend the surface water monitoring program to include additional monitoring on North Wambo Creek upstream of SW04 and immediately downstream of the proposed modification	The existing Surface Water Monitoring Program would require revision to reflect the modification. WCPL would be required to demonstrate compliance with its conditions of consent, which may require the extension of the Surface Water Monitoring Program.
• Updates to the mine water balance with particular regard to increased groundwater inflows, storage and the requirement for discharge of surface water including an up-to-date version of the water management system schematic.	The proposal does not include any material changes to the approved water management system, water supply or water demand. The mine water balance has recently been reviewed to include the proposed United Wambo project and includes consideration of the proposed modification. The Department notes that an existing condition requires an annual revision of the mine water balance, this will allow for adjustments as operations change.
Subsidence:	
• Revise the Subsidence Management Plan to reflect the proposed modification	An Extraction Plan (equivalent to a Subsidence Management Plan) is required to be approved by the Department prior to extraction of longwall panels. WCPL would be required to submit Extraction Plans for the proposed modification area.
• Trigger values and TARPs should be developed and describe when it would be necessary to initiate rehabilitation for the various types of subsidence impacts.	The Extraction Plan process requires updates to the Rehabilitation Management Plan to include specific rehabilitation measures for the proposed modification area. This would include TARPs based on updated trigger values.
• A monitoring program should be developed for subsidence rehabilitation which includes measures to determine the success of rehabilitation with respect to water flows and storage	The existing Rehabilitation Management Plan requires that WCPL monitor and report on the effectiveness of rehabilitation.
• The Subsidence Management Plan should outline the subsidence monitoring to be undertaken both on and off site.	Existing Extraction Plan requirements include a Subsidence Monitoring Program, which would need to reflect WCPL's monitoring commitments such as visual observations within the Wollemi National Park.
• The proponent should commit to designing and constructing the Montrose dam giving appropriate consideration to the changed land surface and altered hydraulic properties of the underlying strata to ensure that there are no potential impacts to either surface or groundwater quality.	WCPL has committed to consider subsidence impacts in the final design of the Montrose dam. See **Section 5.1.4** for further discussion.

Generally, the Department is satisfied that existing monitoring and remediation measures (see **Sections 5.2.1**, **5.2.2** and **5.2.3**) and proposed revisions are appropriate and adequate to mitigate these potential subsidence impacts. The Department has also recommended a number of other conditions for surface water and groundwater resources (see **Sections 5.2.1**, **5.2.2** and **5.2.3**).

Conclusions Concerning IESC Advice

The Department has carefully considered the advice provided by the IESC in regard to the proposal and is satisfied that it can be undertaken:

- using the existing surface water and groundwater models, and future revisions, which are considered appropriate and fit for purpose;
- without causing significantly greater impacts in regard to depressurisation, drawdown, stream leakage and flows, GDEs and other vegetation, fauna (including aquatic biota), hydraulic connectivity and flooding; and
- without causing additional impacts to the significant water resource of Wollombi Brook.

5.2.5 Conclusion

Overall, the Department is satisfied that:

- predicted inflows to mine workings are able to be appropriately managed by WCPL, using existing management practices;
- the proposed modification would have a negligible impact on hard rock aquifer levels at a regional scale and there would be no discernible additional drawdown in any alluvial aquifer;
- there would be a limited impact on stream baseflow or natural river leakage for North Wambo Creek and the North Wambo Creek Diversion beyond that of approved mining operations;
- there would be no significant impact on the quality of groundwater or surface water in the vicinity of the proposal and there is a very low potential for increased flux of more saline water from the Permian strata to the alluvium; and
- no privately-owned registered bores in alluvium or regolith would be significantly affected by drawdown beyond that of the approved mining layout.

However, the proposed mine layout would result in subsidence-induced fracturing and increased hydrological connectivity between the surface and the mine. Under its existing consent, WCPL is required to address these impacts through ongoing surface water and groundwater monitoring (through conditions requiring management and monitoring plans, as well as the Extraction Plan process) and the development of a Surface and Groundwater Response Plan, including trigger values and impact response plans. The Department recommends further strengthening these requirements through additional monitoring and studies (see **Appendix G**).

Based on the Department's assessment of the subsidence impacts of the proposed modification on groundwater and surface water features, it is satisfied that these impacts are either less than or not significantly greater than those already approved. The Department is satisfied that the modification is unlikely to significantly increase the risk of long-term impacts by the project on nearby alluvial and surface water sources beyond impacts permitted under the existing consent.

The Department is satisfied that the modification would not significantly change the surface and groundwater impacts of the approved development and that any incremental impacts can be managed through the existing management and response plans, as may be revised following the modification, and under Extraction Plans.

5.3 Biodiversity

WCPL provided an assessment of the potential impacts on flora and fauna within the modification area. The proposed modification requires 2 ha of vegetation clearing. This clearing is considered to be small in scale and isolated and patchy in nature, since it occurs adjacent to the locations of proposed ventilation shafts and gas management infrastructure.

The assessment focused on a study area totalling 508 ha, located above the extent of conventional subsidence associated with the proposed longwalls but not yet approved for disturbance. The area directly above the proposed longwalls is approximately 407 ha.

5.3.1 Threatened Flora

Eight vegetation communities were mapped in the proposed modification area. The vegetation varies in condition from cleared grasslands through semi-cleared woodlands to extensive continuous woodland areas still supporting most of the original floral diversity.

No threatened flora species or threatened flora populations listed under the *Threatened Species Conservation Act 1995* (TSC Act) or the EPBC Act were identified surveys.

However, several threatened ecological communities were identified within the proposed modification area, as follows:

- one CEEC listed under the EPBC Act: *Central Hunter Valley Eucalypt Forest and Woodland* (CHVEFC);
- one Vulnerable Ecological Community (VEC/CEC) listed under the TSC Act and EPBC Act: *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*; and
- two EECs listed under the TSC Act: *Central Hunter Grey Box – Ironbark Woodland* and *Hunter Lower Redgum Forest.*

WCPL intends to set aside part of the study area as an offset area for the United Wambo project. The proposed offset site is above the south-western ends of the proposed longwalls and contains *Central Hunter Grey Box – Ironbark Woodland*, *Hunter Lower Redgum Forest* and CHVEFC. This area could be indirectly impacted by the modification through surface cracking of soils. The Department notes that

depths of cover increase beneath the proposed offset and that past cracking of soils from adjacent mining in the Whybrow and Wambo seams at similar depths of cover has produced no observable changes in vegetation condition or health. However, the suitability of this offset site would be considered during assessment of the United Wambo project. It is not a matter for consideration for this modification.

5.3.2 Threatened Fauna

Seven vulnerable fauna species listed under the TSC Act were recorded during a field survey of the proposed modification area, as follows:

- three birds: Speckled Warbler, Grey-crowned Babbler, Varied Sittella; and
- four microbats: Little Bentwing Bat, Eastern Freetail-Bat, Yellow-bellied Sheathtail Bat and Eastern Bentwing Bat.

A desktop literature review and a field survey of the site's characteristics by EcoLogical also identified an additional 31 threatened fauna species listed under the TSC Act that are likely to, or have potential to, occur within the proposed modification area. No species listed under further classifications of the TSC Act or species listed under the EPBC Act were recorded during the field survey.

5.3.3 Groundwater Dependent Ecosystems

The Department has discussed the potential impacts of the proposed modification on GDEs in detail in **Section 5.2.1**. Given the existing performance measures within the development consent and additional investigations and monitoring recommended, the Department is satisfied that the impacts to GDEs (or potential GDEs) within the study area are unlikely to be significant.

5.3.4 Other Biodiversity Considerations

Stygofauna

The IESC requested that WCPL provide further consideration of stygofauna and recommended monitoring for stygofauna at "multiple reference sites upstream" and in alluvial aquifers where no drawdown is predicted.

WCPL notes that the shallow alluvial system located above the proposed longwalls was once connected as part of a larger alluvial system associated with Wollombi Brook and its tributaries but is in a highly modified state. The approved and existing Wambo open cut now forms an artificial barrier for any stygofauna present above the proposed longwalls. The alluvial system is now highly modified and fragmented, and WCPL considers further assessment of stygofauna is not warranted. The Department is satisfied that the proposed modification is unlikely to impact stygofauna.

Aquatic Biota

The IESC noted that the potential alterations surface flows could possibly cause ecological implications for aquatic biota. As discussed in **Section 5.2**, the Department is satisfied that the modification would not significantly change the surface and groundwater flow regime. WCPL notes that, once scour protection measures are completed, there is not expected to be any measurable change in the range of TSS concentrations downstream. The existing requirement for a Flora and Fauna Monitoring Program outlines specific monitoring requirements for aquatic fauna, including freshwater macro-invertebrate monitoring incorporating an assessment of SIGNAL A values and water quality.

5.3.5 Assessment of Impacts

Direct Impacts

WCPL proposes to clear 2 ha of derived native grassland to construct additional surface infrastructure to support the proposed longwalls. Clearance results in total loss of the vegetation affected and may cause community and habitat fragmentation, increased erosion, and weed and feral animal incursion. However, since the areas to be cleared are already cleared of woodland, it is unlikely that habitat connectivity would be significantly reduced by the proposal.

Vegetation clearing also results in disturbance of habitat for threatened fauna species including diurnal birds, forest owls and microbats. WCPL proposes to restrict vegetation clearance to derived grassland, avoiding removal of hollow bearing trees. No woodland vegetation would be removed as part of the proposed modification. The Department considers the scale of clearing and any potential adverse impacts to be minor in nature, due to the abundance of similar or better habitat around the modification area as well as the small scale and patchy nature of the clearing and the existing fragmentation of vegetation communities in the broader area.

Indirect Impacts

The surface area located above the proposed longwalls would be subject to some surface and sub-surface subsidence impacts. The proposed modification would result in an additional 508 ha of surface

area being exposed to subsidence impacts. Subsidence impacts could include surface cracking of soils and topographic depressions causing water ponding, erosion and hydrological changes (including groundwater drawdown and resultant impacts on vegetation communities, see **Section 5.2.2**).

Surface cracking of soils may potentially occur over most of the areas of low lying flat topography above longwalls. However, cracking would be less prevalent as depth of cover increases towards the southern escarpment (ie the areas of good quality native woodland). The Department notes that past cracking of soils due to adjacent mining of the Whybrow and Wambo seams at similar depths of cover has produced no observable changes in vegetation condition or health.

The EA's Subsidence Assessment indicates that newly created of topographic depressions could lead to increased ponding of surface water which could result in vegetation death in these areas (see **Section 5.2.2**). The Department notes that any ponding is most likely to occur in areas of derived grasslands.

Nevertheless, WCPL predicts that ponding may impact a small (0.25 ha) area of woodland vegetation, including EECs, which could result in some loss of vegetation due to waterlogging (see **Section 5.2.2**) although this is predicted to be limited to a few individuals of various species.

Increased ponding is also expected to occur on North Wambo Creek, which may adversely impact riparian vegetation. There is also potential for cracking of shallow soils or bedrock to occur in the bed of the upper reaches of North Wambo Creek within the proposed modification area. This cracking has the potential to divert water flows to lower strata, reducing water flows, which may have adverse effects on riparian vegetation along sections of the creek.

Potential GDEs were included within the WCPL's referral to the Commonwealth and its determination. These GDEs are associated with the riparian zone associated with North Wambo Creek. WCPL states that the potential for GDEs only occurs in limited areas near North Wambo Creek where water table depths are less than 5m below the surface. WCPL concludes that, since no distinctive vegetation communities are associated with these areas, none of the vegetation in the proposed modification area is groundwater dependent.

DPI raised concerns that WCPL had not provided enough information to conclude that the riparian *Hunter Lowland Redgum Forest* EEC is not a GDE or that the proposal would not have a significant impact on this community. The IESC raised concern over whether potential groundwater drawdown could affect GDEs, specifically the EBPC listed CHVEFW CEEC and stygofauna (if present).

5.3.6 Avoidance, Mitigation and Management

To avoid impacts to flora and fauna, WCPL has limited new surface infrastructure area so the smallest practicable extent, within technical constraints. The specific location of gas management infrastructure would be determined during post-approval mine planning and engineering studies. WCPL emphasises that this flexibility would allow for optimised avoidance of impacts on threatened flora and fauna.

Where impacts to flora and fauna cannot be avoided, WCPL has proposed mitigation and management measures in accordance with the site's Flora and Fauna Management Plan, including:

- a vegetation clearance protocol, including pre-clearance surveys and procedures;
- collection of habitat features for reinstatement in rehabilitation areas;
- ongoing management of weeds and pest animals;
- rehabilitation of temporary infrastructure sites;
- remedial works for impacts to creek lines arising from subsidence; and
- monitoring of riparian and revegetated areas.

The existing Flora and Fauna Management Plan reflects conditions of consent and contains requirements for fauna and flora monitoring and corrective measures in the event of adverse impacts.

5.3.7 Offsets

The Department considers that WCPL's design of the new surface infrastructure and its proposed management and mitigation measures would limit impacts on vegetation communities and on endangered flora and fauna. The potential impacts of the proposed modification would be minimal, temporary and isolated in nature. The Department is satisfied that WCPL has designed the proposed modification in a manner that avoids impacts on biodiversity values so far as it is reasonable and feasible.

OEH, whilst noting that there have been no reports of unexpected mine subsidence due to previous mining and that significant adverse impacts are unlikely and recommended that, in the event of

unexpected subsidence resulting in adverse impacts on threatened biodiversity, an offset should be provided.

Existing conditions already contain performance measures to offset potential subsidence impacts on, Wollemi National Park, certain vegetation communities and other threatened species, populations or communities. Should these performance measures be exceeded and it is not reasonable or feasible to remediate the impact or environmental consequence, or remediation measures have failed to satisfactorily do so, then WCPL must provide a suitable offset to fully compensate.

5.3.8 Matters of National Environmental Significance

Direct Impacts

DoEE found in its review of WCPL's referral documentation that the action was likely to cause significant impacts on the CHVEFW CEEC, the Swift Parrot and the Regent Honeyeater. These three potential biodiversity impacts were components of the Commonwealth's decision to declare the proposed modification to be a controlled action. One additional Commonwealth-listed threatened species, the Endangered Spotted-tailed Quoll, was considered to be at possible risk of being impacted. However, DoEE informed the Department that this species was not considered likely to be significantly impacted.

The CHVEFW CEEC is equivalent to several vegetation communities listed under the TSC Act and assessed in **Section 5.3.1** above. The proposed modification would not require clearing of this vegetation community.

Neither the Swift Parrot or the Regent Honeyeater has been recorded during field surveys for the proposed modification. They were also not recorded during previous field surveys undertaken in 2003 for the original development application, or for the subsequent 15 modification applications, or for other WCPL approvals or during ongoing monitoring.

The Swift Parrot and Regent Honeyeater are both highly mobile species and the proposed modification area is surrounded by similar contiguous and suitable habitat. As such, it is unlikely that the small area of clearing of derived grassland would affect the size, occupancy, survival and breeding of the Swift Parrot and Regent Honeyeater populations within the Hunter Valley or nationally.

Indirect Impacts

The proposed modification area includes 296 ha of CHVEFW CEEC located directly above the proposed longwalls part of (343 ha within the extent of predicted conventional subsidence) that have not been previously undermined or approved for subsidence impacts. Underground mining has the potential to impact this woodland community by disrupting hydrological processes, triggering erosion, and changing soil structure and chemistry.

WCPL predicts that the subsidence impact most likely to affect the CHVEFW CEEC is topographic depression, resulting in ponding. Ponding can cause tree death and conversion of dryland sites to ephemeral wetlands. However, ponding is predicted to affect only a small part of the plant population on-site (ie a few individuals of particular species). As noted in **Section 5.2.2**, the predicted areas of topographic depressions (ie ponding areas) generally do not coincide with areas of mapped CHVEFW CEEC. Furthermore, of the conservatively assessed 0.25 ha of woodland that may be affected by waterlogging, less than 0.1 ha relates to the CHVEFW CEEC.

Soil cracking also has some potential to affect sub-surface water flows. However, this would be unlikely to affect more than a few individuals of particular species due to the predicted wide spacing of surface cracks. As such, it is likely that the extent of the impacts to this community would be localised to small areas or to individuals within the study area that would be unlikely to impact the regional population in any way.

CHVEFW CEEC is a dryland vegetation community that would be unlikely to be significantly adversely affected by groundwater drawdown. WCPL also contends that the limited impact of subsidence cracking is demonstrated by the continued health of native vegetation on parts of the proposed mining area that have been undermined by extraction in the Whybrow and Wambo seams, at shallow depths of cover.

Management, Mitigation and Offsets

The Department is satisfied that the proposed modification has applied appropriate avoidance principles. The underground mining methods proposed avoid the need for large scale surface disturbance, and the proposed surface infrastructure area which would be cleared consists of derived grassland (2 ha).

In addition, WCPL has proposed to conduct surveys of proposed gas management infrastructure locations so that threatened species and habitat can potentially be further avoided. Under the existing conditions of approval, WCPL must undertake a range of management measures under a specific Vegetation Clearance Protocol, which includes requirements for progressive clearing, pre-clearance surveys and clear delineation of areas to be cleared.

More generally, the modification would be undertaken in accordance with WCPL's Flora and Fauna Management Plan which applies appropriate mitigation measures for potential impacts. This includes the Vegetation Clearance Protocol, weed and pest management strategies, monitoring requirements and details on implementing remediation works. The Flora and Fauna Management Plan would be revised to fully reflect the proposed modification.

As discussed in **Section 5.3.3**, the Department is satisfied that WCPL has designed the proposed modification in a manner that avoids impacts on biodiversity values so far as it is reasonable and feasible. Given that the only direct clearing associated with the proposed modification is 2 ha of derived grassland, the Department considers that an offset for the proposed modification is not appropriate, since the transactional costs are likely to exceed any biodiversity benefit that would arise.

The proposed modification and its impacts are not inconsistent with approved Recovery Plans for the Swift Parrot, Regent Honeyeater and CHVEFW CEEC. In this respect WCPL's application and the Department's assessment have considered the approved Conservation Advices for both the Regent Honeyeater and Swift Parrot (see **Appendix F** for further detail).

Overall, the Department is satisfied that the proposed modification would avoid or minimise significant impacts to the Swift Parrot, Regent Honeyeater and CHVEFW CEEC and that appropriate mitigation and management measures have been proposed for the modification's limited impact. The modification would cause minor consequences resulting from subsidence to the CHVEFW CEEC EECs. DoEE requested that the Department includes a specific performance measure for the CHVEFW CEEC in conditions of consent. The Department supports this request and is otherwise satisfied with WCPL's proposed mitigation and management measures. The Department concludes that impacts on Commonwealth-listed threatened species and EECs are acceptable.

5.4 Other Impacts

The Department is satisfied that the other impacts of the proposed modification are likely to be minor. The assessment of other impacts is summarised in **Table 14** below.

Table 14: *Assessment of other impacts*

Issue	*Consideration and Assessment*	*Recommendation*
Noise Impacts	• WCPL proposes to construct and operate two ventilation shafts and gas drainage and other ancillary infrastructure, including conveyors. • The proposed extension of mine operations until 2039 would result in continued noise impacts for a further seven years. While noise impacts would not increase, they would continue for this additional period. • Wambo's open cut operations are currently approved until 2020; with underground operations and the CHPP approved until 2032. The United Wambo project seeks to continue open cut mining operations after 2020 until 2039. If this application is approved, then the open cut operations would continue under a separate, new consent. The underground, CHPP and rail facilities would continue to operate under the current consents, modified as necessary to mesh in with the separate, new consent. • The proposed extension to the mine's operational life through this modification is consistent with that sought under MOD 16 (associated with the United Wambo project). If the United Wambo project is approved, then the noise emissions associated with open cut mining and related haul trucks would be transferred to the new consent. Concomitantly, the noise emissions managed under DA 305-7-2003 would be substantially reduced. Consequently, noise criteria in the consent would also be reduced, but this can only be considered in MOD 16. • WCPL's Noise Impact Assessment predicts that the currently proposed modification could increase maximum noise levels at sensitive receivers by 0.1 dBA. An increase of this level would be quite imperceptible. • The Department is satisfied any that increased noise impact from the proposed modification would be insignificant. The Department recommends the mine's existing Noise Management Plan should be updated to reflect the modification.	No additional conditions necessary.

Issue	*Consideration and Assessment*	*Recommendation*
Aboriginal Heritage	• A Cultural Heritage Impact Assessment (CHIA) was undertaken by South East Archaeology Pty Ltd. • A total of 35 Aboriginal sites have been identified in the modification area, comprising 20 that were already registered and 15 previously unrecorded and found during field work for the CHIA. • All 35 sites were considered to be of low regional archaeological significance. At a local level, one site was considered to be of moderate archaeological significance and eight sites of low to potentially moderate archaeological significance. • One rock shelter (site 499) is predicted to experience subsidence and would be monitored during undermining. WCPL does not anticipate that a previously recorded scar tree would be impacted. • WCPL must obtain consent from OEH under the *National Parks and Wildlife Act 1974* to destroy Aboriginal sites and objects on the site. • OEH advised that WCPL would require a new AHIP for the majority of the proposed modification area. • The Department is therefore satisfied that the modification's potential impacts to Aboriginal objects would be appropriately managed through the AHIP process, Extraction Plans and by amending WCPL's existing Heritage Management Plan.	No additional conditions necessary.
Air Quality and Greenhouse Gases	• An Air Quality and Greenhouse Gas Review was undertaken by Todoroski Air Sciences. • The proposed modification would generate greenhouse gas emissions through combustion of diesel fuels, consumption of electricity and release of gases from within the coal seam. • The estimated annual greenhouse gas emissions generated from the proposed modification would be of a similar scale to those previously assessed, with annual Scope 1 and Scope 2 emission levels ranging from 0.01 to 0.28 Mt CO2-e. • Dust emissions would be generated through construction activities (ventilation shafts, gas management infrastructure and an additional access road), operations (underground ROM production rate increase and additional ventilation shafts) and transport of product coal. • The EPA considered that air quality impacts from the modification are unlikely to differ from those currently approved (see further discussion in **Section 4.1**) and recommended a condition to limit visible emissions from methane flares. • WCPL proposes to minimise dust generation and potential off-site impacts in accordance with the site's existing Air Quality and Greenhouse Gas Management Plan. • The Department is satisfied that the proposed modification is unlikely to cause any significant impacts at surrounding receptors, above existing air quality criteria. It recommends a condition to reduce visible emissions from flares as far as reasonable and feasible.	The Department recommends a condition requiring WCPL to reduce visible emissions from flares as far as reasonable and feasible.
Agriculture	• The Department has considered relevant provisions of the Mining SEPP and notes that the modification area does not contain BSAL or Viticulture Critical Infrastructure Cluster land. • Potential impacts on agricultural resources in the modification area are primarily associated with surface disturbance in the surface infrastructure extension area and subsidence-related impacts. • Approximately 2 ha of derived grassland, used for pasture and beef production, is proposed to be cleared for this proposed surface development. This land has been assessed as having Class 4 or Class 7 Soil Capability and has a gross productivity margin for beef cattle grazing of approximately $117.39 per hectare per annum. • The proposed modification would not change the existing Remnant Woodland Enhancement Project. • The proposed modification's subsidence impacts are predicted to be generally similar to or less than those of the approved mine layout. WCPL has proposed to implement existing mitigation measures to minimise potential risks to soil resources including remediation of surface cracks, regrading hill steepness and water erosion hazards, stabilisation of surface cracking and drainage works and rehabilitation of subsidence troughs. • The Department is satisfied that the agricultural impacts of the modification are minimal and can be managed under the Extraction Plan process and the mine's Erosion and Sediment Control Plan.	No additional conditions necessary.

Issue	*Consideration and Assessment*	*Recommendation*
Historic Heritage	• The Whynot Homestead and Outbuildings are located above the proposed LW21. While these buildings are close to the heritage-listed Wambo Homestead Complex, they do not share the same associations or significance and are not protected under the *Singleton Local Environmental Plan 2013*. The proposed modification would not impact the Wambo Homestead Complex. • The Whynot Homestead and Outbuildings are currently vacant, have signs of termite activity and are in poor condition. • WPCL predicted vertical subsidence of 1,800 mm and tilting of 5 mm/m at the homestead and 55 mm/m at the outbuildings. Strains of 12 mm/m tensile and 17 mm/m compressive are also predicted. • Visual monitoring of the buildings is proposed during and after longwall extraction. It is possible that tilting may adversely affect the brick chimney. If distortion occurs WCPL proposes to stabilise the building with bracing or a fence to prevent access. • If the condition of the buildings becomes unstable, WCPL proposes to remove the buildings. • The Heritage Council supported WCPL's proposed mitigation and management measures for the Whynot Homestead and recommended that WCPL completes Archival Recording of the Whynot Homestead and Outbuildings before the buildings are impacted by subsidence, with copies of these records to be deposited with the Local Council and relevant Local Historical Society. • WCPL committed to providing an archival recording of the site to the local Council and relevant Local Historical Society, as recommended by the Heritage Council. • The Department is satisfied that any subsidence impacts to the Whynot Homestead and Outbuildings would be acceptable and can be effectively mitigated and managed under the conditions proposed.	The Department recommends an additional condition requiring an archival recording of the Whynot Homestead and Outbuildings prior to longwall extraction.
Surface Infrastructure	• The modification would require the construction and operation of: o two additional ventilation shafts; o gas management infrastructure including two centralised gas plants and gas drainage boreholes (progressively constructed, operated and decommissioned); o access tracks; and o ancillary surface and water management infrastructure. • WCPL proposed that the exact locations of gas drainage infrastructure would be confirmed in relevant Extraction Plans. This would allow it to undertake further surveying to avoid potential impacts to threatened flora and fauna species. • Surface disturbance associated with proposed gas drainage boreholes was included as vegetation to be cleared within the Flora and Fauna Impact Assessment. Since the surface disturbance for these facilities is within derived grassland, no additional offsets are necessary. • The Department is satisfied that impacts associated with the extensions to surface infrastructure can be effectively mitigated and managed through existing conditions of consent.	Locations of gas management infrastructure would be considered further in the Extraction Plan and Flora and Fauna Management Plan, prior to commencement of operations under this modification.
Rehabilitation	• WCPL implements a rehabilitation program in accordance with its existing approved Flora and Fauna Management Plan. • WCPL is also required to prepare and implement a separate rehabilitation management plan to the satisfaction of DRG. • WCPL notes that the modification would: o not require a material change to the rehabilitation program presented in the *Wambo Development Project Environmental Impact Statement (WCPL, 2003);* and o not alter the rehabilitation schedule for tailings disposal facilities. • There would also be sufficient storage capacity for the additional coal rejects generated by the modification. • WCPL proposed the following mitigation/rehabilitation measures for the proposed modification: o locating portals to underground workings outside the Probable Maximum Flood and sealing at the completion of mining; o filling of cracks and minor erosion holes; o installing sediment fences downslope of subsidence-induced erosion areas; o stabilisation of erosion areas using rock or other appropriate materials; o stabilisation of banks subject to soil slumping; and o revegetation using brush matting, seeding or tubestock.	No additional conditions necessary.

Issue	*Consideration and Assessment*	*Recommendation*
	• DRG considered that the project could achieve sustainable rehabilitation outcomes. The Department is satisfied that rehabilitation of the Wambo Coal Mine can be effectively mitigated and managed through existing conditions of consent, which should be updated to reflect this modification.	
Social and Economic Impacts	• The modification would use the existing operational workforce and equipment fleet to optimise coal recovery, with minor additional impacts on nearby receivers. • The modification would recover an additional 18 Mt of ROM coal, provide continued employment for Wambo Mine's underground employees and contractors, provide continued State and Commonwealth royalties and taxes, and efficiently recover State-owned mineral resources that would otherwise be sterilised. • Importantly, this modification allows recovery of a resource which would not be feasible without using the existing mining fleet. • The Department considers that, overall, the modification would enable the benefits of the project to be realised without any significant adverse social or economic impacts to the local community.	No additional conditions necessary.
Waste Materials	• The modification would produce an additional 3.7 Mt of coarse coal rejects and 2.1 Mt of coal tailings. In line with approved arrangements, the tailings would be pumped as a slurry to dedicated emplacement areas and encapsulated in open cut voids. The coarse rejects would be co-disposed in open cut voids or used as bulk fill to cap the mine's tailings emplacement areas. • WCPL noted that there would be sufficient storage capacity for the additional coal rejects generated by the modification and no alteration of rejects or tailings management measures would be required.	No additional conditions necessary.

5.5 Changes to Existing Conditions

WCPL requested a number of changes to existing conditions of consent (see Table 14 of Section 5 of the EA). The Department has considered these requests in **Table 15** below.

Table 15: *Proposed modifications to the development consent*

Proposed modification	*WCPL's Justification*	*Department's recommendation*
In Schedule 1, replace the 5th bullet point with "longwall mining in the Whybrow Seam via the open cut highwall.	The proposed modification proposes additional longwalls in the Whybrow Seam.	The Department recommends replacing this existing bullet point to reflect the additional longwalls in the Whybrow Seam.
Insert the proposed modification into condition 2 of Schedule 2.	-	The Department has recommended conditions to this effect.
Extend the life of allowed mining operations from 2032 to 2039.	The modification application involves an extension to the mine life of 7 years.	The Department has recommended conditions to this effect.
Replace the footnote reference 'a' with a 'b' in the second row, third column of Table 3 of condition 4 of Schedule 4.	The short-term impact assessment criterion for PM10 over a 24-hour averaging period should be based on incremental impact, consistent with current NSW Government policy.	The Department is satisfied that this correction is appropriate.
Remove reference to the Deed of Agreement and the requirement for a conservation agreement for Aboriginal Cultural Heritage from condition 51 of Schedule 4 and replace with the requirement for a protocol.	The condition contains an outdated reference to a Deed of Agreement with the Minister, which is no longer required following a previous amendment to condition 41 of Schedule 3. It is proposed that a separate protocol (to form part of WCPL's environmental management system) is developed to meet the intent of this condition.	While the Department generally supports this proposed administrative change, both OEH and the Department consider that a protocol does not hold the same weight as a management plan. The Department recommends that the requirement for a Deed of Agreement is replaced with a management plan.
Replace Appendices 1 and 5 with updated versions.	-	The Department has recommended conditions to this effect.

6. RECOMMENDED CONDITIONS

The Department has drafted a recommended notice of modification (see **Appendix G**) and a consolidated version of the consent as it is proposed to be modified (see **Appendix H**). These conditions strengthen the existing conditions in addition to addressing the concerns raised by several agencies.

The Department recommends updating the 'limits on approval' conditions in Schedule 3 to more accurately reflect the split between the open cut and underground mining operations.
To minimise subsidence and water resource impacts, the Department recommends changes to conditions relating to Natural Features Performance Measures, the Groundwater Monitoring Program and the Surface Water Monitoring Program. The Department also recommends an independent study to investigate the groundwater dependence of vegetation communities within the modification area.

WCPL does not object to the recommended conditions.

7. CONCLUSION

The Department has assessed the merits of the proposed modification in accordance with the requirements of the EP&A Act. This assessment has shown that, with the implementation of minor amendments to existing conditions, coupled with WCPL's proposed mitigation measures and required amendments to existing management plans, the proposed modification can be carried out with limited and acceptable environmental impacts.

The proposed underground longwall mining can be carried out economically and is a relatively straightforward variation to existing approved underground operations at Wambo.

Following on from its assessment of the project, the Department of Planning and Environment considers that the project is approvable, subject to the proposed conditions of consent (see **Appendix G**). This assessment report is hereby presented to the Planning Assessment Commission for determination.

13/11/17

Megan Dawson
A/Director
Resource Assessments

13/11/17

Oliver Holm
Executive Director
Resource Assessments and Compliance

APPENDIX A – ENVIRONMENTAL ASSESSMENT

Refer to the Department's website:
http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5586

APPENDIX B – COPY OF SUBMISSIONS

Refer to the Department's website:
http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5586

APPENDIX C – RESPONSE TO SUBMISSIONS

Refer to the Department's website:
http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5586

APPENDIX D – AGENCY COMMENTS ON RESPONSE TO SUBMISSIONS

Refer to the Department's website:
http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5586

APPENDIX E – IESC ADVICE

Refer to the Department's website:
http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5586

APPENDIX F – MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

In accordance with the Bilateral Agreement between the Commonwealth and NSW Governments, the Department provides the following additional information required by the Commonwealth Minister, in deciding whether or not to approve a proposal under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

F.1 REQUIREMENTS FOR DECISIONS ABOUT THREATENED SPECIES AND ENDANGERED ECOLOGICAL COMMUNITIES

In accordance with section 139 of the EPBC Act, in deciding whether or not to approve, for the purposes of section 18 or section 18A of the EPBC Act, the taking of an action and what conditions to attach to such an approval, the Commonwealth Minister must not act inconsistently with certain international environmental obligations, Recovery Plans or Threat Abatement Plans. The Commonwealth Minister must also have regard to relevant approved conservation advices.

Australia's International Obligations
Australia's obligations under the *Convention on Biological Diversity* (Biodiversity Convention) include the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding. The recommendations in the Department's Assessment Report are not inconsistent with the Biodiversity Convention, which promotes environmental impact assessment (such as this process) to avoid and minimise adverse impacts on biological diversity. The recommended approval requires avoidance, mitigation and management measures, and offsetting for listed threatened species and communities in the event of adverse impacts. All information related to the proposed action is required to be publicly available to ensure equitable sharing of information and improved knowledge relating to biodiversity.

Australia's obligations under the *Convention on Conservation of Nature in the South Pacific* (Apia Convention) include encouraging the creation of protected areas which together with existing protected areas will safeguard representative samples of the natural ecosystems occurring therein (particular attention being given to endangered species), as well as superlative scenery, striking geological formations and regions. Additional obligations include signatories using their best endeavours to protect such fauna and flora (special attention being given to migratory species) so as to safeguard them from unwise exploitation and other threats that may lead to their extinction. The Apia Convention was suspended with effect from 13 September 2006. While this Convention has been suspended, Australia's obligations under the Convention have been taken into consideration. The recommendations are not inconsistent with the Convention, which has the general aims of conservation of biodiversity.

The *Convention on International Trade in Endangered Species of Wild Flora and Faunas* (CITES) is an international agreement between governments which seeks to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The recommendations are not inconsistent with CITES as the proposed action does not involve international trade in specimens of wild animals or plants.

Recovery Plans and Approved Conservation Advices
The applicable recovery plans and approved conservation advices are discussed below.

- National Recovery Plan and Approved Conservation Advice for the Regent Honeyeater (*Anthochaera Phrygia*)

The National Recovery Plan considers the conservation requirements of the Regent Honeyeater across its known range and identifies actions to ensure its long-term viability. The Recovery Plan provides information on habitat requirements, ecology, distribution, conservation status, key threats, management issues, research and monitoring, captive breeding and translocation, and community education. The Hunter Valley is identified in the recovery plan as a known breeding area for the Regent Honeyeater, where the species is regularly recorded.

The Conservation Advice for the Regent Honeyeater was approved by the Commonwealth Minister on 25 June 2015 and identifies the main threats as destruction/degradation/fragmentation of the

species' habitat. The Conservation Advice identifies local and regional priority actions that could be implemented to support recovery of the species.

The objectives of both documents are to:
- *Reverse the long-term population trend of decline and increase the numbers of regent honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years; and*
- *Maintain key regent honeyeater habitat in a condition that maximises survival and reproductive success, and provides refugia during periods of extreme environmental fluctuation.*

WCPL proposes to clear 2 ha of derived grassland to construct additional surface infrastructure to support the proposed longwalls. Vegetation clearance results in total loss of the vegetation affected and may cause community and habitat fragmentation, increased erosion, and weed and feral animal incursion. However, since the areas to be cleared are already cleared of woodland, it is unlikely that Regent Honeyeater habitat or habitat connectivity would be significantly reduced by the proposal.

As such, the proposed modification aligns with the Regent Honeyeater Recovery Plan and Approved Conservation Advice objectives by avoiding impacts to the extent and quality of Regent Honeyeater habitat.

- National Recovery Plan and Approved Conservation Advice for the Swift Parrot (*Lathamus discolor*)

The National Recovery Plan considers the conservation requirements of the Swift Parrot across its known range and identifies actions to ensure its long-term viability. The Recovery Plan provides information on habitat requirements, ecology, distribution, conservation status, key threats, management issues, research and monitoring, captive breeding and translocation, and community education. The Hunter Valley is identified in the recovery plan as a winter foraging area for the Swift Parrot where the species is regularly recorded.

The Conservation Advice for the Swift Parrot was approved by the Commonwealth Minister on 5 May 2016 and identifies the main threats as predation from Sugar Gliders and loss/alteration of its habitat. The Conservation Advice identifies local and regional priority actions that could be implemented to support the recovery of the species.

The objectives of both documents are to:
- *to prevent further decline of the Swift Parrot population; and*
- *to achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity.*

WCPL proposes to clear 2 ha of derived grassland to construct additional surface infrastructure to support the proposed longwalls. Vegetation clearance results in total loss of the vegetation affected and may cause community and habitat fragmentation, increased erosion, and weed and feral animal incursion. However, since the areas to be cleared are already cleared of woodland, it is unlikely that Swift Parrot habitat would be significantly reduced by the proposal.

As such, the proposed modification aligns with the Swift Parrot Recovery Plan and Approved Conservation Advice objectives by avoiding impacts to the foraging habitat of Swift Parrot.

- Approved Conservation Advice (including listing advice) for the *Central Hunter Valley Eucalypt Forest and Woodland*

In April 2015, the Commonwealth Minister approved the Conservation Advice for the *Central Hunter Valley Eucalypt Forest and Woodland*. The Conservation Advice identifies vegetation clearance and landscape fragmentation as a key threat affecting this CEEC. Other key threats include invasive flora species, pests, infrastructure development and removal of fallen timber and trees. The Conservation Advice identifies and prioritises conservation actions that could be implemented to assist the recovery of the ecological community. A recovery plan for the community is not recommended.

No woodland vegetation would be removed as part of the proposed modification. The Department considers the scale of clearing of derived grassland, and any potential adverse impacts, to be minor in nature due to the abundance of similar or better habitat surrounding the modification area as well as the small scale and patchy nature of the clearing and the existing fragmentation of vegetation communities in the broader area.

The Department considers WCPL's proposed actions to be in accordance with the Conservation Advice, particularly in regard to the priority of avoidance of adverse impacts to this community.

Threat Abatement Plans
The Threat Abatement Plans relevant to this action are discussed below and are available at http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans/approved.

- Threat abatement plan for competition and land degradation by rabbits

Rabbits (along with foxes and cats) are considered to be Australia's most serious vertebrate pests. They are significant predators of native fauna in Australia, and severely affect native flora and fauna, vegetation communities, landforms, geomorphic processes and sensitive sites. Due to the widely established population of rabbits, the Threat Abatement Plan for this species aims to minimise its impacts on biodiversity.

The proposed action could increase the competition for Swift Parrot and Regent Honeyeater habitat through clearance and modification of habitat. However, given the small nature of the proposed surface disturbance area and the fact that the area to be cleared is derived grassland, the risk of this impact is considered to be very low.

WCPL has proposed that feral animal management and control would be continued using the site's Flora and Fauna Management Plan, which would be updated to reflect the proposed modification.

The proposed modification would not be inconsistent with the Threat Abatement Plan, particularly in relation to Objective 2 which promotes the maintenance and recovery of native species and ecological communities that are affected by rabbit competition and land degradation. The site operates under an approved Flora and Fauna Management Plan. This plan includes management measures to control pests and weed infestations.

- Threat abatement plan for predation by feral cats

Feral cats are a serious pest in Australia and can have severe effects on native fauna through predation, competition and disease transmission. The Threat Abatement Plan for this species focuses on reducing recruitment of domestic/stray cats near human habitation to the feral cat population and to manage negative impacts of feral cats.

As the proposed surface disturbance area is small (2 ha) and the area to be cleared is derived grassland, the risk of this impact is considered to be very low. WCPL has proposed that feral animal management and control would be continued using the site's Flora and Fauna Management Plan, which would be updated to reflect the proposed modification. With these measures in place, the Department is satisfied that the action would not be inconsistent with the threat abatement plan for predation by feral cats.

F.2 ADDITIONAL EPBC ACT CONSIDERATIONS

Table F1 contains the additional mandatory considerations, factors to be taken into account and factors to have regard to under the Act, additional to those already discussed, which the Commonwealth Minister must consider in determining the proposed action.

Table F1: *Additional considerations for the Commonwealth Minister under the EPBC Act*

EPBC Act Section	***Considerations***	***Conclusion***
Mandatory considerations		
136(1)(b)	Social and economic matters are discussed in the EA and Section 5.4 of the Department's Assessment Report.	The Department considers that the project would result in a range of benefits to the local community and local and regional economy.
Factors to be taken into account		
3A, 136(2)(a), 391(2)	Principles of ecologically sustainable development (ESD), including the precautionary principle, have been taken into account, particularly: • long-term and short-term economic, environmental, social and equitable considerations that are relevant to this decision; • conditions that restrict environmental impacts and impose monitoring and adaptive management	The Department considers that the project, if undertaken in accordance with the recommended conditions of approval, would be consistent with the principles of ESD.

	reduce any lack of certainty related to the potential impacts of the project; • conditions requiring the project to be delivered and operated in a sustainable way to protect the environment for future generations and conserve the affected matters of national environmental significance; • advice provided within this report reflects the importance of conserving biological diversity and ecological integrity in relation to the controlling provisions for the project; and • mitigation measures to be implemented which minimise potential impacts of the project on biodiversity within the project area.	
136(2)(e)	Other information on the relevant impacts of the proposed action – the Department is not aware of any relevant information not addressed in this assessment report.	The Department considers that all information relevant to the impacts of the project have been taken into account in this assessment. The Department's consideration on key issues is in Section 5 of this report.
Factors to have regard to		
176(5)	Bioregional plans	There is no relevant bioregional plan.
Considerations on deciding on conditions		
134(4)	Must consider: • information provided by the person proposing to take the action or by the designated proponent of the action; and • the desirability of ensuring as far as practicable that condition(s) are a cost-effective means for the Commonwealth and the person taking the action to achieve the object of the condition.	Documentation is provided by WCPL in Appendices D & E of its EA (see **Appendix A** of the assessment report) and RTS (see **Appendix C** of the assessment report). The Department considers that the proposed conditions are a cost-effective means of achieving their purpose.

F.3 THREATENED SPECIES AND COMMUNITIES (SECTIONS 18 & 18A OF EPBC ACT)

For the reasons set out in **Section 5.3** of the assessment report, the Department recommends that the impacts of the action on threatened species and communities would be acceptable, subject to implementation of the avoidance and mitigation measures described in WCPL's EA and RTS, and to the requirements of the recommended conditions of approval.

The Department believes that existing conditions 40 – 41A and 44 – 50 in Schedule 4 of the existing development consent provide a suitable regulatory framework to manage the risk of impacts to listed threatened species from the modification.

Accordingly, the Department recommends that the Commonwealth Minister require WCPL to implement conditions 1, 2 and 2A of Schedule 3, conditions 22, 22C, 40 – 41A and 44 – 50 in Schedule 4 of the consent (as proposed to be amended by the Notice of Modification), where they relate to the management of potential impacts on listed threatened species under the EPBC Act.

F.4 A WATER RESOURCE, IN RELATION TO COAL SEAM GAS DEVELOPMENT AND LARGE COAL MINING DEVELOPMENT (SECTIONS 24D AND 24E OF THE EPBC ACT)

For the reasons set out in **Section 5.2** of the assessment report, the Department concludes that the impacts of the action on water resources are acceptable, subject to the avoidance and mitigation measures described in WCPL's EA, RTS and response to the IESC review, and the requirements of the existing development consent and recommended Notice of Modification.

The Department believes that existing conditions 22 – 39 in Schedule 4 of the existing development consent provide a suitable regulatory framework to manage the risk of impact to water resources from the modification, in particular, potential impacts to private water users and the need to monitor surface water and groundwater, and implement a response plan in the event of adverse impacts.

Accordingly, the Department recommends the Commonwealth Minister require WCPL to implement conditions 1, 2 and 2A of Schedule 3 and conditions 22, 22C, 22D and 23 - 39 in Schedule 4 of the

consent (as proposed to be amended by the Notice of Modification), where they relate to the management of potential impacts on water resources under the EPBC Act.

F.5 OTHER PROTECTED MATTERS

The Commonwealth Department of the Environment and Energy determined that other matters under the EPBC Act are not controlling provisions with respect to the proposed action. These include listed migratory species, Ramsar wetlands, the Commonwealth marine environment, world heritage properties, national heritage places, nuclear action and the Great Barrier Reef Marine Park.

APPENDIX G – NOTICE OF MODIFICATION

APPENDIX H – CONSOLIDATED CONSENT