Planning Assessment Commission

NSW GOVERNMENT

Russell Vale Colliery
Underground Expansion Project

Second Review Report

Joe Woodward PSM (Chair)
Paul Forward
Andrew Stoeckel

March 2016

NSW Planning Assessment Commission
Level 13, 301 George St Sydney NSW Australia
Telephone: (02) 9383 2100
Email: pac@pac.nsw.gov.au
ISBN: 978-0-9942315-8-1

Executive Summary

Background

Russell Vale Colliery is an existing underground coal mine under the Woronora Plateau in the Sydney Drinking Water Catchment Area within the Wollongong and Wollondilly Local Government Areas. The pit top facilities are located on the slopes of the Illawarra Escarpment west of the Princes Highway. The suburbs of Russell Vale and Corrimal are located directly to the east and south of the pit top site.

The mine has been in operation since the 1880s using various underground mining methods to mine different coal seams. The nature of underground mining is that subsidence and cracking will occur and have been observed in the catchment area. The extent of subsidence and cracking and their environmental consequences in the area are largely unknown. Prediction of crack occurrence, crack attributes and crack connectivity within the subsidence zone is especially difficult[1]. The multi-seam mining that has previously been undertaken makes the prediction even more difficult. The implication of these uncertainties for water quality and quantity in the catchment area is therefore a major issue. Noise and dust from the operations of the existing mine are major concerns to the nearby residents in Russell Vale and Corrimal.

The Application

In August 2009, the Environmental Assessment for the Russell Vale Colliery Underground Expansion Project was lodged with the then Department of Planning. The proposal sought a major expansion to the underground operation to the west of the existing mine. Due to major concerns raised in submissions from the public and government agencies, the application was substantially modified to remove a significant portion of the western part of the expansion area. The current application seeks approval to mine a small area to extract 4.7 million tonnes of coal over a 5-year period.

In December 2014, the Commission was asked to review the project including the holding of public hearings. The Commission's review report was submitted to the Minister for Planning in April 2015. The report was critical of the piecemeal approach to small approvals and concluded that "*the Commission does not have sufficient information or confidence to determine the merits of the proposal sufficient for a determination for approval. It may be possible for the proposal, or a modified proposal to be approved if all the additional information identified in this Review Report provides a greater level of confidence for the protection of water quality and quantity in the Sydney Catchment Area and satisfies all the other issues identified in this review*". The report included 15 recommendations.

The Commission's Process

On 23 October 2015, the Minister for Planning requested the Commission to carry out a second review of the project including the holding of public hearings. A public hearing was held on 8 December 2015. The Commission received submissions both for and against the proposal. In support of the application, submissions highlighted the regional economic benefits, the positive relationship between the mine and the community, and the outcomes of the Integrated Risk Assessment (IRA). The objections to the mine included adverse impact on the upland swamps located in the Sydney Drinking Water Catchment, risks and impacts on water resources within the catchment, the Integrated Risk Assessment process, historical actions and reputation of the mining company, the adequacy of the cost/benefits analysis, climate change, adverse health impacts, adverse impacts on residential amenity (noise and dust), particularly for the local community, biodiversity and Aboriginal cultural issues.

[1] Mackie Environmental Research Pty Ltd, letter to Planning Assessment Commission dated 7 March 2016, p.5

Commission's Considerations

The Commission continues to have a concern with the incremental approach to the assessment of a project which may have significant environmental consequences in a highly sensitive area, the Sydney drinking water catchment area. This concern was first raised by an earlier Commission panel when determining the 2010 application for a small extension to the existing mine to allow continue operation pending the determination of the current application. The same concern was raised again in the 3 subsequent modifications to the approval of the 2010 application and in the first Commission review of this project. The key issue is the potential cumulative environmental impacts to the catchment area and nearby residents. The "bracket creep" effect is a substantial concern to this Commission.

The Commission's First Review recommended the setup of an integrated assessment process to provide independent inputs into the assessment of the project. The proponent formed an independent panel in response to this recommendation. However the public submissions and the Commission's experts, E/Prof Jim Galvin and Dr Colin Mackie, questioned the adequacy of the process. As pointed out by E/Prof Galvin, the expectation of the process is the assessment team would include "*outside expertise in order to tap into other knowledge and experience; promote discussion and critical evaluation; test assumptions; calculations and analyses; and provide an independent layer of assurance that all meaningful hazards had been identified and appropriately assessed for likelihood and consequence and that proposed controls were sensible and likely to be effective"*.[2] This appears not to be the case here. It should be noted that the Commission is not questioning the independence of any individual expert on the panel.

Dr Mackie in reviewing the underground water information found weakness in the water modelling. He questioned the suitability of calibration as it appears to be biased with a very limited baseline data and high reliance on the results of one piezometer RV20. He also questioned the interpretation of the results of piezometer RV20.

Despite extensive effort, the Commission's two experts have concluded that the concern about the potential loss of surface water flow due to subsidence and cracking remains uncertain.

WaterNSW, the authority responsible for the care and protection of the catchment area objects to the project because of concern about the risks of water losses to the catchment and water quality impacts and associated treatment costs, should upland swamps be impacted and/or lost, along with their associated ecosystem functions.

The Department of Primary Industries is also concerned about the significant uncertainty in the project impacts to water quantity and quality.

The Office of Environment and Heritage (OEH), Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) and WaterNSW all raised concerns about the risk to upland swamps, an endangered ecological community and the Giant Dragonfly, an endangered species.

The Commission recognises that the upland swamps are complex ecosystems, and predicting the ecological and hydrological response of each upland swamp being undermined is difficult. The Commission notes that while these swamps have been undermined previously, the resulting impact on the swamps remains uncertain, particularly as a result of multi-seam mining. There is general agreement that at least some of the swamps to be undermined would be damaged to some extent by the proposed mining.

[2] Galvin and Associated Pty Ltd, Letter to Chair Planning Assessment Commission dated 8 March 2016, p6.

As highlighted by WaterNSW, a biodiversity offset policy for upland swamps could only ever address biodiversity issues and does not resolve potential hydrological impacts and loss of ecosystem functions.

The community adjacent to the pit top site and the Environment Protection Authority raised concern about the potential operational noise impacts to nearby residents and truck noise on residents along Bellambi Lane. The pit top site directly adjoins a number of residential streets making noise and traffic impacts difficult to manage at the "current" production rate of less than 1 million tonnes per year. The Commission finds the noise impact assessment under-estimated the noise impact on residences adjacent to the pit top site and along Bellambi Lane because the assessment relied on modelled rather than existing noise levels for comparison, which is inconsistent with the *Industrial Noise Policy*.

The project as proposed, may generate short-term benefits including up to 300 jobs for the 5 year approval period, about $23 million in royalties to the NSW Government, $85 million capital investment and other direct and indirect flow on effects. Other benefits include the maintenance of coal production in the Southern Coalfields and the utilisation of the Port Kembla Coal Terminal, which is currently underused.

However, the Commission notes the Department of Trade and Investment's advice that this is a small project ranked 50 out of 56 producing coal mines in NSW if approved. Furthermore, the mine is currently not operating and is in care and maintenance. There are some external costs which have not been included in the economic assessment as identified in the CIE report and by the Commission. These include WaterNSW's ongoing monitoring requirement, greenhouse gas emissions and monetary compensation for the loss of water, additional mitigation measures to reduce noise impacts and potential long term operation and management cost of the water treatment system, if required, after mine closure.

The Commission has considered all the available information including additional information provided by relevant agencies and experts. There is no disagreement about the importance of protecting Sydney's drinking water catchment, both in terms of the water quality and quantity. The proponent has argued that this can be achieved by the proposed mining layout and mining methods, acknowledging that the mine plan has been substantially modified and reduced compared with the original proposal. The Department's assessment concluded that the social and economic benefits of the project outweigh the residual costs and it is in the public interest that the project be approved subject to conditions.

Advices from WaterNSW and the Commonwealth's Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development have both identified significant risks with respect to the proponent's water modelling of the predicted impacts. The Commission's experts confirmed the risk of water loss remains uncertain. The magnitude of water loss is uncertain with the projected range from the proponent and Water NSW varying from minimal to 2.6GL/year. The Commission considers this is a high risk situation. The Commission also has regard to the objectives of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*, particularly "*a project will have neutral or beneficial effect on water quality"*. From the evidence currently presented to it, the Commission is of the opinion that the project satisfies neither of these requirements.

On the basis of all the information provided, the Commission is of the view that the social and economic benefits of the project as currently proposed are likely outweighed by the magnitude of impacts to the environment.

In reaching its conclusion, the Commission has had regard to the evidence presented to it by the proponent, the Department, the public submissions and presentations to the public hearing and from the advice provided by the Commission's independent experts, the IESC, OEH, and WaterNSW and the relevant State Environmental Planning Policy (Mining SEPP and Sydney Drinking Water Catchment SEPP).

Recommendations:

The Commission recommends that any further consideration of the proposal should have regard to the issues raised in this Review Report.

Glossary

Commission:	The Commission to review this application, constituted by Mr Joe Woodward PSM (chair) Mr Paul Forward; and Dr Andrew Stoekel
Council:	Wollongong City Council
DoE:	Commonwealth Department of the Environment
DSC:	NSW Dams Safety Committee
DRE:	Division of Resources & Energy (within the Department of Trade & Investment)
DP&E:	Department of Planning & Environment
EA:	Environmental Assessment.
EEC:	Endangered Ecological Community (under both the TSC Act and EPBC Act)
EPA:	Environment Protection Authority
EP&A:	Environmental Planning and Assessment Act 1979.
EPBC:	Environment Protection and Biodiversity Conservation Act 1999
IESC:	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
IRAP	Integrated Risk Assessment Panel
LGA:	Local Government Area.
DGR:	Requirements provided by the Director General of the Department of Planning for an environmental assessment or environmental impact statement.
NOW:	NSW Office of Water.
OEH:	Office of Environment and Heritage
PAC:	Planning Assessment Commission.
PM_{10}:	Particulate matter with an aerodynamic diameter smaller than 10 micrometres.
$PM_{2.5}$:	Particulate matter with an aerodynamic diameter smaller than 2.5 micrometres
The proponent:	The applicant under Part 3A of the EP&A Act 1979, in this report being Wollongong Coal Limited. 'Proponent' includes the proponent's EA consultants.
The project:	The subject of the application under Part 3A of the EP&A Act 1979, in this report being the Russell Vale Colliery Underground Expansion Project (UEP).
SCA:	Sydney Catchment Authority (now WaterNSW)
TOR:	Terms of Reference.
TSC:	Threatened Species Conservation Act 1995.
TSP:	Total suspended particulate matter
WaterNSW:	formerly Sydney Catchment Authority (SCA)

CONTENTS

1. INTRODUCTION AND TERMS OF REFERENCE

On 23 October 2015 the Minister for Planning, the Honourable Robert Stokes MP requested the Planning Assessment Commission to conduct a second review of the Russell Vale Colliery Underground Expansion Project. The Minister's request was made under Section 23D of the *Environmental Planning and Assessment Act 1979* and Clauses 268R and 268V of the *Environmental Planning and Assessment Regulations 2000.* A copy of the Minister's request is provided in Appendix 1.

The Terms of Reference are as follows:

1. *Carry out a review of the Russell Vale Colliery Underground Expansion Project (MP09_0013) by considering:*
   a) *the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Significance of Resource) 2015 as amended on 2 September 2015;*
   b) *the Department of Planning and Environment's addendum to its original environmental assessment report and recommended conditions for the project;*
   c) *the likely economic, environmental and social impacts of the development in the locality, in the region and for the State;*
   d) *any submissions made to the Planning Assessment Commission as part of the public hearings held in relation to this review; and*
   e) *any submissions made by the applicant to the Planning Assessment Commission on the matters the subject of this review.*
2. *Hold a public hearing on matters arising from or relevant to the review as soon as practicable.*
3. *Complete the review and provide a final report to the Department of Planning and Environment containing any findings and recommendations within 5 weeks of receiving the Department's addendum report, unless the Secretary of the Department agrees otherwise.*

Mr Joe Woodward PSM (Chair) with Mr Paul Forward and Dr Andrew Stoeckel constituted the Commission to undertake the second review of the project. The Commission also retained the services of two experts in subsidence, Emeritus Professor Jim Galvin and groundwater, Dr Colin Mackie to assist its review. They were engaged previously by the Commission in the First Review of the project.

2. THE PROJECT

2.1 THE PROPONENT

Wollongong Coal Pty Ltd (formerly Gujarat NRE Coking Coal Ltd) owns and operates the Russell Vale Colliery, which is located in the Illawarra region, approximately eight kilometres (km) north of the centre of Wollongong and 70km south of Sydney. Jindal Steel and Power Limited acquired a majority stake in Gujarat NRE Coking Coal Ltd in October 2013. The mine was known as the NRE No. 1 Colliery prior to February 2014 (Department of Planning & Environment, 2014b).

2.2 PROJECT DESCRIPTION

The proponent (Wollongong Coal Pty Ltd) proposes to expand its longwall mining operations further to the northwest across the Wonga East area, to extract 4.7 million tonnes (Mt) of Run of Mine (ROM) coal over a project life of 5 years. The proposal involves the extraction of coal from eight longwalls, in three blocks (Longwalls 1-3, 6-7 and 9-11) and the continued operation of the mine's surface facilities. The major components of the project were summarised in the Commission's First Review Report of 2 April 2015.

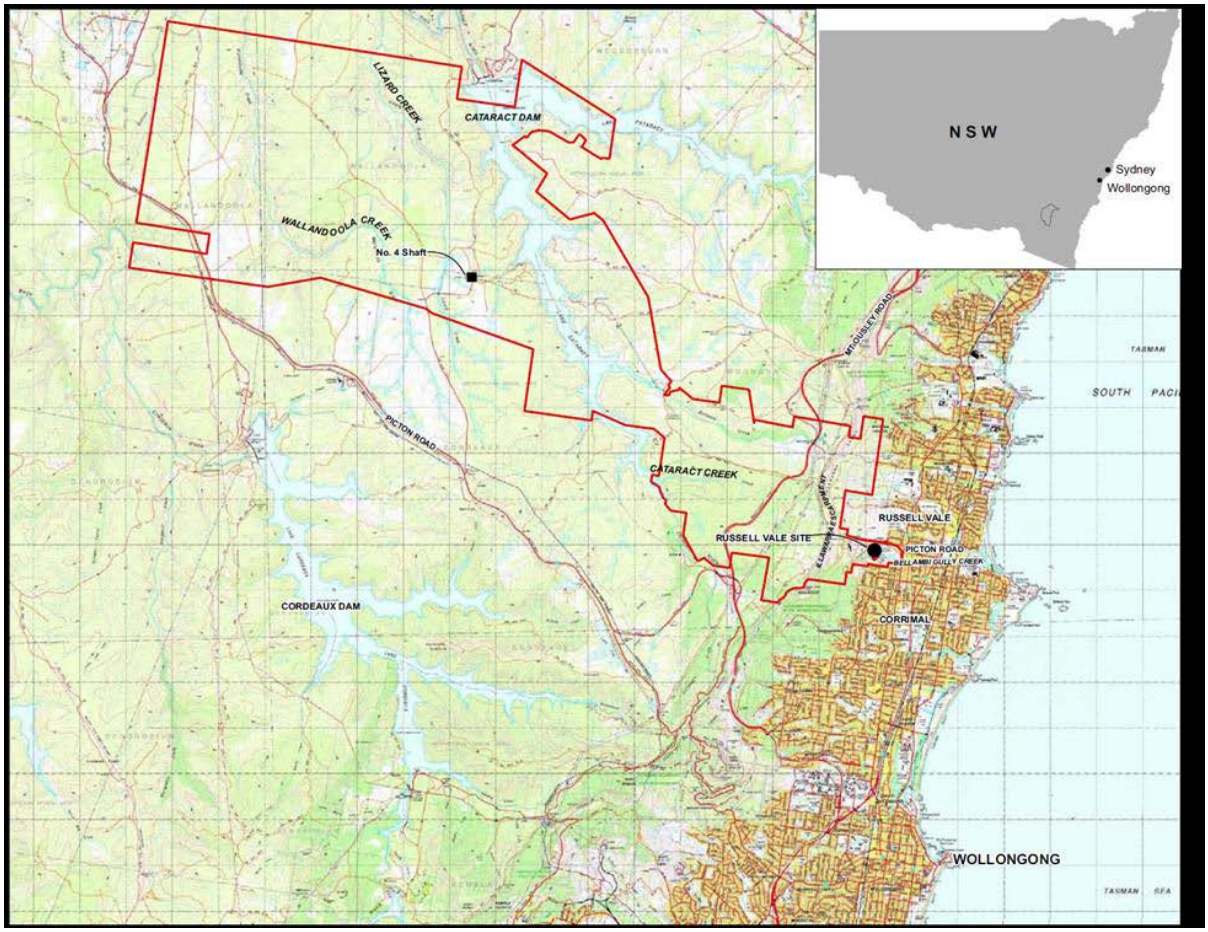


Figure 1: Regional location and project area including the future western expansion area(outlined in red)

2.3 PROJECT SURROUNDS

Russell Vale Colliery is located within the Wollongong and Wollondilly local government areas. The project application area covers about 6,500 hectares (ha) of land and the majority of this comprises an existing underground mining lease area, which lies under the Woronora Plateau.

The surface facilities site, which is approximately 100ha in size, is located on the slopes of the Illawarra Escarpment, at Russell Vale, west of the Princes Highway. To the east and the south of the surface facilities site are the suburbs of Russell Vale and Corrimal respectively.

The vast majority of the land that is covered by the underground mining lease is owned and managed by WaterNSW, formerly Sydney Catchment Authority and lies within the Metropolitan Special Area water catchment. As a consequence, the project assessment must consider State Environmental Planning Policy (Sydney's Drinking Water Catchment) 2011, which states that:
"Consent for development on land in the Sydney Drinking Water Catchment cannot be granted unless it has a neutral or beneficial effect on water quality".

The project site is overlain by the catchment area of the reservoir behind Cataract Dam, which supplies potable water to parts of Sydney. It also includes part of the Mt Ousley Road, a Telstra fibre optic cable, fire trails and various electrical transmission lines. Other key features close to the area of proposed mining include Picton Road, Cataract River, Cataract Creek and Bellambi Creek.

2.4 CURRENT PROPOSAL AND ITS HISTORY

Underground mining has been undertaken at this mine since the late 1880s in the Bulli and Balgownie Seams. A range of mining techniques including bord and pillar mining, pillar extraction and longwall mining have been employed at Russell Vale since mining commenced in 1887. An outline of the historical context and history of applications on the site is included in the Commission's First Review Report.

Briefly, the mine has produced very little coal from 2003 to 2012 when long wall mining commenced. An application for a significant expansion of the underground mine was lodged in August 2009. However, the Department considered the application inadequate for public exhibition. In 2010, the proponent lodged an interim application known as Preliminary Works Project to allow for the mine to continue its operation for a 3 year period. Three modifications followed the approval of the Preliminary Works Project to keep the mine in operation pending the determination of the proposed expansion. The approval of the most recent modification lapsed in December 2015. According to the Wollongong Coal Quarterly Report (October to December 2015), a decision was made "*to place the Russell Vale Colliery on Care and Maintenance on the 1st September 2015… No production was completed during the Quarter".*

The original application for the mine expansion lodged in August 2009 has been substantially changed in response to issues raised in public and agencies' submissions and an independent expert review carried out for the Department. The key changes that are of particular concern to the Commission include the reduction of the project life from 18 years to 5 years and the removal of the Wonga West area.

It is a major concern to this Commission that the current project application again seeks incremental piecemeal approval of a small extension to the existing operation with a stated intention to seek approval for a larger extension to the west of the mine at a later time. The Commission has significant doubt as to the timing of the assessment process of the Wonga West area given the time taken from the lodgement of the EA for this project in August 2009 and the Commission's first review in late 2014. The potential of small modifications over time to the current project (if approved) cannot be ignored so as to allow the mine to continue its operation until the approval of the bigger expansion project. This incremental approach to the assessment of a major development in a sensitive area (drinking water catchment) combines with the uncertainty of cumulative impacts of past and future mining in the area warrants a cautious approach in the review of this application.

3. COMMISSION ACTIVITIES

3.1 FIRST PLANNING ASSESSMENT COMMISSION REVIEW

On 9 December 2014 the Minister for Planning requested the Commission to conduct a public hearing and review the merits of this project, paying particular attention to the potential impacts on upland swamps and water resources, and potential impacts on the residents in the vicinity of the Russell Vale pit top site resulting from noise and air emissions and the trucking of coal. In addition, the Commission was requested to provide recommendations on any reasonable and feasible measures that could be implemented to avoid, reduce and/or offset potential impacts of the project. In accordance with the Commission's terms of reference, a public hearing was held on 3 February 2015.

In its first review, the Commission concluded that it did not have sufficient information or confidence to determine the merits of the proposal necessary for a determination for approval, and made a total of 15 recommendations. The Commission noted that it may be possible for the proposal, or a modified proposal, to be approved if all the additional information identified in the Review Report could provide a greater level of confidence for the protection of the water quality and quantity in the Sydney Catchment Area and satisfied all the other issues identified in the review. (Planning Assessment Commission, 2015).

3.2 SECOND PUBLIC HEARINGS AND SUBMISSIONS

In accordance with the terms of reference for this Commission, a public hearing was held on Tuesday, 8 December 2015 at the WIN Entertainment Centre, Wollongong. A total of 43 verbal submissions were made to the Commission at the hearing, comprising 20 special interest groups and 23 individuals (Appendix 2). A number of written submissions were also made to the Commission. A summary of these submissions is contained in Appendix 3 of this Report.

3.3 DOCUMENTS, MEETINGS, SITE INSPECTIONS AND CORRESPONDENCES

3.3.1 Documents

Through the course of this review the Commission accessed a wide range of documents including, but not limited to:

- the proponent's Environmental Assessment (February 2013 ERM);
- the proponent's Preferred Project Report including Response to Submissions (undated) and the Residual Matters Report (June 2014 Hansen Bailey);
- the Department of Planning & Environment's Assessment Report (December 2014);
- Commission's First Review Report (April 2015);
- the proponent's Response to the Commission's First Review Report both Parts 1 and 2 which included the Independent Risk Assessment (July 2015);
- independent economic analysis undertaken by the Centre for International Economics on behalf of the Department of Planning and Environment (October 2015);
- the Department's Addendum Report (November 2015); and
- submissions from government agencies, special interest groups and the public.

3.3.2 Meetings and Site Visit

The Commission also held a number of meetings and site inspections. Further details of each meeting are provided in Appendix 4. Submissions from the agencies are provided in Appendix 5.

Briefing with WaterNSW

The Commission met jointly with WaterNSW (formerly Sydney Catchment Authority) and the Department of Planning and Environment on the 7 December 2015. The purpose of the meeting was to discuss the residual concerns of WaterNSW with particular focus on the following:

- the delineation of the draw down zone
- the ongoing role of the Dams Safety Committee as outlined in draft condition 11 of Schedule 3
- potential loss of water from the catchment and appropriate levels of compensation
- the ongoing Terms of Reference for the Risk Assessment Panel
- validation of the surface water monitoring, and
- the potential impact on upland swamps.

Briefing with the Department of Planning & Environment

The Commission met with the Department of Planning & Environment on 7 December 2015 (prior to the joint meeting with WaterNSW), for a briefing on the project. In addition to the issues discussed with WaterNSW, further items discussed included the terms of the current approval requiring the cessation of mining activity at the end of December 2015, noise, truck parking facilities, and flooding.

Meeting with Wollongong City Council

The Commission met with representatives from Wollongong City Council on 8 December 2015 to receive an update on the Council's positions. The key topics discussed at this meeting were the voluntary planning agreement and the potential to focus expenditure on Bellambi Road, impact on property values, protection of upland swamps, breaches in the development consent for the emplacement area, noise and flood mitigation.

Briefing from the proponent

The Commission visited the pit top site on 8 December 2015 with Wollongong Coal staff and their consultants. The Commission was briefed on the financial position of the company and Wollongong Coal's response to the Commission's First Review Report particularly addressing the following:

- establishment of the Risk Assessment Panel and the Risk Assessment
- establishment of a network of piezometers within and surrounding the upland swamps
- responses to the offset policy
- update of the economic assessment
- noise mitigation
- air quality monitoring
- flood mitigation works
- truck movements and road maintenance
- capacity of the facilities to handle additional throughput.

Meeting with the Office of Environment and Heritage

On 13 January 2016 the Commission met with the Office of Environment and Heritage, and representatives from the Department of Planning and Environment. The draft swamp offset policy and its status and applicability to this application were discussed. The issues raised in the Office of Environment and Heritage's submission were then also discussed. As a result of this discussion the Department of Planning and Environment agreed to review the draft conditions relating to the up-land swamps.

Further site inspection and meeting with the proponent

Due to the concerns regarding subsidence and ground water impacts, the previous Commission engaged the services of Emeritus Professor Jim Galvin and Dr Colin Mackie, experts in these fields, to

assist the assessment of these issues. This Commission retained the two experts to assist in its review of the additional information provided by the proponent, particularly issues related to risk to groundwater loss as a result of subsidence and the Integrated Risk Assessment process. On 28 January 2016, a second meeting was held with the proponent. The meeting's focus was on groundwater and subsidence and included a site inspection.

Mr Paul Forward, Dr Andrew Stoeckel, and E/Professor Jim Galvin inspected upland swamps: CCUS4, CCUS5, CCUS23 and Cataract Creek. Mr Joe Woodward PSM (chair of this Commission) and Dr Colin Mackie attended the meeting discussing groundwater issues. It should be noted that Mr Woodward had previously inspected the uplands swamps as part of the Commission's first review.

3.3.3 Correspondences

The Commission corresponded with certain government agencies, and the proponent during the course of the review. Following a review of the documentation, the Commission sought clarification from the proponent on issues relating to water, subsidence and upland swamps. The proponent's consultants responded in writing including the provision of the numeric water model for the Commission's expert's review.

The key pieces of correspondence are attached in Appendix 5.

4. COMMISSION'S CONSIDERATION

4.1 MINING SEPP AS AMENDED

Although the provisions of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Significance of Resource) 2015* (Mining SEPP) do not strictly apply to this project because it is a transitional Part 3A application, the terms of reference in the Minister's request require the Commission to consider the Mining SEPP as amended.

Clause 12AA of the Mining SEPP, before its repeal, required the consent authority to give the significance of the resource as the principal consideration. This requirement was repealed on 2 September 2015.

Section 4.1 of the Department's Addendum Report considered the key provisions of the SEPP. Briefly, the Department is satisfied that the project can be managed in a manner that is generally consistent with the aims, objectives, and provisions of the Mining SEPP, following the repeal of clause 12AA, and that the project is in the public interest.

Although the Commission accepts the Department's assessment of most of the provisions in the Mining SEPP, it remains to be convinced that the conclusions drawn under the headings of landuse compatibility and the Voluntary Land Acquisition and Mitigation Policy are reasonable and can be supported.

4.1.1 Compatibility with Other Land Uses (Clause 12)

The Department concluded that the project is not likely to result in unacceptable impacts to surrounding land uses in general. Residual impacts could be minimised, mitigated or compensated for to achieve acceptable environmental and amenity outcomes via recommended conditions of approval.

The Commission is yet to be convinced the Department's conclusion is reasonable and justified. Land use compatibility requires that each land use type should not pose any significant threat or impact to the other use.

As will be discussed in Section 4.5 of this report, the Commission finds potential noise impacts on adjacent residences would not be negligible or beneficial, if reasonable benchmarks for existing noise were used for the assessment instead of using the "modelled maximum noise levels for 1Mtpa". Similarly, traffic noise impact on residences along Bellambi Lane requires reassessment.

The risk of subsidence induced cracking to surface resulting in water loss remains uncertain. As a result, the potential impacts on water quality and quantity and the upland swamps remain uncertain and the environmental consequences are also uncertain. Even if the risk of water loss is low, if it occurs, how and what mitigation measures could apply to remediate the situation and the likelihood of success has not be clearly demonstrated. Any water loss and the associated impact on water quality and upland swamps could be permanent and irreversible. Sections 4.2 and 4.3 of this report discuss these concerns in detail.

On the evidence, the Commission is not convinced that "*the project is not likely to result in unacceptable impacts to surrounding land uses in general*". In reaching this conclusion, the Commission is also mindful of one of the key objectives of the Sydney Drinking Water Catchment SEPP that consent cannot be granted unless the project has a neutral or beneficial effect on water quality. From the evidence currently presented to it, the Commission is of the opinion that the project satisfies neither of these requirements.

4.1.2 Voluntary Land Acquisition and Mitigation Policy (Clause 12A)

The Department is of the view that the consent authority cannot grant voluntary mitigation and acquisition rights to reduce operational noise impacts for existing developments with legacy noise issues, such as Russell Vale because its assessment concluded that "the project would have beneficial or negligible noise impacts on nearby residences".[3] (Appendix 5)

Again, as discussed in the noise section of this report (Section 4.5), the Commission considers the potential noise increase on nearby residences would be significant, not beneficial or negligible, if assessment is based on criteria derived from the *Industrial Noise Policy*.

4.1.3 Significance of the Resource (Clause 12AA)

Although this provision was repealed on 2 September 2015, the Department concluded that the repeal of this clause has no material bearing on the outcomes of the Department's assessment of the project or the conclusions reached regarding its net overall social and economic benefits.

In the First Review Report, the Commission noted the Division of Resources & Energy's (DRE) advice to the Department in support of the project because it would "*provide diversity of supply within the NSW coal industry, generate employment opportunities and bring economic benefits to the local region and to the State as a whole*".[4]

This Commission finds it is also important to note that in the same correspondence, the DRE also pointed out that "*the project would be the second smallest producing mine in the Southern Coalfield … ranked 50 out of the 56 producing NSW coal mines in 2013-14*". The letter further advised that "*the significance of the Project's coal resource lies mainly in its ability to maintain coal production from the Southern coalfield and utilisation of the Port Kembla Coal Terminal*"[5], which is currently underutilised. The economic benefit of this project is discussed in Section 4.4 of this report.

4.2 WATER AND SUBSIDENCE

The Commission's first review found that the proposal had a number of residual uncertainties and risks associated with impacts to the catchment and it did "*not have sufficient information or confidence to determine the merits of the project*"[6]. Given these uncertainties, the Commission was unable to recommend any approval of the proposal. The First Review Report recommended:

> ***Recommendation 1***
> *The establishment of a risk assessment panel, constituted by an independent chair, Water NSW, the Dams Safety Committee, the Division of Resources and Energy and the proponent to oversee an integrated risk assessment, particularly focusing on links between subsidence and water (both groundwater and surface water) impacts of the proposal. This risk assessment, including associated work rerunning the groundwater modelling as recommended by Dr Mackie; and addressing the issues raised by the relevant agencies and experts (as highlighted in this report), needs to be completed before the application can be determined.*

A risk assessment has since been provided by the proponent, finding that there is a low to moderate risk of most of the identified potential impacts. Two potential impacts (cracking of bedrock beneath

[3] Department of Planning and Environment letter to Planning Assessment Commission dated 4 February 2016
[4] Planning Assessment Commission, 2015, *Russell Vale Colliery – Underground Expansion Project Review Report,* April 2015, p.34
[5] Division Resources & Energy, Trade & Investment, letter to Department of Planning and Environment dated 16 December 2014, Attachment A
[6] Planning Assessment Commission, 2015, *Russell Vale Colliery – Underground Expansion Project Review Report,* April 2015, p.iii

the swamp and fracturing of controlling rockbars) were found to pose a high risk to the swamp known as CCUS4, with drying of the upland swamp and detrimental effects on the swamp ecosystem. Risks of other impacts were said to be of medium to low risk (Broadleaf Capital International, 2015).

The Department's Addendum Report concluded that:

- the estimated average water loss of 7.3ML/day would have negligible impacts on the water stored within Cataract Reservoir
- the predicted 14.9ML/year transfer of stream flow to the underlying strata in the Cataract Creek, Cataract River and Bellambi Creek catchments at the end of the proposed mining is not 'lost' as a portion as it would migrate to the reservoir via lower elevation, down-gradient, groundwater seeps into the lower catchments and reservoir
- The *Groundwater Assessment*'s predictions of baseflow and stream flow losses are a much more accurate reflection of potential actual impacts than those in the Surface Water Modelling, and that they should be adopted for assessment purposes.
- There is no policy basis for restricting baseflow losses to an arbitrary (and exceedingly low) limit. The policy requires surface water take to be licensed under the *Water Management Act 2000.* It is of the view that the surface water take can be licenced within the Upper Nepean and Upstream Warragamba Water Source in contrary to WaterNSW's concern that it might not be possible to authorise the surface water take.
- The project might result in some iron oxide staining of the beds of watercourses. However, it is of the view that the iron staining is likely to be localised and would have negligible effect on the overall water quality of Cataract Creek and more particularly Cataract Reservoir. It has recommended specific requirement to monitor surface water to address both dissolved iron and filterable iron oxides/hydroxides.
- The revised assessment has addressed the groundwater-related issues raised in the Commission's first review report and groundwater management plan including the preparation of groundwater monitoring program is a standard condition of approval for underground coal mines.

At the public hearing, the Commission heard concerns about the independence of the integrated risk assessment process, criticism of the groundwater modelling, risk of water loss, cumulative impacts of other mines within the catchment area, water should be the primary consideration, and adequacy of supporting studies.

In reviewing the Department's Addendum Report and correspondences between the Department and agencies, the Commission notes the OEH in an email dated 2 September 2015 to the Department of Primary Industries raised significant concerns, particularly that "*the UEP ignores the advice and recommendations of the Australian Governments Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mines (IESC 2014, 2015)*". Regarding subsidence assessment and potential for connective fracturing, the email pointed out that "*the IESC does not have increased confidence from the proponent's response that the proposed project would not have a significant impact on the stored waters of Cataract Reservoir through connective cracking*". Reference was made to the Tammetta assessment, which "*indicated that the height of depressurisation was predicted to extend to the surface over many areas of the proposed mine plan*". The Tammetta assessment "*is likely to underestimate the degree of depressurisation due to the presence of multi-seam mining…*"[7]

[7] Email correspondence between J Dawson and M Kirton dated 2 September 2015, *OEH preliminary comments on Russell Vale UEP risk assessment report*

The Department of Primary Industries (letter to the Department dated 16 October 2015) also raised concern about the uncertainty in the project impacts on surface water flow into Cataract Reservoir and potential loss if water does not re-emerge downstream. The issue of licences for taking of surface and groundwater was also raised. Impact to creek baseflow due to groundwater depressurisation is another issue of concern to the DPI.

WaterNSW also provided additional written comments to the Commission following its meeting with the Commission in December 2015. Briefly, the key concerns to WaterNSW are:

- The need to consider the requirement of financial compensation for any water losses from Cataract Reservoir if the measures in the proposed Contingency Plan fail.
- The estimated water loss of 7.5ML/day is unacceptable, particularly during dry periods.
- The conclusion that the likely estimated baseflow loss of 0.04ML/day is questioned.
- Real surface water reductions are likely to be within the range of 15ML/year and 2.6GL/year.
- If the current replacement value of water of $2276/ML is used, a potential cost of the estimated loss of water would be about $22.1 million.

Following a review of the documents provided by the proponent, the Department and submissions made to the public hearings, the Commission retained the services of E/Prof Jim Galvin and Dr Colin Mackie to assist in reviewing the latest subsidence and groundwater information provided by the proponent in its response to the First Review Report. Both experts were involved in the first review by providing expert advices to the previous Commission. They again identified a number of questions that required further clarification. The Commission wrote to the proponent on 15 January 2016. The proponent's consultants GeoTerra Pty Ltd, Biosis and SCT Operations Pty Ltd replied in writing dated 27 January 2016, 5 February 2016, 12 February 2016 and 16 February 2016 respectively. See Appendix 5.

Dr Mackie and E/Professor Galvin Mackie provided their advice to the Commission on 7 March 2016 and 8 March 2016 respectively (Appendix 6).

4.2.1 Potential Loss of Surface Water due to Subsidence Related Cracking

Notwithstanding the additional works and a revised water model, Dr Mackie remains concerned, particularly from the potential loss of surface water flow in Cataract Creek via subsidence related cracking. His review concluded that:

> *Prerequisites for such a loss to occur include:*
> 1. *Seam to surface cracking that is interconnected and provides a vertically continuous pathway down to mine workings. Based upon the observed vertical pore pressure distributions at piezometer RV20, it is plausible that the longwall panel areas identified on Figure 5 by yellow shading will exhibit seam to surface connected cracking, particularly at the eastern ends of longwalls LW6 and LW7 where depths of cover are reduced compared to the cover that prevails at RV20.*
> 2. *Stream bed cracking and diverted flows. While creek bed damage to date appears to be low or negligible, there remains a risk that strata movements associated with valley closure could initiate cracking of the stream bed.*
> 3. *Connection between the two crack regimes. This may follow from valley closure movements with sliding of beds leading to development of horizontal flow pathways.*
>
> *The 2015 Independent Risk Assessment concluded that the possibility of creek bed damage from subsidence related cracking was real. However the analysis appears to have been restricted to tributaries of Cataract Creek exclusive of Cataract Creek itself. As a worst case scenario, the proponent considers re-direction of all surface flow from sub-catchments that are upstream of or overlying the proposed longwall panels. This area includes upland swamps.*

To determine the reductions in stream flow resulting from cracking, these sub-catchments together with sub catchments associated with Cataract River and Bellambi Creek were excluded from the catchment runoff model. This resulted in a reduction in total flow in Cataract Creek of 6.38ML/day and in Cataract River and Bellambi Creeks of 0.56 and 0.4ML/day respectively. These losses total 7.34ML/day which represents 9.6% of the average flow from these catchments. The risk associated with these scenarios is classified as ***medium*** *according to Risk ID AQH2121, BH2121 and CH2121.*

If Cataract Creek was to be included (assuming diverted flow and subterranean connection to the mine workings at the eastern end of LW6 and LW7), then the diverted flow losses could be substantially greater than has hitherto been assessed. This flow loss pathway appears to have been considered only in the context of adaptive management in the risk assessment. Just how this management approach would be invoked is unclear and raises significant concerns. Certainly, if such a diverted flow pathway occurs, experience at other locations in the Southern Coalfields suggests remediation would prove difficult if not impossible.

Other concerns associated with the above relate to water access licences (surface and groundwater), which would need to be procured in a timely way should losses be identified. The logistics of this process are unclear.[8]

E/Prof Galvin raised similar concerns. He noted that in his earlier advice to the Commission, the uncertainty that the height of depressurization may reach the surface was raised. The additional information provided by the proponent, particularly the results from piezometer site RV20 indicated the area is highly fractured and hydraulically connected. He questioned why there was no confirmation that fracturing developed all the way through to the surface. The results of RV20 are inconsistent with earlier reported conclusion that depressurisation to surface is not predicted at the end of mining. E/Prof Galvin is of the view that *"if the height of fracturing is at or close to the surface over the deeper western end of Longwall 4, then careful consideration will need to be given to cross connections to this fracture network from surface and groundwater sources, especially at the eastern ends of Longwall Panels 5, 6 and 7 which are adjacent to Cataract Creek and up to 90m shallower".*[9]

E/Prof Galvin also noted that the current control for changes to groundwater regime is to monitor to detect abnormal flows to allow adaptive management intervention to adjust mining activities. He questioned what other management measures apart from reducing mining height and/or panel width, or not mining could be adopted to prevent fracturing extending all the way to the surface. Based on the information available, he concluded that *"a reasonable degree of uncertainty still surrounds the potential for fracturing to extend all the way to the surface over portions of the application area and, if it did, how it could be responded to by adaptive management or be remediated".*[10] Dr Mackie raised similar concern and pointed out that experience "*in the Southern Coalfields suggests remediation would be proven difficult if not impossible*".[11]

4.2.2 Integrated Risk Assessment

The Commission notes the independence of the Risk Assessment Panel was questioned in the OEH September 2015 email to the DPI.

In view of such concern, the Commission's request to E/Prof Galvin included a review of the Integrated Risk Assessment. He is critical of the risk assessment process. He is of the view that

[8] Mackie Environmental Research Pty Ltd, letter to Planning Assessment Commission dated 7 March 2016, p11
[9] Galvin and Associates Pty Ltd, letter to Chair Planning Assessment Commission dated 8 March 2016, p.6
[10] Ibid, p.7
[11] Mackie Environmental Research Pty Ltd, letter to Planning Assessment Commission dated 7 March 2016, p11

an essential element for robust risk assessment, as reflected in risk assessment guidelines such as MDG1010 – Risk Management Handbook for the Mining Industry (MDG-1010, 1997, 2011) is the use of a team with appropriately varied and relevant experience for risk identification… the risk assessment team would include outside expertise in order to tap into other knowledge and experience; promote discussion and critical evaluation; test assumptions, calculations, and analyses; and provide an independent layer of assurance that all meaningful hazards had been identified and appropriately assessed for likelihood and consequence and that proposed controls were sensible and likely to be effective. A risk assessment by oneself of one's own work, even if a recognised expert in the field, does not constitute a truly independent or high level risk assessment…

The context of the integrated risk assessment did not extend to the effects of water quantity and quality on fauna and on water dependent species along watercourses.

The integrated risk assessment was based on quantitative descriptions of levels of likelihood that were expressed in terms of annual probability. However, levels of consequences were defined in qualitative terms. For example, reduction in water quantity (which is a critical factor in this matter) was classified in terms of very large, large, moderate, small and negligible. Similarly, reduction in water quality was classified as significant, major, moderate, small and minimal. These descriptors can mean different things to different people. Hence, the risk outcomes lack objectivity for those not involved in the risk assessment process".[12]

4.2.3 Sealing of Mine Adit[13] to Manage Water Inflow

With regard to the issue of sealing of mine adit as a control for managing water inflow, E/Prof Galvin is of the view that:

… If sealing of a mine adit constitutes a control, then this control needs to be risk assessed to determine its likely practicality and effectiveness and hence, residual risk. In this particular instance, sealing of a mine adit is likely to present significant challenges for a number of reasons, two of which are:

- *Sealing an adit located toward the base of the escarpment may have the potential to induce landslides due to the escarpment being charged with water pressure over time; and*
- *Should a seal fail, there is a potential for an outrush (inrush) of water through residential and public areas downhill from the adit.*[14]

He also found the consideration of sealing is inconsistent with earlier documentation which indicated that the adits would remain open and water outflows being managed by a water treatment system. If this is the case, the ongoing costs of management and maintenance of the treatment system should be included as part of the mine closure plan.

Dr Mackie raised similar concern that "*the flow loss pathway appears to have been considered only in the context of adaptive management in the risk assessment*". He questioned how the adaptive management regime would be invoked and considered this raised significant concerns. He also pointed out that "*experiences at other locations in the Southern Coalfields suggest remediation would prove difficult if not impossible*"[15].

[12] Galvin and Associated Pty Ltd, letter to Chair Planning Assessment Commission dated 8 March 2016, p.3
[13] Mine adit means an entrance to an underground mine for the purpose of access, drainage of water, ventilation or extraction.
[14] Galvin and Associated Pty Ltd, letter to Chair Planning Assessment Commission dated 8 March 2016, p.9
[15] Mackie Environmental Research Pty Ltd, letter to Planning Assessment Commission dated 7 March 2016, p.11

4.2.4 Barrier to Stored Waters of Cataract Reservoir

E/Prof Galvin also raised concern in relation to the potential subsidence impact to the base of the reservoir. He pointed out that:

> *The concept of leaving a solid protective barrier against surface infrastructure is well established in subsidence engineering…*
>
> *In the case of Longwall 7 at Russell Vale Colliery, however, bord and pillar workings and some limited pillar extraction workings occur within the so-called protective pillar, which has a width of some 200m. I concur with the stability assessment undertaken for these workings, which indicates that overloading of the workings is a credible possibility. It has been estimated that if this were to occur, surface subsidence of up to about 600mm is possible over the workings. The analysis does not address the angle of draw associated with this subsidence event, which is likely to result in some (minor) subsidence of the base of the reservoir.*
>
> *The analysis concludes that the subsidence associated with the workings becoming overloaded would not be expected to cause any increase in hydraulic conductivity between the reservoir and the mining horizon. I concur in respect of direct vertical conductivity. However, I do not subscribe to the proposition that the consequence of an increase in vertical compression [due to the pillars yielding] is that the hydraulic conductivity above the start of Longwall 7 is likely to be reduced by pillar compression. Any such increase will be associated with high stress concentrations in the immediate roof and floor of the pillars and dissipate with distance into the roof and floor.*[16]

4.2.5 Trigger Levels for Responding to Future Subsidence

E/Prof Galvin is concerned about the trigger criteria proposed by the Department and Water NSW. He is of the view that cumulative effects and impacts of subsidence in the area are not known with certainty presents a challenge to setting trigger levels for responding to future subsidence, therefore:

- *The criteria outlined in DoP(2010) for strain required to fracture rock cannot be applied directly to future measured values (as appears to be proposed) because the amount of incremental strain that may have already developed is unknown.*
- *The proposal by WaterNSW that any consent should only permit mining up to a point where the valley closure is predicted to be 200mm needs to be assessed with caution for a number of reasons. These include firstly, that predictions of valley closure can be unreliable. Secondly, it is not known how much valley closure has already occurred and, therefore, what tolerance there is to further valley closure without resulting in unacceptable impacts. Rather, more emphasis may need to be given to trigger levels based on observed and measured impacts of valley closure (such as surface cracking and horizontal shear planes).*[17]

4.2.6 Commission's Consideration and Findings

The expert advices provided by Dr Mackie and E/Prof Galvin have confirmed the Commission's concern that the uncertainty of potential impact to the catchment area remains unresolved, particularly when the cumulative impacts are considered. The additional works carried out by the proponent's consultants and the review by the Integrated Assessment Panel have not been able to allay the Commission's concern or give the Commission enough confidence and certainty that the potential impacts to water both quality and quantity would be acceptable.

The Commission shares both Dr Mackie and E/Prof Galvin's concerns. If flow loss does occur, what and how adaptive management measures could be implemented, when there is no clear indication of what these measures are and their effectiveness in remediate the situation. As pointed out by Dr

[16] Galvin and Associated Pty Ltd, letter to Chair, Planning Assessment Commission dated 8 March 2016, p9-10
[17] Ibid, p11-12

Mackie, "*experience in the Southern Coalfields suggests remediation would prove difficult, if not impossible*". Further that, it may be too late to remediate by the time the impact is observed.

WaterNSW estimated the potential water loss would be between 15ML/year and 2.5GL/year. It considers the predicted loss of 7.5ML/day is not acceptable, particularly during dry periods. The Commission agrees that potential loss of about 10% flow in the Cataract catchment would be a significant loss.

In terms of financial compensation for the loss of water, the CIE estimated the cost of 15ML/year could be up to $430,000 (present value). It is not clear how this figure compares with the WaterNSW estimate of $22 million. The Commission's concern is that any payment could be a one-off payment. However, the loss will be permanent and irreversible. The loss will also have its associated impact on water quality due to the damage of upland swamps and other vegetation that rely on surface and shallow groundwater, which play a significant role in water quality control. See further discussion in the next section 4.3.

A further concern to the Commission is the Department's assessment treating water loss as water take, which requires water licence to allow the take. In the Commission's view, if the loss is negligible, the water licence system could be employed to compensate the loss. However, the estimated potential loss ranges between 15ML/year and 2.6GL/year. The question is at what point does a water licence as a compensatory mechanism become unacceptable?

The Commission is also concerned about the ongoing costs of management and maintenance of the water treatment system, if required, to treat water outflows from the adit after the mine closes. It is not clear whether the proponent or the community will bear the long term management and operational cost of the treatment system after mine closure as it will have significant impact on the economic assessment of the project.

On the evidence, the Commission finds the uncertainty of potential water impacts to the catchment remains unresolved and it does not have sufficient confidence that the project would have negligible impact. The long-term cost of managing and monitoring water loss, water quality control and residual impacts after mine closure could be substantial. Hence, the Commission is not in a position to give any conditional support to the project as it currently stands.

4.3 IMPACTS ON UPLAND SWAMPS

In its first review of the project the Commission considered the potential impacts on upland swamps. The uncertainties around impacts on water (quality and quantity) and upland swamps led it to recommend that an independent risk assessment should be undertaken. The Commission also made the following recommendations specifically relating to the swamps.

> ***Recommendation 2***
> *The establishment of a network of piezometers within and surrounding the upland swamps, the establishment of this network should be guided by the relevant authorities (ie Office of Environment & Heritage, WaterNSW, the Dams Safety Committee and the Department of Planning & Environment). This network will collect additional baseline data and monitor the impacts to the swamps, through changes to the groundwater supporting the swamps, from the mining. This monitoring data should be made available to the independent risk assessment panel.*

> ***Recommendation 3***
> *Any more definitive policy developed regarding triggers for offsets and mitigation measures under the "Policy Framework for Biodiversity Offsets for Threatened Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence" should be made available for consideration by the independent risk assessment panel (see Recommendation 1).*

Recommendation 4

Any potential offset policy should address key elements including:

a. the potential delayed onset of subsidence and associated hydrogeological and ecological impacts to swamps;

b. potential ecological and structural tipping points; and

c. mechanisms to adequately secure offset sites (with consideration of the current land tenure and exploration licence and mining lease tenements of the proposed offset site; and the need for site specific offset management plans).

There are nine upland swamps over a 17.51 ha area in the vicinity of the longwalls that have the potential to be impacted. Each of the swamps meet criteria to be classified as Endangered Ecological Communities under both State and Commonwealth legislation.

In its first review, the Commission found that there were a number of uncertainties about the long-term consequences for the swamps of project-related impacts. These were mainly related to hydrological changes as a result of subsidence either cracking the swamps bedrock base or affecting the inflows or outflows of water that support the swamps. These uncertainties and the need for further quantitative data led the Commission to its 'Recommendation 2'.

The Commission also noted that calculating offsets for the impacts of underground mining on upland swamps is difficult as offsetting is usually based on the amount of vegetation cleared, but in this case the impact will most likely be a long term change in the vegetation communities of the swamps bought about by changes in hydrological conditions. It was suggested that the trigger for provision of offsets should be the loss of the shallow groundwater aquifer, reinforcing the need for further piezometric monitoring data. This led to the Commission's 'Recommendation 3' and 'Recommendation 4'.

OEH and the Department of Planning and Environment developed and recently exhibited the draft *Policy Framework for Biodiversity Offsets for Threatened Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence* (draft upland swamps offsetting policy) in order to overcome these offsetting difficulties and addressing Recommendations 3 and 4 of the First Review Report.

4.3.1 Proponent response

The proponent has responded to the Commission's 'Recommendation 2' by installing 15 new shallow groundwater piezometers within the upland swamps, following consultation with WaterNSW and OEH, in addition to the eight piezometers previously installed.

Swamp	**No. of Piezometers** (as at Oct 2014)	**Proximate Longwall**	**Overall Risk Classification**
BCUS4	4	Longwall 10 and pillar	Medium
BCUS11	0		Low
CCUS1	0		Medium
CCUS2	1	Pillars of Longwalls 2 & 3	Medium
CCUS3	1	Longwall 5	n/a
CCUS4	4	Longwall 6 and pillar	High
CCUS5	4	Longwall 7 and north	Low
CCUS6	1	Pillar of Longwall 4	n/a
CCUS10	2	South of Longwall 9	Low
CCUS11	0		Low
CCUS12	2	Longwall 10	Low
CCUS24	0		Negligible

CRUS1	4	Longwall 6 and southeast	Negligible
CRUS3	0		Negligible
CRUS6	0		Low

Note: n/a-CCUS3 and CCUS6 already impacted by previous longwall mining

Subject to further consultation, these piezometers will be augmented with another approximately 30 shallow groundwater piezometers to be installed in all upland swamps within 400m of the longwalls.

Figure 2 shows the existing and proposed upland swamps monitoring network[18]. Data from the piezometer network is being provided to the Integrated Risk Assessment Panel.

4.3.2 Integrated Risk Assessment Panel (IRA Panel)

Subsidence impacts

The IRA Panel noted that compared to single seam mining, subsidence resulting from the multi seam environment at Russell Vale occurs over a smaller area, resulting in greater tilts and strains. Perceptible fracturing of sandstone bedrock may potentially occur when tensile strains exceed 1-2mm/m and compressive strains exceed 2-3mm/m. This fracturing can result in a loss of any stored water within the swamp. The project is predicted to result in subsidence of such a magnitude to cause fracturing of swamp bedrock. These subsidence related impacts are expected to be confined to the region where vertical subsidence is greater than 200mm[19].

The IRA panel assessed the risks to each swamp separately due to the individual geomorphological, hydrological and pedological characteristics of each swamp[20]. It concluded that the 'risk of impacts due to fracturing is assessed as low for all swamps except CCUS4, which is assessed as being at a high risk of impact. However CCUS4 is not considered to contribute significant flow volumes to the catchment.

Changes to Swamp Water Regimes

The IRA Panel found that subsidence induced tilting has the potential to alter the water distribution and flow patterns within a swamp, potentially leading to scour and erosion. Changes in vegetation composition may also occur as a result. Potential tilting related impacts were assessed using flow accumulation modelling[21].

CCUS5 is predicted to experience a significant (26%) decline in overall water availability due to tilting associated with Longwall 7. Flow pathways within the swamp are predicted to change, possibly resulting in changes to vegetation composition in parts of the swamp.

[18] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Response to the Planning Assessment Commission Review Report- Part 2, prepared for Wollongong Coal Limited, September 2015 p.13 Figure 2

[19] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment p.31

[20] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment p.31

[21] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment p.37

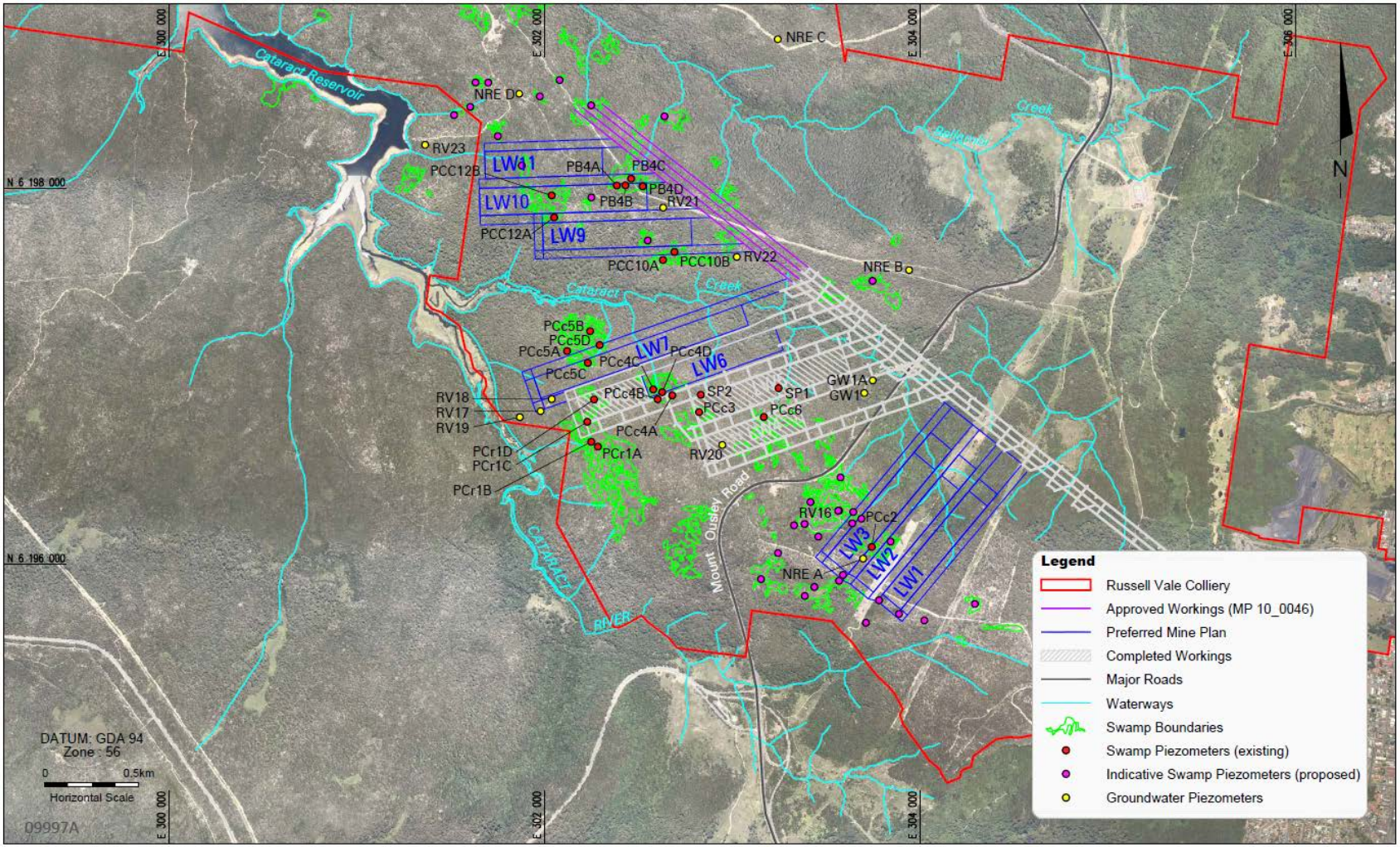


Figure 2. Existing and Proposed Upland Swamp Monitoring Network

CCUS11 is predicted to experience a significant (50%) decline in catchment yield with tilting associated with Longwall 8 resulting in the flow pathway diverting around this swamp. Due to the small catchment of this swamp the changes are not predicted to have a significant impact on water availability.

All other swamps assessed were found to have minor to negligible changes in flow accumulation post mining.

Overall risk classification

Four swamps were assessed as having a greater than 'Low' risk; BCUS4, CCUS1, and CCUS2 were assessed as at 'Medium' risk; and CCUS4 was assessed as at 'High' risk[22].

The bedrock of Upland Swamp BCUS4 is likely to be fractured, however this is predicted to occur over a small upper section of the swamp which supports vegetation not reliant on a perched water table. The Commission notes that BCUS4 is a comparatively large swamp and appears that at least 50% of the swamp and 12% of its catchment is within the subsidence zone. It is also a known habitat for the Giant Dragonfly, which is an endangered species.

Upland Swamp CCUS1 is predicted to experience bedrock cracking but impacts are expected to be confined to a limited area. Upland Swamp CCUS2 is also predicted to experience bedrock cracking, however this swamp does not support vegetation reliant on waterlogging. Due to its small catchment area this swamp does not contribute significant baseflow.

Swamp CCUS4 lies directly over Longwall 6 and is predicted to experience subsidence resulting in cracking of its bedrock and potentially the controlling rockbar. This would likely lead to drying of the swamp, which supports vegetation reliant on the perched water table. Localised impacts to the Giant Dragonfly are possible as the species is reliant on the perched water tables found in upland swamps. The swamp does not provide significant baseflow to Cataract Creek.

Risk Controls

In terms of the measures that should be implemented to control the risks that have been assessed by the panel the proponent refers to the mine plan, which has been re-designed to, in part, avoid significant risks to upland swamps, resulting in only one swamp at 'High' risk of impact. A network of piezometers has also been installed to monitor swamp water levels, to assist in adaptive management of subsidence related impacts. The proponent has committed to ceasing mining of active longwalls if it is found that greater than 200mm of valley closure is occurring.

The proponent proposes to compensate for the residual impacts on upland swamps by obtaining suitable offsets in accordance with relevant offsetting policies[23].

4.3.3 Offset Policy

The recently exhibited draft Policy Framework for Biodiversity Offsets for Threatened Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence is yet to be adopted by the government. The Commission also understands it is yet to be formally consider by the Integrated Risk Assessment Panel.

[22] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment p.47

[23] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment p.53

4.3.4 Office of Environment and Heritage view

OEH has raised concerns with the risk assessment in relation to upland swamps. OEH *'considers that the risk assessment is compromised by assumptions that consistently lead to an under-estimation of the project's consequences'*[24]. The OEH stated that the permanent and irreversible nature of bedrock cracking beneath upland swamps should warrant a 'High' or greater risk classification. It is also concerned that the area of assumed impact is not sufficiently conservative given the inherent uncertainty of predicting subsidence impacts in a multi-seam environment. OEH also dispute the conclusions made in relation to vegetation communities waterlogging dependence and the assumption that the Banksia Thicket vegetation community is deemed as less susceptible to decreased groundwater availability. It noted that assumptions about swamp hydrology have been made in the absence of groundwater data.

In an email to the Department of Primary Industries, the OEH also raised concern about the potential impact to the Giant Dragonfly, which

> *is a swamp dependant endangered species that is known from only a limited number of swamps on the Woronora Plateau. Two of the three swamps the species is known to inhabit within the UEP mining domain are planned to be undermined however impacts to this species has not been included in the risk assessment. "The IESC (2014) carried out a sensitivity analysis of the likely impacts to individual species resulting from a range of likely impact factors resulting from mine subsidence in upland swamps. They concluded 'because inundation controls peat stability and fire (the other two strongest influences), it is the most important aspect of the swamp to maintain'. Furthermore, 'the giant dragonfly appears to be the worst affected at high-impact scenarios but is also substantially affected with low-impact scenarios'"*.[25]

4.3.5 WaterNSW

Water NSW advised that offsets would need to be within Sydney's drinking water catchment Special Areas and the proponent has proposed two swamps as offsets, both within the Special Area. If offsets cannot be obtained, the mine plan should be adapted to avoid greater than negligible impacts on swamps. WaterNSW also recommended that:

- Define the determination of the 'negligible environmental consequences' as per the OEH draft Swamp Offset Policy
- Conditions of any approval should require the consultation with WaterNSW in the development and implementation of an offset strategy including a variation to the strategy.
- Swamp monitoring data should also be provided to WaterNSW (recommended condition 10(j) dot point 7 should be amended accordingly.

4.3.6 Department view

The Department acknowledged OEH's concerns and accepted *'that there is uncertainty in predicting subsidence and environmental outcomes for upland swamps'*[26].

On this basis the Department questioned the need for further technical analysis noting that the draft upland swamps offsetting policy provides for variability in predictions of impact. The Department noted that *'it is vital that there is strict monitoring of the impacts on swamps and an obligation to*

[24] OEH correspondence to the Department of Planning and Environment, dated 21 October 2015, re Russell Vale Colliery UEP – Wollongong Coal Response to PAC Review.
[25] OEH preliminary comments on Russell Vale UEP risk assessment report, J Dawson email to M Kirton dated 2 September 2015
[26] Department of Planning and Environment, 2015, Addendum Report: Major Project Assessment Russell Vale Colliery Underground Expansion Project (MP 09_0013), November 2015, p.15

offset all such impacts. If offsets cannot be obtained, then Wollongong Coal would have to adapt the mine plan to avoid greater than negligible impacts on swamps'[27].

4.3.7 Commission's Consideration and Findings

In considering the potential impacts to upland swamps, the Commission notes the advices from the proponent's consultant, the Integrated Risk Assessment Panel, the Department of Planning and Environment, the DPI, the OEH and WaterNSW. Of particular concern to the Commission is the OEH view that the risk assessment underestimated the project's impacts, given the permanent and irreversible nature of bedrock cracking beneath the swamps. The OEH is responsible for the care and protection of the environment. One of its functions is to provide scientific evidence and expert knowledge to underpin environmental decision making[28]. Therefore, the Commission considers significant weigh must be given to its advice.

The OEH's opinion together with the Commission's experts' advices on groundwater and subsidence and their review of the integrated assessment process reinforce the Commission's concern about the uncertainty of the project's potential impact to the catchment area in terms of water quantity & quality, upland swamps and biodiversity. The Commission's consideration has regard to the general principle of the Offset Policy that when an impact is identified, avoidance should be the first consideration, followed by mitigation and finally offsets.

In the circumstances here, there is significant doubt in any mitigation measures that could remediate the impact or be able to reduce the impact to an acceptable level. Any loss of water could be permanent and irreversible resulting in changes to the composition and nature of the swamps with unknown long-term consequences. Any socio-economic benefits arising from the project must be balanced with the risk of water loss and associated impacts in the drinking water catchment area, which is a highly sensitive area.

In response to the Commission's question regarding options to avoid impacts to CCUS4, the proponent advised that the cost of avoiding 230m section of longwall 6 beneath CCSU6 would be $10 million. No independent verification of the cost has been provided to the Commission. As discussed in the previous section of this report, the Commission's experts raised significant concerns about the potential cracking to surface at the eastern ends of LW6 and LW7 with a resulting potential loss of 10% of water flow in the Cataract Creek. This leads to the question of whether LW6 should be mined at all.

The proposed offsets may be able to offset the swamps, although the question is raised that the proposed offsets are not similar in characteristic, nature and composition to the damaged ones. A further question that appears to be overlooked is the potential water quality impact from the damaged swamps.

The Commission finds that

1. The uncertainty in predicting subsidence and the environmental outcomes for upland swamps and the sensitive nature of the area warrants a cautious approach.
2. There is significant doubt as to what mitigation measures could be applied to remedy the cracking of bedrock beneath the swamps, apart from offset.
3. If the OEH's classification of risk is considered, the potential damage of 14 swamps with uncertain environmental consequences in a drinking water catchment area is a significant concern, if offset could not be found within the catchment area.

[27] Department of Planning and Environment, 2015, Addendum Report: Major Project Assessment Russell Vale Colliery Underground Expansion Project (MP 09_0013), November 2015, p.15
[28] Office of Environment & Heritage, Corporate Plan 2014-2017, p.6

4.4 SOCIO-ECONOMIC BENEFITS AND IMPACTS

The First Review Report recommended that:

> ***Recommendation 5***
> *The proponent's economic assessment, in particular the estimated costs and benefits, should be updated to reflect the current economic climate.*
>
> ***Recommendation 6***
> *The final assessment and determination of the application should be informed by an independent analysis of the economic costs and benefits of the project, including any additional information/updated economic assessment provided by the Applicant. The independent analysis should be managed by the Department of Planning & Environment.*

The proponent revised its Economic Assessment[29], including an updated cost benefit analysis (CBA) as part of its response to the Commission's first review.

4.4.1 Updated Economic Assessment

The updated Economic Assessment used more up to date forecasts of an AUD/USD exchange rate of 0.73 and export prices of US$84 per tonne for coking coal and US$61 per tonne for thermal coal. It maintained the assumptions, made in the previous CBA, of an average annual production rate of 934,000 tonnes and export coking/thermal coal split of 52.6%/28.6%[30] to conclude that the project would generate an estimated $323 million in revenue for the proponent and $23 million in royalties for the State. This compares with the previous Economic Assessment that assumed an AUD/USD exchange rate of 0.85 and export prices of US$150 per tonne for coking coal and US$90 per tonne for thermal coal to arrive at an estimated $400 million in revenue and $34million in Royalites[31].

Sensitivity testing was undertaken for a number of variables that highlighted the value of royalties was most sensitive to changes in production rates and to changes in the USD price for coal. For instance a further 20% drop in either production or coal prices would result in the royalties decreasing to $18.6 million.

The updated Economic Assessment considers that the $23 million in royalties is a minimum estimate of the net production benefits of the project and provides a minimum threshold value against which the residual environmental, social and cultural costs of the project can be compared.

The residual environmental, social and cultural costs of the project are those remaining impacts after avoidance, mitigation and offsetting or compensation strategies have been applied. The costs associated with avoidance, mitigation and offsetting or compensation has been included in the capital and operating costs borne by the proponent.

The updated Economic Assessment notes that impacts related to noise, surface water, groundwater, visual amenity, biodiversity, and infrastructure associated with the project would be either mitigated or offset or compensated for and would form part of the capital or operating costs of the project. No material economic effects were considered likely in relation to air quality, traffic and

[29] Gillespie Economics, 2015, *Russell Vale Colliery Underground Expansion Project Economic Assessment* (revised Economic Assessment)

[30] This is equivalent to a product coal split of 65% coking coal and 35% thermal coal, Gillespie Economics, 2015, *Russell Vale Colliery Underground Expansion Project Economic Assessment* (revised Economic Assessment) footnote 14

[31] ERM, 2013 NRE No.1 Colliery Project Application (09_0013) EA prepared for Gujarat NRE Coking Coal Pty Ltd p.497 and Department of Planning and Environment 2014, Major Project Assessment: Russell Vale Colliery Underground Expansion Project (MP09_0013) p.55

transport, [32]historic or Aboriginal cultural heritage. Greenhouse gas emissions were considered to be the only unmitigated/uncompensated impact. These were costed at $0.15 million (present value).

Overall the revised CBA put the net social benefits at $23 million minus the $0.15 million in greenhouse gas costs and concluded that the project is '*desirable and justified from an economic efficiency point of view'*[33].

The updated Economic Assessment states that the project will directly provide average annual output of $79 million, average annual wages of approximately $34 million and employment for up to 300 people for up to 5 years[34].

4.4.2 Department's Addendum Report

The Department engaged the Centre for International Economics (CIE) to undertake the independent review of the revised economic costs and benefits of the project, as requested by the Commission in its first review.

The CIE found that the 'minimum threshold value' approach used in the updated Economic Assessment was a reasonable basis on which to frame the economic analysis. This approach focusses on the quantification of royalty payments as these are the most certain of the benefits to arise from the project[35].

In terms of royalty payments, the CIE was of the opinion that the estimated royalties of A$23 million (present value) was appropriately conservative and an indicator of the minimum net production benefit of the project. In its analysis CIE assumed A$87 per tonne for export thermal coal and A$148 per tonne for hard coking coal and calculated that this would generate royalties equivalent to $28 million in present value terms. CIE explained that *'while coal export prices are low, in US dollar terms, this has been 'countered' by the lower exchange rate*'.

The CIE reviewed the Commission's recommendations in relation to noise, air quality and traffic impacts. It accepted that, based on the proponent's conclusions in relation to these impacts and the risk management strategies adopted, that the impacts have been appropriately accounted for in the revised CBA. In reviewing the Commission's recommendations in relation to surface water quality impacts the CIE's analysis concluded that minor additional monitoring costs of $62,000 (present value) accruing to WaterNSW as a result of the project should be reflected in the CBA. It also concluded that the economic costs of a project-related loss of stream baseflow within the Sydney Basin Nepean Groundwater Source of a maximum of 15 ML per year could be up to $430,000 (present value), and that this should also be included as a cost in the CBA if it was not factored in as an operational cost by the proponent[36].

---

[32] Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment Appendix J Biosis, 2015, Independent Risk Assessment – Addendum Report p.13 and Appendix 2 Presentation to the IRAP, Slide 13.

[33] Gillespie Economics, 2015, *Russell Vale Colliery Underground Expansion Project Economic Assessment* (revised Economic Assessment)

[34] Gillespie Economics, 2015, *Russell Vale Colliery Underground Expansion Project Economic Assessment* (revised Economic Assessment).

[35] The Centre for International Economics, 2015, *Review of CBA for Russell Vale extension*, prepared for the Department of Planning and Environment p. 3

[36] The Centre for International Economics, 2015, *Review of CBA for Russell Vale extension*, prepared for the Department of Planning and Environment p. 7

Overall the CIE raised no issue with the way in which the updated Economic Assessment had been framed[37].

The Department noted that recommended conditions would require the proponent to bear the costs of any stream baseflow loss by purchasing water licences.

Any impacts to upland swamps or other biodiversity will be compensated for by the proponent purchasing suitable offsets in accordance with the government's draft '*Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species Impacted by Longwall Mine Subsidence'*.

The Department is satisfied that the project would result in socio-economic benefits to the region and the State through employment generation, significant capital investment and royalty returns in the order of $23 million.

4.4.3 Submissions to the Commission

A number of submissions to the Commission raised concerns with the proponent's updated Economic Assessment, that the stated benefits to NSW of the project seemed optimistic considering the decline in coal prices, and that any benefits of the project would flow to the State and broader community rather than the local community which would be most affected by the environmental impacts, the financial viability of the proposal, the financial capacity of the proponent to fund rehabilitation of the mine site and whether the proponent was a 'fit and proper person'. Two particularly detailed and considered submissions were received.

A submission made on behalf of the Illawarra Residents for Responsible Mining, raised a number of points. In summary the submission was concerned that: social costs of environmental impacts (biodiversity, noise, air quality) were not accounted for properly in the CBA; the cost ascribed to carbon emissions was unjustifiably low; and that the regional economic impact analysis and the non-market employment benefits should be ignored.

A submission made by the IEEFA questioned the claimed economic benefits of the project in what the IEEFA views as a market in structural decline, citing continuing declines in the price of coal. The submission also makes a number of claims in relation to the financial viability of Wollongong Coal Ltd, worker safety and the risk that rehabilitation of the mine will fall to the State of NSW.

WaterNSW in a letter to the Commission dated 11 December 2015, raised concerns regarding the predicted water quantity loss from the project and the monetary value placed on the predicted loss. The submission contended that surface water reductions are likely to be within the range of 15ML/year and 2.6GL/year. It further noted that the price of water as set by IPART is under represented in the revised cost benefit analysis and rejects the Department's estimate that the "*predicted extreme water loss is negligible*". It expressed the view that "*if the current replacement value of water of $2,276/ML is used, a potential cost to Water NSW of approximately $22.1M could ensure, which is not significantly different from the threshold value of the project given by Gillespie of $23M*".

4.4.4 Commission's Consideration

The Commission is of the opinion that the proponent's updated Economic Assessment has used reasonably up to date data and its future coal price assumptions are not out of step with current

[37] The Centre for International Economics, 2015, *Review of CBA for Russell Vale extension*, prepared for the Department of Planning and Environment p. 12

government forecasting for the resources sector. The Commission has addressed the key economic issues raised in submissions below.

Compensation and offsets

The Commission understands that the way the CBA accounts for environmental impact mitigation costs and residual environmental costs is in line with government policy as reflected in the recently finalised '*Guidelines for the economic assessment of mining and coal seam gas proposals*'[38] (economic guidelines). As these economic guidelines were exhibited and finalised after the proponent's updated economic assessment was completed in June 2015 it is not expected that the proponent needs to achieve full compliance with them. The Commission notes that government policies, such as the '*NSW Biodiversity Offsets Policy for Major Projects*' and the '*Voluntary Land Acquisition and Mitigation Policy*' (VLAMP), operate to mitigate and compensate for impacts.

The Commission further notes that the independent review by CIE accepted the treatment of environmental impact mitigation costs, such as the purchase of biodiversity offsets or implementing noise mitigation measures as proposed in the proponent's response to the First Review Report, in the updated economic assessment (ie absorbed as part of the operating costs).

The Commission's experts pointed out there is a need to consider the potential long term management and operation costs of the water treatment system that may be required to control water outflows from the adit following mine closure as well as the long term on-going monitoring cost to WaterNSW if it is to be responsible for the long-term monitoring water quality after mine closure.

Greenhouse Gas emissions

The Commission understands that without a carbon pricing mechanism operating in Australia and without specific guidance provided within the economic guidelines it will be up to the proponent to quantify GHG impacts with regard to '*relevant research and approaches used in other Australian and international jurisdictions for quantifying similar impacts*'[39]. It is noted however that Gillespie Economics' approach of scaling Greenhouse gas impacts by Australia's share of global GDP has been criticised in the past by two separate peer reviewers for another project reviewed by the Commission[40]. Nevertheless, it is evident that there is a wide array of different methods currently employed by economic consultants to quantify GHG impacts, with no settled approach on this issue. In fact the exhibited draft of the economic guidelines required comparison of three different carbon pricing models: the European Union Emission Allowance Units carbon price forecast; the Clean Energy Future Policy Scenario/Australian Treasury carbon price estimate; and the US EPA Social Cost of Carbon[41]. Each of these models would have returned a higher social cost for GHG in the CBA.

The independent review undertaken by CIE for the Department provided no comment on the calculation of GHG costs in the updated Economic Assessment. The Commission notes that the draft conditions for the project provided by the Department require that an Air Quality Management Plan

[38] NSW Government, 2015, Guidelines for the economic assessment of mining and coal seam gas proposals pp.11 and 19

[39] NSW Government, 2015, Guidelines for the economic assessment of mining and coal seam gas proposals p.16

[40] BDA Group, 2015, Drayton Mine Extension Project Economic Impact Assessment Peer Review, prepared for Hansen and Bailey on behalf of Anglo American; Deloitte Access Economics, 2015, Peer Review of economic assessment of Drayton South Coal Project, prepared for the Department of Planning and Environment. Accessed at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6875 on 19/01/2016

[41] NSW Government, Draft Guidelines for the economic assessment of mining and coal seam gas proposals p.60

describing measures to minimise the release of GHG be prepared and implemented for the project. In this regard the proponent identified within its preferred project report measures to potentially reduce total emissions by at least 59%[42].

The Commission finds the net benefit of the project could be improved by committing to the costs of the mitigation measures to minimise the release of GHG in the CBA.

Regional economic impacts and non-market employment benefits

The Commission notes that the governments '*Guidelines for the economic assessment of mining and coal seam gas proposals*' support the inclusion of a 'local effects analysis' (LEA) to support the CBA. The LEA is intended to analyse the *'local effects of the project on local employment and income effects; other local industry effects, for example on suppliers; and environmental and social changes in the local community'*[43]. It is considered that the regional economic impact analysis and the non-market employment benefits information provided as part of the updated economic assessment provides some similar information as required for an LEA and, while reporting should be separate, it is a useful adjunct to the CBA which remains the primary tool for evaluating whether the project will deliver net benefits to NSW.

Market for Coking Coal

Despite the continuing decline in coking coal prices Australia's exports of coking coal are forecast to increase[44]. It is noted that while worldwide steel production is projected to remain steady over the short-term world steel consumption is forecast to return to growth[45]. The Commission is satisfied that there will be continued demand for coking coal.

Project Finances and Worker Safety

In relation to concerns raised in public submissions and at the public hearings about the financial viability of the proposal, the financial capacity of the proponent to fund rehabilitation of the mine site, and whether the proponent was a 'fit and proper person' the Commission notes that these issues are regulated under the *Mining Act 1992*. The *Work Health and Safety (Mines) Act 2013* regulates safe working environments at mines. These are separate statutory regimes and not relevant considerations under the *Environmental Planning & Assessment Act 1979*, to which the Commission must have regard.

4.4.5 Commission's Findings

The Commission questions the quantum of economic benefits that would be generated from the project and the proponent's capacity to deliver the claimed benefits including employment, expected production rates and associated royalty payment.

The claimed benefits include employment, engagement of contractors, and royalty payments. The Commission notes the Division of Resources & Energy in a letter to the Department dated 16 December 2014 concluded that the significance of the project is its ability "*to maintain coal production from the Southern coalfield and utilisation of Port Kembla Coal Terminal*". The Division directed attention to the potential economic impact on the region, if the project were not approved. "*The combined economic impacts of job losses at the company's Wongawilli and Russell Vale Collieries may be as high as $886 million and impacting on over 1000 jobs directly and indirectly*". In

[42] Gujarat NRE Coking Coal Limited, Underground Expansion Project Preferred Project Report, p.34
[43] NSW Government, 2015, Guidelines for the economic assessment of mining and coal seam gas proposals p.5
[44] Department of Industry, Innovation and Science - Office of the Chief Economist 2015, *Resources and Energy Quarterly- December 2015*, Canberra p.23
[45] Department of Industry, Innovation and Science - Office of the Chief Economist 2015, *Resources and Energy Quarterly- December 2015*, Canberra p.12

this regard, the Commission notes the Wollongong Coal Quarterly Report (October to December 2015) reported "Wongawilli Colliery to commence operation in the fourth quarter" and a decision has been made "to place the Russell Vale Colliery on Care and Maintenance on the 1st September 2015…"[46]

Put simply, the claimed socio-economic benefits include:

- the creation/continue employment opportunity for up to 300 people including contractors for 5 years
- the generation of $23 million royalties for NSW
- indirect employment by adopting a multiplier of 4
- direct flow on effects in the region of $114 million
- $85 million in capital and operation expenditure that would generate $580 million in regional output over the mine's life
- Tax for the Commonwealth
- Maintain coal production from the Southern Coalfields
- Utilisation of the Port Kembla Coal Terminal

The CIE identified the following costs should be included in the CBA analysis:

- The ongoing monitoring requirement at a cost of $62000 (present value) to WaterNSW
- Greenhouse gas emissions at $0.15 million
- Monetary compensation to the loss of water at up to $430,000 (present value). This may be included as the proponent's operating cost resulting in a reduction in profit.

The Commission finds the economic assessment requires updating to take into consideration that:

- The additional mitigation measures are required to reduce noise impact from the pit top site to private residences and truck traffic noise impact to residents along Bellambi Lane when the benchmark existing noise levels are updated to reflect actual existing noise.
- How does the $22 million cost of water loss estimated by WaterNSW compare with the CIE estimate of $430,000 present value?
- Who should bear the potential long term management and operational cost of the water treatment system, if require to control water outflows from the adit following mine closure assuming it is part of the operating cost while the mine is in operation.
- The timeframe factored in the estimated $62,000 (present value) to WaterNSW for on-going monitoring requirements as monitoring will continue to be required after mine closure.

The key issue to the Commission is how to balance the short-term immediate economic benefits with the uncertain long-term costs and environmental consequences.

4.5 NOISE

Noise from the pit top site has been an ongoing issue for the mine. The Commission's First Review heard concerns from surrounding residents and the EPA. During the review, the Commission noted there were significant differences between the noise assessment for this application and the one provided for the 2011 preliminary works application, and found that:

> *The proposed less stringent noise levels have not been justified adequately by the information available to the Commission nor have additional practical measures been adequately investigated to meet intrusive noise levels recommended by the Industrial Noise Policy.*[47]

[46] Wollongong Coal, Quarterly Report, October to December 2015, p.3-4

[47] Planning Assessment Commission, 2015, *Russell Vale Colliery – Underground Expansion Project Review Report, April 2015, p.40*

The Review Report made the following recommendation:

> ***Recommendation 7***
> *The Commission recommends that further consideration of the noise impacts of the project needs to be provided including consideration of further noise mitigation measures as recommended by the EPA. Detailed justification should be provided for any deviations from the existing noise limits in current planning approval. Also clarification should be provided on the outcomes and applicability of the noise audit required in the 2011 approval.*[48]

4.5.1 The Proponent's Response to the Commission's First Review Report

The Wilkinson Murray Report No 14141-A Version B dated July 2015 (WM2015) responded to the recommendations in the Commission's First Review Report.

Briefly, the report advised that the noise levels predicted by the ERM 2010 assessment for the approval of the 2011 preliminary works (2011 Approval) were lower than the levels predicted by Wilkinson Murrary 2014 assessment "*principally due to the incorrect assumption that adverse meteorological conditions were not a feature of the area, and the adoption of different source sound power levels*". Table 3-2 of the WM2015 report shows the inconsistency with the ERM assessed PSNLs, the predicted noise levels and the 2011 Approved noise limits. Due to the incorrect assumption in the ERM 2010 assessment, the proponent considered it appropriate to reconsider the approved noise levels based on the findings of the noise assessment for the current project.

The proponent advised that most of the noise mitigation measures have been implemented. Other measures including fitting conveyors with poly rollers and maintaining a minimum level of coal in the loading bin, have been accepted and would be implemented. It has also committed to replace the front-end loaders, undertake a trial of tripper automation, and carry out further noise monitoring to determine whether a noise barrier is warranted.

As to the 2012 Noise Audit results, the WM2015 report advised that "*the 2012 audit noise levels represent the levels found to occur during the brief period of the audit. Whilst it is not clear from the audit report exactly which on-site noise sources influenced the measured noise levels, it is apparent that the results of the attended noise survey indicated compliance with the Interim Intrusive Noise limits outlined in the Project Approval*." The report also directed attention to "*the Department's proposed levels are based on assessment of the site at full capacity and reliant on modelling which has accounted for the simultaneous operation of all equipment operating concurrently and at full capacity*."[49]

4.5.2 Agencies and Council's Comments on the Proponent's Response

<u>Environment Protection Authority (EPA)</u>

By letter dated 20 August 2015, the EPA advised the Department that:

> *In relation to noise impacts the EPA advised on 11 December 2014 … "noise from the premises will be clearly audible and likely to be considered as intrusive by some members of the surrounding community" … and …"proposed limits exceed what the EPA would consider licensing to" … The PSNLs will be exceeded even following the implementation of reasonable and feasible noise mitigation measures. In such cases, if Approval was granted, it would have to be granted taking account of the balance of overall social and economic benefits against undesirable local amenity impacts. The notes to the Industrial Noise Policy (INP) state that*

[48] Ibid, p.41
[49] The Wilkinson Murray Report No 14141-A Version B dated July 2015, p.22

"decisions of feasible and reasonable mitigation option, the absolute level of noise and existing measures of community impact including complaints".

The EPA recommended that if approval were to be granted,

1. Consideration be given to requiring the provision of noise mitigation measures at private residences where proposed noise limits are measurably exceeded as this is consistent with the INP, and
2. The scope of mitigation works and timeframes for completion should be clearly defined and secured as a condition of approval.

Wollongong City Council

By letter dated 14 October 2015, Council advised that it supports the construction of a noise barrier to reduce the noise impacts on the surrounding residences and a condition of approval should require appropriate consultation with adjoining residential property owners.

4.5.3 The Department's Addendum Report and Recommended Conditions of Approval

Table 2 of the Department's Addendum Report (Nov 2015) summarised the "existing noise levels" against the predicted noise levels for the project. As the two sets of noise levels are "either the same as, or less than, those currently being experienced with the exception of one receiver, which is predicted to experience a 1dB(A) increase in existing noise level" with the proposed project. Such minor increase would not be noticeable.

As to best practice noise mitigation measures, the Department noted that "*the EPA has reviewed the additional noise and costing reports and has indicated that Wollongong Coal has undertaken a 'reasonable and feasible' assessment of the noise control recommendations and costs*". Further that, "*the majority of the EPA's recommended noise mitigation measures have already been implemented on-site. Those that have not been implemented have been assessed as having limited acoustic benefit*".

The Department noted Wollongong City Council's support of the construction of a noise barrier. However, the Department maintained "*its long-held position that the topography in the vicinity of the pit-top site is not conducive to a noise barrier being an effective noise management technique. Furthermore, such a barrier would result in significant visual impacts on nearby receivers, which have generally not raised noise as an issue in the past*". Notwithstanding such views, the Department supports the proposal that the proponent should carry out further real time in-situ noise monitoring and discuss the results with the affected residents before a final position is made on whether the noise barrier should be constructed. A condition of approval is recommended accordingly by the Department.

With regard to the proposed noise limits, the Department considered the flaws in the ERM noise assessment for the preliminary works in 2010 resulted in a significant underestimate of the predicted noise levels when the site is operated to capacity leading to unrealistically low noise criteria in the 2011 approval. The WM2014 report revised the earlier assessment and the Department's noise specialist reviewed the results and found them to be "*representative of the existing and future operational activities under the UEP*".

The Department acknowledged that the proposed noise levels would exceed the PSNLs at certain locations, even following the implementation of all reasonable and feasible noise mitigation measures. However, "*in no case would the predicted levels exceed the Acceptable Amenity Criteria*". Attention was directed to the Voluntary Land Acquisition and Mitigation Policy (November 2014) that voluntary mitigation and acquisition rights should not be granted to resolve existing development's legacy noise issues, "where the modification would have beneficial or negligible

noise impacts." The Department maintains that its recommended noise criteria are appropriate and the recommended conditions would require the proponent to continue its investigation and implementation of any reasonable and feasible noise reduction measures.

Following a review of the Addendum Report, other available information and the submissions made at the public hearing, the Commission sought further clarification from the Department. The response is in Appendix 5.

Briefly the Department advised that the pit top site is an existing operation with legacy noise issues. Its assessment concluded that the proposed project would have beneficial or negligible noise impacts on nearby residences and under the current Government policy, the consent authority should not grant voluntary mitigation and acquisition rights. The Department further advised that current noise policy requires noise level objectives to apply under 'worst-case operational and meteorological conditions'. It does not consider it is realistic or applicable to use noise levels measured during the noise audit as 'benchmark' noise levels. The Department considered it is reasonable to limit noise from the pit top sit to levels that do not exceed the Acceptable Amenity Criteria for the area. Under the proposed draft Industrial Noise Guideline, industries that have operated for a long period of time in one location will not be treated the same as for green-field sites. If the site were assessed under the draft guideline, the intrusive noise criteria would increase significantly. The Department maintains the assessment methodology undertaken is the most reasonable and applicable option.

4.5.4 Public Submissions to the Commission

Issues raised at the second public hearing are quite similar to those raised in the first hearing. Briefly the main concerns are:

- The predicted noise levels from the mine will exceed the project specific noise levels at certain locations.
- Noise mitigation measures at private residences should be considered.
- Recommended conditions of consent are insufficient as they rely on the applicant identifying what is *reasonable and feasible* in relation to noise and air quality.
- No other mine in Australia is as close to residential areas.

4.5.5 Commission's Considerations

The key issues for the Commission's consideration are:

1. the appropriate benchmark noise levels for the assessment of impact on residences, and
2. the adequacy of the proposed and recommended mitigation measures to reduce impact on residences, if the project were to be approved.

1. Benchmark noise levels for the assessment of impact on residences

This is the most critical question as they determine whether the proposed project would have negligible or beneficial impact on nearby residences, hence the application of the *Voluntary Land Acquisition and Mitigation Policy* (November 2014).

The Department is of the view that given the flaws in the earlier ERM's assessment for the 2010 application, the remodelled noise levels in the WM2014 should be taken as the "existing" noise levels for comparison with the predicted noise levels for the current proposal. As the "existing" and predicted levels are quite similar, almost the same, the Department concluded that the proposed project even with the significant increase in production levels, would have a negligible noise impact

on nearby residents. The Commission sought further clarification from the Department in relation to the benchmark noise levels and the Department's response is in Appendix 5.

Notwithstanding the detailed explanation and justification provided by the Department, the Commission is not convinced that the modelled noise levels should be adopted as the "existing" noise levels for the assessment of the current application.

The Department's approach to setting the "existing" noise levels fails to give due regard to the noise limits set out in the 2011 approval, notwithstanding the approved limits were based on flawed assumption and methodology. It is fair to say that there is no certainty that approval would have been granted to the earlier application, or if granted, what additional mitigation requirements would be imposed if the WM2014 revised noise levels were presented to the 2011 consent authority.

The 2011 approved noise limits gave certain expectation to the community that those were the noise impacts that they would receive. The 2012 noise audit showed compliance with the night time limits except for residences on West Street and Broker Street, Russell Vale. The Commission does not accept the argument that the reason for the reported low levels of operational noise was due to operational constraints, which did not allow the mine to operate to its full capacity. If the mine were to operate to its full capacity, it would breach the approved noise limits. A modification application would have been required to increase the noise limits, and there is no knowing what conditions the consent authority would impose if the noise limits were allowed to increase.

The Commission agrees that the 2012 noise audit results are not appropriate for benchmarking the existing noise levels for the assessment of the current project. However, they provide reference points for the consideration of the current application. In the Commission's view, the setting of the benchmark noise levels for assessment should have regard to the 2011 approved noise limits, the 2012 noise audit results and the *Industry Noise Policy.*

The *Industrial Noise Policy* provides a clear framework and process to establish the criteria for noise assessment. The Commission noted the draft Industrial Noise Guideline. However, it is yet to be adopted by the Government and there is no certainty that the draft will be adopted as exhibited. In the absence of a fair and reasonable alternative benchmark noise levels for the assessment, the Commission will focus its consideration of the noise issue having regard to the existing *Industrial Noise Policy*.

Table 5-2 of the WM2015 report shows the revised predicted worse case noise levels from the project in Year 4 and the relevant criteria (PSNLs) derived from the *Industrial Noise Policy*. Predicted exceedances range up to 10dB (day time), 13dB(evening) and 5dB(night time). Notwithstanding the already implemented and proposed mitigation measures, the range of exceedances clearly indicate noise impacts on nearby residences are not negligible or beneficial.

In this regard, the Commission notes the EPA's advice that

> *the PSNLs will be exceeded even following the implementation of reasonable and feasible noise mitigation measures. In such cases, if Approval was granted, it would have to be granted taking account of the balance of overall social and economic benefits against undesirable local amenity impacts. The notes to the Industrial Noise Policy (INP) state that "decisions of this nature will be determined on a case-by-case basis, taking into account various factors, for example, feasible and reasonable mitigation option, the absolute level of noise and existing measures of community impact including complaints".*

If approval was granted, the PAC could consider discussing with the DPE the option of requiring the provision of noise mitigation measures at private residences where proposed noise limits are measurably exceeded. The consideration of such a benefit is consistent with the INP's approach where there is a residual level of impact after reasonable and feasible measures are implemented. It might also address the PACs expressed concerned that "the project should be considered on its merits, rather than simply against the mine's historic noise impacts.[50]

Based on the information available, the Commission is not convinced that the *Voluntary Land Acquisition and Mitigation Policy* should not apply as concluded in the Department's Addendum Report. However, the application of the policy should take into consideration the history of the mine, which has existed in the locality since the late 1800s. In the circumstances, the Commission agrees with the EPA that mitigation measures on private residences could be considered.

2. The adequacy of the proposed and recommended mitigation measures to reduce impact on residences, if the project were to be approved

The evidence indicates that the implementation of the EPA recommended mitigation measures would not be sufficient to reduce the noise levels to an acceptable level. The Commission notes that noise barrier is an option that is being considered. Wollongong City Council supports the construction of the barrier. The proponent has committed to carry out further noise monitoring and discuss the results with the community before finalising its position whether to construct the barrier. The Department held the view that the construction of a noise barrier would create a visual impact and the effectiveness is limited to those residences that are close to the barrier. As discussed earlier, the Commission supports the EPA's recommendation that consideration be given to provide "*noise mitigation measures at private residences where proposed noise limits are measurably exceeded*".

<u>The draft recommended noise criteria</u>

Draft condition 1 in Schedule 4 provides the noise criteria that are applicable to the 14 identified receiver. For all other privately owned land, the applicable criteria are 63dBA (day), 53dBA (evening) and 48dBA (evening) with a $L_{A1\ (1min)}$ of 52 for the night period. The Commission has serious concern about this condition.

For example, the day time criterion for 14 West Street, Russell Vale is 53dBA and for 30 West Street, Russell Vale is 54dBA. There are several residences between these two properties. The noise criteria condition as drafted means these residences would be subject to noise level up to 63dBA during day time unless they have an agreement with the proponent. The Commission finds this condition not fair or equitable. The same situation applies to Broker Street, Midgley Street, and Lyndon Street. The Commission considers a noise contour map should be provided to indicate the predicted noise levels to allow appropriate criteria to be applied.

4.5.5 Commission's Findings

The Commission finds:

1. The Department's adoption of the modelled noise levels as existing noise levels is not reasonable or sufficiently justified.
2. The setting of benchmarks should have regard to the 2011 approved noise limits, the 2012 noise audit results and the *Industrial Noise Policy*.
3. If the PSNLs are accepted as the benchmark for assessment of impact, the proposed project would have significant residual noise impact on certain nearby residences, notwithstanding the already implemented and proposed on site mitigation measures.

[50] NSW EPA letter to the Department of Planning and Environment, *Request for Comment, Wollongong Coal Response to PAC Recommendations,* dated 20 August 2015, Attachment 1, p.2-3

4. The draft recommended noise criteria for the identified receivers are not reasonable, particularly the criteria for "all other privately-owned land" especially to those who are neighbours to the identified receivers.

The Commission notes the advice from the EPA that the Industrial Noise Policy that where acceptable noise levels cannot be achieved with reasonable and feasible measures then the determining authority should consider the impacts against the social and economic benefits of the project. The Commission addresses this balance in its conclusions for this Review.

4.6 AIR QUALITY

The Commission's First Review Report found that although the proponent has predicted that the mine would be able to comply with current air quality criteria, further assessment of $PM_{2.5}$ emission against the National Environmental Protection Measures (NEPM) criteria is warranted. It should also demonstrate how the increased coal handling capacity (proposed to increase from the existing 1 Mtpa to 3 Mtpa) would be managed to minimise emissions and achieve best practice.

The First Review Report recommended:

> ***Recommendation 8***
> *The $PM_{2.5}$ emissions from the proposal need to be assessed prior to any determination of the application.*
>
> ***Recommendation 9***
> *Consideration of best practice standards needs to be provided to demonstrate that air emissions would be minimised and to justify the proposed increase in coal handling capacity.*
>
> ***Recommendation 10***
> *The mine's existing monitoring and reporting systems should be strengthened to clearly demonstrate compliance with current conditions, environmental standards and reporting goals (i.e. for $PM_{2.5}$ emissions).* (Planning Assessment Commission, 2015, p. 43)

4.6.1 The Proponent's Response to the First Review Report

The proponent advised that an assessment of $PM_{2.5}$ emissions was carried out by Pacific Environment Limited (PEL letter dated 23 July 2015). "The modelling results show that no sensitive receptor is predicted to experience ground level concentrations of $PM_{2.5}$ greater than the relevant assessment criteria due to the project alone or cumulatively". (p 7)

In terms of monitoring and reporting of $PM_{2.5}$, the proponent advised that it currently provides quarterly reports on PM_{10} as there are no criteria for $PM_{2.5}$. It also advised that the two new monitors installed in late 2013 have produced $PM_{2.5}$ data. The proponent has logged and evaluated the data for internal environmental management purposes. It will include the $PM_{2.5}$ results in future reporting and published on its website.

With regard to best practice, an evaluation of best practice dust management at the mine site was carried out by PAEHolmes in 2012 (PAEH2012). The report identified the four highest ranking activities in terms of PM generation are wind erosion of coal stockpiles, trucks unloading coal, material transfer of coal and wheel generated particulates on unpaved roads. The best practice measures that are proposed as part of the current application include new truck loading facility, two new conveyors with enclosures, underground reclaim, secondary sizer building, water sprays on moving tripper and upgrade fleet from 34 tonnes to 44 tonnes. Other potential measures have been considered including vegetative windbreaks on stockpiles, trial chemical wetting agents on the stockpiles, pave the surface of the haul roads, and trial suppressants on the haul roads. Of these

four measures, the proponent has committed to trial chemical wetting agents on haul roads and stockpiles, and paving the proposed haul road through the stockpile area.

4.6.2 EPA's Comments on the Proponent's Response to the First Review Report

By letter dated 20 August 2015, the EPA advised the Department that it has reviewed the proponent's response to the First Review Report and noted that "*all sensitive receivers are predicted to experience $PM_{2.5}$ concentrations below the current national NEPM criteria*". It further noted that the proponent has committed to install new works including a reclaim conveyor/coal hopper loading facility and sealing of the main haul roads so as to reduce dust emissions. Additional dust mitigation measures have been proposed including trial use of chemical wetting agents on haul road and stockpiles, sealing of the proposed haul road and water sprays on the moving tripper. The EPA recommends the scope and timeframes for completion of all works be clearly defined and secured as conditions of approval, if the project were to be approved.

With regard to monitoring and reporting of $PM_{2.5}$, the EPA supports the proponent's commitment to include $PM_{2.5}$ monitoring and future reporting be published on its website.

4.6.3 The Department's Addendum Report and Recommended Conditions of Approval

The Department advised that its assessment concluded that the proposed project would comply with all relevant dust criteria (project specific and cumulative) at privately owned residences near the pit top site with one exceedance of short term (24 hour) cumulative impact over the year. This is considered "*to be infrequent and would only occur rarely under worst case meteorological conditions*".

Attention is directed to a range of air quality mitigation measures that have been implemented by the proponent for the existing mining operations. The proponent has committed to construct the new truck loader facility and the secondary sizer building by the end of 2016, truck fleet upgrade would be phased in over a 24 month period following approval of the current application, and the two new conveyors and underground reclaim operations would be implemented when production reaches about 2.7mtpa.

The Department also noted the proponent's commitment to trial chemical wetting agents on haul roads and stockpiles, sealing of haul road and installing water sprays on the tipper.

In summary, the Department maintains its view that the proposed air quality criteria and operating conditions remain applicable to the proposed project. It also noted the EPA's request and recommended additional conditions to ensure the scope and timeframes of the proposed mitigation measures are implemented.

4.6.4 Submissions to the Commission at the Public Hearing

The Commission heard from a number of local residents at the public hearing raising concerns about various dust sources associated with the pit top, particularly the expansion of coal stockpiles, emplacement areas and emissions from trucks transporting coal to the Port Kembla Coal Terminal.

4.6.5 Commission's Considerations

The three issues raised in the First Review in relation to air quality are:

1. The need for assessment of $PM_{2.5}$ emission
2. Best practice to manage emissions
3. Monitoring and reporting of performance

Assessment of $PM_{2.5}$ Emission

The evidence indicates that the proposed project would meet the NEPM $PM_{2.5}$ criteria at all sensitive receivers. However, the Commission notes that although "*the modelling results show that no sensitive receptor is predicted to experience ground level concentrations of $PM_{2.5}$ greater than the relevant assessment criteria, due to the Project alone or cumulatively*".[51] Table 4 indicates that two of the receivers (R1-1 and R2-2) are very close (24.4µg/m^3) to the NEPM 24 hour criterion of 25µg/m^3. Receiver R3_10 is at 23.9µg/m^3. This is a concern to the Commission. When this concern and the predicted one exceedance of PM_{10} 24 hour criterion referred to in the proponent's RTS[52] are considered together, the Commission finds a strong real time monitoring and pro-active management system including shutdown of facilities is of critical importance to minimise impact on nearby residents, particularly during adverse weather conditions.

Implementation of Best Practice Standards

The Commission notes the already implemented best practice measures for the existing operations. It also supports the proposed measures to be implemented if the project were approved. The Commission also notes the Department has accepted the EPA's recommendation to include the scope of works and specific time frames for the implementation of the measures as additional recommended conditions of approval. However, the Commission is concerned regarding the inherent delay in implementation of the measures due to the generous time limit proposed in the draft conditions. For example, the draft condition requires the sealing of the haul roads through the stockpile area within 12 months of the commencement of mining operations. The Addendum Report has not explained why the haul roads cannot be sealed before commencement of mining operation or within 3 months of commencement.

The Commission is concerned that the construction of the two conveyors and underground reclaim is linked to production levels reaching an equivalent of 2.7 Mtpa. Information from the proponent indicates that this level of production may never be achieved for this project. The Commission is of the view that further consideration of the implementation timeframe and assessment of the predicted impacts is required if these measures are not implemented.

Monitoring and Reporting System

The Commission notes that the proponent has included in its Statement of Commitments to report on:

- Annual average and 24 average PM10 criteria;
- Annual average and 24 hour average PM2.5 criteria; and
- Adaptive management and ongoing improvements implemented to reduce dust emissions throughout the reporting period.

The Commission supports the introduction of the reporting regime and reporting on the proponent's website.

Emplacement Area and Stockpiles

At the public hearing the community raised concerns regarding both the existing emplacement area and the proposed stockpile areas, particularly the height of the stockpiles.

The Russell Vale Emplacement Area (RVEA) is not part of the current application. The RVEA land lies north of the mine site and operates under a separate consent issued by Wollongong City Council. The proponent has advised that there is no intention to use this emplacement area as part of the

[51] Pacific Environment Limited letter to Hansen Bailey, *Response to Planning Assessment Commission Air Quality Recommendations,* dated 23 July 2015, p.7

[52] Hansen Bailey, *Response to Planning Assessment Commission Review Report Part 1,* July 2015 p.15

project. The Commission has discussed outstanding compliance issues with Wollongong City Council and recognises that the Council is the regulatory authority. To ensure that the proposed project does not exacerbate existing compliance issues at the RVEA a prohibition of transport materials from the project to the RVEA should be considered.

The existing stockpile (SP1) has a capacity of 60 000t to 80 000t and will continue to be used for the proposed project. Two additional stockpiles (SP2 and SP3) are proposed to be located to the east of SP1. Each new stockpile will have a capacity of approximately 140 000t. Following construction of SP2 and SP3, the total stockpiling capacity will be about 340 000 to 360 000 tonnes of coal on site. The Commission notes the stockpiles has been included as part of the surface facilities in the air quality assessment and the proposed mitigation measures will minimise potential impacts on nearby residents.

The Commission notes that the dimensions of the proposed stockpiles are not easy to find in the main documents. Two drawings in Appendix 3 of the EA (Dwg No 282800 Rev G and Dwg No 282801 Rev E) show the locations and approximate elevations of the 3 stockpiles.

4.6.6 Commission's Findings

The Commission finds:

1. The concerns raised in the First Review Report have largely been addressed in the additional information provided.
2. A strong real time monitoring and pro-active management regime is of critical importance to minimise potential impact on residents and annual reporting should be available on the proponent's website
3. A review of the draft conditions of approval in relation to timeframes for implementation of the various proposed mitigation measures is required, particularly when production rate is unlikely to reach 2.7mtpa.
4. A prohibition condition may be required to disallow the transport of materials from the site to the RVEA without the agreement of the Wollongong City Council.
5. A clear description of the stockpiles' dimensions (height, length and width) would assist the understanding of the visual relationship of the stockpiles and the surrounding landuses.

4.7 BELLAMBI CREEK - FLOOD MANAGEMENT

The Commission's First Review recommended that

> ***Recommendation 11***
> *Any new approval should retain the existing requirement to realign Bellambi Creek or a full justification why this is no longer necessary to provide protection to the creek downstream from the pit top surface area.*

4.7.1 Proponent's Response to the First Review Report

In response to the recommendation in the First Review Report, the proponent submitted a report entitled *Bellambi Gully Flooding Approach* prepared by Cardno in July 2015 (Cardno 2015 Report). This study considered the originally proposed creek realignment and presented alternate mitigation measures to address the flooding issue. It recommends a number of mitigation measures to reduce clean water runoff entering the stockpile area, while conveying all site runoff into Bellambi Gully Creek in a manner to prevent flooding of Bellambi Lane.

4.7.2 Wollongong City Council's Comment on the Proponent's Response

By letter dated 14 October 2015, Wollongong City Council advised the Department that it recommended a condition of consent be imposed requiring the carrying out of appropriate flood mitigation works as per the recommendations contained in the Cardno 2015 Report.

4.7.3 The Department's Addendum Report

The Department advised that it is satisfied that the additional reports from Cardno have adequately addressed the issues of concern and Wollongong City Council is also satisfied with the proposed flood mitigation measures. It has recommended a condition be imposed to require the implementation of mitigation measures within 12 months of the date of approval. The Department is also satisfied that "*the existing water performance measure requiring dams to be designed, installed and maintained in accordance with the series 'Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries' is otherwise sufficient to ensure the treatment of runoff water within the stockpile area prior to discharge*".[53]

4.7.4 Submissions to the Commission

The Commission heard concerns regarding flooding, failure to construct flood mitigation works and previous flood events in the first public hearing. Similar concerns were raised at the second public hearing. Reference was also made to the recent pollution event caused by a malfunction of the stockpile spray.

4.7.5 Commission's Considerations and Findings

The Commission is satisfied that the issue raised in the First Review Report has been adequately addressed and supports, if the project were to be approved, the inclusion of a condition of consent that requires the implementation of flood mitigation measures recommended in the Cardno 2015 Report within 12 months of the date of approval. It also supports the draft recommended condition requiring the installation of a swale alongside the stockpile access road, which should improve water management on the site, though it is noted that the discharge of dirty water from the site is regulated by the EPA under the site's Environment Protection Licence.

4.8 TRAFFIC AND TRANSPORT

The Commission's First Review Report made the following recommendations:

> ***Recommendation 12***
> *The proponent should negotiate with Council and Roads & Maritime Services regarding maintenance contributions to mitigate impacts from the increase in truck movements along the haulage route.*
>
> ***Recommendation 13***
> *Consideration should be given to further limiting the hours of truck movements.*
>
> ***Recommendation 14***
> *Proponent should investigate and cost a number of options to reduce the noise impacts to the most effected residents along Bellambi Lane, particularly those near the intersections with the Princes Highway and the Northern Distributor. Options to be considered by the proponent, should include, but not be limited to:*
> *a. construction of a coal truck parking area (for trucks to wait prior to the commencement of haulage hours) within the mine boundary*
> *b. construction of a noise barrier near the intersections of Bellambi Lane/Princes Highway and Bellambi Lane/Northern Distributor; and*
> *c. use of pavement modifications along Bellambi Lane, to reduce truck/trailer banging.*
>
> ***Recommendation 15***

[53] Department of Planning and Environment, 2015, Addendum Report: Major Project Assessment Russell Vale Colliery Underground Expansion Project (MP 09_0013), November 2015, p.28

No increase in the currently approved maximum rate of extraction should be approved without clear demonstration that facilities can handle the additional volume without unacceptable impacts for local residents.

4.8.1 Submissions to the Commission at the Second Public Hearing

Public submissions at the second public hearing raised issues similar to those raised at the first public hearing. The following is a brief summary of these concerns.

- Current truck noise is already having a significant impact on residents in Bellambi Lane, particularly noise and fumes. The proposed production level will significantly increase truck traffic with unacceptable impact, particularly in the evening.
- Contribution to maintain Bellambi Lane should be required.
- Consultation for the Traffic Control Plan should be expanded to include the Council and residents.
- Transportation of coal should be via a conveyor belt to the rail line, not road.
- Road transport should be restricted to 1mtpa. Any production above this level should be transported via a conveyor belt.
- Previous government position was coal to be transported by rail with only residual approval to be transported by road and those to be subject to stringent conditions.

4.8.2 Commission's Consideration

Road Maintenance Contributions

Both Wollongong City Council and the proponent advised the Commission that negotiation of a road maintenance contribution has commenced. Council also recommended "*a condition be imposed requiring the proponent to successfully conclude negotiations with the Council (through a Planning Agreement) regarding the payment of appropriate road maintenance contributions towards Bellambi Lane*"[54]. The Department's Addendum Report advised that it has included a draft condition that requires "*agreement with Council to be reached within 6 months of approval, and referral to the Secretary if agreement cannot be reached*".[55]

The Department also directed attention to the RMS's advice via its letter to the Department dated 28 May 2015 that the proposed increase in traffic would not have a significant impact on the operation and performance of the main road network and raised no objections in principle to the application.

The Commission finds the issue has been adequately addressed and supports the requirement to reach an agreement within 6 months of approval, if the project were to be approved.

Truck Movements and transportation hours

The proponent advised that current approval allows coal transportation between 7am to 10pm on weekdays and 8am to 6pm on weekends and public holidays. The current application does not seek to alter these hours.

The Department advised that it has recommended the same transportation hours to be continued for the current application. To support its recommendation, the Department pointed out that the increase transport of coal from 1Mtpa to 3Mtpa would increase the number of truck movements

[54] Wollongong City Council letter to the Department of Planning and Environment dated 14 October 2015

[55] Department of Planning and Environment, 2015, Addendum Report: Major Project Assessment Russell Vale Colliery Underground Expansion Project (MP 09_0013), November 2015, p29

from 22 to 34 per hours. The noise assessment concluded that traffic noise would increase by 1.7dB(A) from the current road traffic noise. Such increase "*is considered negligible, particularly within the historical context of noise levels generated on Bellambi Lane until 2009, which were much higher than future predictions. The Department notes there would be no night-time trucking (apart from the odd over-sized vehicle) and that the project would remain fully in compliance with criteria in the Road Noise Policy*".[56]

The Commission is concerned about how the conclusion of noise increase of 1.7dB(A) was reached. The issue here appears to be similar to that discussed in the noise section of this report.

In the July 2010 Cardno Report, it outlined the then existing transportation of coal on a day to day basis with about 110-120 truck movements per delivery day[57]. In the April 2014 Cardno Report[58], it reported the March 2014 summary of average weekday truck movements of 144 equivalent to 17 movements per hour. For 3 million tonnes per annum production there would be an average of 34 movements per hour, equivalent to 510 truck movements per day. The February 2013 ERM Report[59] predicted the peak coal delivery would generate 682 trips per day.

The figures in these reports indicate the increase in truck movement would be from 17 to 34 movements per hour and could be as high as 45 movements per hour during peak delivery. The Commission fails to understand how such increase in truck movement numbers would only generate an increase of 1.7dB(A) in traffic noise level. It appears the Department's assessment was again based on the modelled maximum production of 1mtpa as the existing noise levels for comparison. However, this still fails to take into consideration of peak delivery and the frequency of its occurring.

A reassessment of traffic noise impact is required to provide a true picture of existing and predicted traffic noise levels due to the increase in truck movement. The assessment should include peak delivery to allow a proper consideration of appropriate mitigation measures to be implemented, if required, to maintain reasonable amenity for residents along Bellambi Lane. Consideration of mitigation measures should include limiting truck movement after 6pm.

Truck parking area within the site

The proponent advised that the current application includes a proposed haul trucks parking area to address the concerns of the residents.

The Commission notes the proposed parking area is adjacent to the entrance of the pit top site and in close proximity to a number of residences. It is also noted that the proposed truck parking area may require the removal of part of the existing noise bunds as indicated in Figure 6-4 of the WM2014. The Commission is concerned the impact of noise associated with truck queueing on nearby residences, particularly in the early morning hours.

Noise barrier

As to the proposal to construct a noise barrier near the intersection of Bellambi Lane and Princes Highway, the proponent advised that Section 7 of the WM2015 report detailed the analysis of perimeter noise barrier to reduce potential noise and concluded that only a section of 6m high noise barrier may benefit those who are close to the barrier. This section does not include the intersection of Bellambi Lane and Princes Highway.

[56] Ibid, p 30
[57] Cardno, *Gujarat NRE No. 1 Mine Traffic Study* , dated July 2010, p.7
[58] Cardno, *Wollongong Coal Russell Vale Colliery – Traffic & Transport Impact Assessment for the Preferred Project,* dated April 2014
[59] Environmental Resources Management, *NRE No. 1 Colliery Noise Assessment Major Works Project,* Feb 2013

Regarding the construction of a barrier on the corner of Bellambi Lane and Northern Distributor, the proponent argued that according to the WM2014 report, "*the increase in traffic noise levels due to the Project is predicted to be less than 2dB. On that basis, it is considered that the impact associated with increasing the haulage is relatively minor and likely to be barely perceptible. Therefore, the construction of a barrier at the Bellambi Lane/Northern Distributor intersection is considered to provide no benefit*".[60]

As discussed earlier, the Commission considers the traffic noise issue requires reassessment as the predicted increase of 1.7dBA is not a true reflection of potential increase. The construction of a noise barrier may be one of the mitigation measures that could reduce the impact to an acceptable level.

Pavement upgrade

The proponent advised that the RMS previous attempt to upgrade the pavement along Bellambi Lane met with objection from local residents due to concerns of access during upgrading. The proponent submitted that if approval is granted, it would make a monetary contribution to the relevant roads authority for upgrading the pavement along this section of the road.

The Commission accepts the proponent's offer as reasonable and considers a condition of consent should be included, if the project were to be recommended for approval, to ensure an appropriate contribution is made when requested by the relevant roads authority.

Capacity of Facilities to handle increase volume of extraction

In terms of the capacity of the facilities to handle the proposed production level of 3mtpa, the proponent advised that an assessment was carried out by its consultant Hatch.[61] The report finds "*the project includes new coal handling facilities, a 2nd and 3rd Stockpile and associated reclaim systems along with new processing equipment and truck loading bin. The proposed material handling equipment system capacity has been assessed and we confirm that proposed materials handling infrastructure has the system capacity to handle 3Mtpa*".[62]

The Department's Addendum Report confirmed that

> *The air quality, noise and traffic assessments undertaken for the UEP have all modelled an operational scenario with an annual coal production rate of 3 Mtpa. The Department is satisfied that the additional mitigation measures required under the recommended project approval would ensure that the UEP would comply with applicable criteria and standards, despite the proposed increase in coal handling capacity.*

The Commission accepts the advice.

Production Levels

The Commission notes that the original EA proposed a production level of 3 million tonnes per annum for an 18 year mine life. The project has been substantially modified since it lodgement in 2009 by removing the Wonga West area and mine life has been reduced to 5 years. Yet the annual

[60] Wilkinson Murray, *Russell Vale Colliery Noise Impact Assessment,* Report No. 14141 Ver C, September 2014, p.14

[61] Hatch, *Report Wollongong Coal Russell Vale Material Handling Assessment,* dated 16 July 2015, Appendix F of Hansen Bailey, *Response to Planning Assessment Commission Review Report Part 1*, July 2015

[62] Ibid, p.2

production rate remains at 3 million tonnes. The Commission requested clarification from the proponent, which has provided the following predicted production levels.

Wonga East Mining	ROM Coal Extracted (tonnes)	Estimated Commencement	Estimated Completion
1st Workings	620,000	2016	2020
LW 6	454,000	2016	2016
LW 7	625,000	2016	2016
LW 1	388,000	2016	2017
LW 2	396,000	2017	2017
LW 3	485,000	2017	2018
LW 9	500,000	2018	2018
LW 10	564,000	2019	2019
LW 11	403,000	2020	2020

Source: Email from D Clarkson – Wollongong Coal 27/01/16

The information above indicates it is unlikely the production level would reach 3 million tonnes in any given year. Hence the Commission questions the reason for the application seeking approval for 3mtpa. It is a concern to the Commission that if approval were granted for a production level of 3Mtpa without credible reasons, the approval would be used as justification for assessment of future incremental increase in amenity impacts on residences and the environment as demonstrated in the noise and traffic assessment.

4.8.3 Commission's Findings

The Commission finds:

1. The issue of road maintenance contribution has been adequately addressed.
2. The predicted traffic noise increase of 1.7dBA is not credible and should be reassessed having regard to the then existing truck movements not modelled movements.
3. The proposed truck parking area is in close proximity to a number of residences near the entrance to the pit top site. The review of the need for the construction of a noise barrier and/or mitigation measures on private residences should have regard to the noise impact arising from truck queuing.
4. The proponent's offer to make a contribution to the RMS for pavement upgrade along Bellambi Lane is reasonable and should be accepted as a condition of approval, if the project were to be approved. However, the contribution should be made to the relevant roads authority.
5. The issue of capacity of facilities to handle the proposed increase in volume of extraction has been adequately addressed.
6. There is insufficient justification to increase production level to 3Mtpa based on the predicted production levels provided by the proponent.

5. FINDINGS, CONCLUSION AND RECOMMENDATION

5.1 FINDINGS

The Minister's Terms of Reference requires the Commission to review the project by considering the Mining SEPP; the Department's assessment report, addendum report and recommended conditions; the likely economic, environmental and social impacts of the project in the locality, region and State; and submissions made to the Commission as part of this review.

The following is a summary of the Commission's findings for each of the Terms of Reference.

1(a) The Mining SEPP

The Department's Addendum Report concluded that the project is not likely to result in unacceptable impacts to surrounding land uses in general. The Commission finds it is yet to be convinced the Department's conclusion is reasonable and can be justified, particularly in relation to noise impacts on nearby residents and along Bellambi Lane and risk to water loss and impacts on upland swamps with uncertain environmental consequences in the catchment area.

1(b) The Department's environmental assessment report, the addendum report and the recommended conditions for the project

The Department's environmental assessment report concluded that "the Department is satisfied that Wollongong Coal has designed the project in a manner that achieves an appropriate balance between maximising recovery of coal resources and minimising potential impacts on the environment, while further reducing impacts on neighbouring residents" (p60). The report recommended the project application be approved subject to conditions.

The addendum report concluded that "the additional assessment… provides greater confidence in the previous predictions made in relation to the impacts of the UEP on swamps, underground and surface waters, and the risks to stored waters in Cataract Reservoir… With the proposed amendments, the Department considers that its recommended conditions provide a comprehensive, strict, and precautionary approach to ensuring that the project can comply with relevant criteria and standards, and ensure that the predicted residual impacts can be effectively minimised, mitigated and/or compensated for… The Department has carefully weighed the impacts of the project against its social and economic benefits. On balance, the Department is satisfied that the project's benefits substantially outweigh its residual costs, that it is in the public interest and should be approved, subject to strict conditions of consent". (p33)

The Commission finds it is not in a position to support the Department's conclusion and recommendation when regard is given to:

- the Commission's expert advices on water and subsidence
- The concerns expressed by the IESC, OEH and DPI on the risk of water loss and impact to upland swamps
- the advices from WaterNSW on the potential water loss in the range of 15ML per annum and 2.6GL per annum and the estimated cost to the loss
- the OEH's view on risk classification of upland swamps
- the noise assessment (pit top site and truck movements) based on modelled rather than existing noise.
- The short term economic benefits versus the risk of permanent and irreversible loss of water up to 2.6GL per year and damage to upland swamps with resulting impact on water quality and uncertain environmental consequences.

1(c) the likely economic, environmental and social impacts of the development in the locality, in the region and for the State

Socio-Economic impacts

The project, if approved, may generate immediate short-term benefits including up to 300 jobs for 5 years, about $23 million in royalties to the NSW Government, $85 million capital investment and other direct and indirect flow on effects. Other benefits include the maintenance of coal production in the Southern Coalfields and the utilisation of the Port Kembla Coal Terminal, which is currently underused. However, the Department of Trade and Investment advised that this is a small project ranked 50 out of 56 producing coal mines in NSW if approved. Also the mine is currently not operating and is in care and maintenance.

There are some external costs which have not been included in the economic assessment including the on-going monitoring role of the WaterNSW, Greenhouse gas emissions, monetary compensation to the loss of water at a cost between $430,00 (present value) and $22 million as estimated by WaterNSW. Negligible water loss may be acceptable with offset via the water licence system. The question is what is negligible loss and the cumulative loss over time.

Other costs include the likely additional mitigation measures that are required to reduce noise impacts to residents bordering the pit top site and along Bellambi Lane, which may be absorbed by the proponent as part of the operating costs. The ongoing operation and management of water treatment system, if required, to control water outflows from the adit and the WaterNSW on-going monitoring requirement following mine closure would be a significant financial burden to the community unless the proponent is prepared to absorb the on-going costs in perpetuity.

Environmental impacts

The operational noise from the pit top site would have significant impact on nearby residences if the noise criteria derived from the *Industrial Noise Policy* is used for assessment instead of the modelled existing noise levels. Similarly, the traffic noise impact on residences along Bellambi Lane is likely to be higher than assessed if actual existing truck movements were used as a base for the assessment. As a result of under-assessment of the level of impacts, it is likely that extra mitigation measures including mitigation on private residences are required to reduce the noise impact to acceptable level.

Air quality impact is edging toward exceedance of established criteria. Real time monitoring and strong proactive measures including facilities shutdown is of critical importance to ensure emissions would not exceed relevant criteria.

The independence of the Integrated Risk Assessment is questionable. Hence the risk outcomes lack objectivity.

The potential impacts of the project to the catchment area remain uncertain. The risk of loss of surface water due to subsidence related cracking is still a significant concern to the Commission. The additional information provided by the proponent remains inadequate to support the conclusion in earlier reports that depressurisation to the surface is not predicted at the end of mining. The latest piezometer results suggest the area is highly fractured and hydraulically connected. Question is also raised as to what adaptive management measures could be implemented to remediate if fracturing extends to the surface and the effectiveness of such measures.

The proposal to seal the mine adit to manage water inflow would itself become a significant issue and require a risk assessment as it could lead to land slips on the escarpment or outrush of water if a seal fails as pointed out by E/Prof Galvin. The earlier report indicated the adit would remain open and a water treatment system would be installed to control water quality of outflows. If the water treatment system is implemented, the question of its long-term operation and maintenance cost has not been addressed.

The trigger criteria proposed by the Department and WaterNSW are a concern to the Commission's expert as the cumulative effects and impacts of subsidence in the area are not known with certainty, which presents a challenge to setting trigger levels for responding to future subsidence.

The OEH disagreed with the IRA risk classification of the upland swamps and is of the view that the risk assessment has underestimated the project's impacts to upland swamps and the environmental consequences. Any loss of water due to cracking presents a significant risk to the swamps' long-term viability. It is a significant concern that 14 swamps are predicted to be impacted by cracking and are likely to experience negative environmental consequences. The hydrological and soil conditions within the swamps provide habitats for an array of threatened flora and fauna communities. The loss or severe decline of the swamps within the area would negatively impact these species.

The Giant Dragonfly is an endangered species and swamp dependent. Two of the three swamps within the site are Giant Dragonfly habitats and will be undermined but impacts to the Giant Dragonfly have not been included in the risk assessment.

The Commission notes the Department has updated the recommended project approval to strengthen the monitoring conditions requiring an expansion of the existing piezometers network in and around the upland swamps and also reflect the draft Offset Policy. The Commission acknowledges and accepts these conditions should be imposed if the project were to be approved. However, the fundamental question is the uncertainty in the extent of fracturing to surface. As a result of such uncertainty, the extent and magnitude of impacts to the upland swamps and the Giant Dragonfly is also uncertain.

1(d) Any submissions made to the Planning Assessment Commission as part of the public hearings held in relation to this review

A summary of public submissions is in Appendix 3. The Commission has considered all relevant issues raised in these submissions.

Some submissions raised concerns that the applicant is not a fit and proper person and presented information in relation to the proponent's financial and legal status. While this is a relevant factor for approval under the Mining Act 1992, it is not a relevant consideration for planning consent under the Environmental Planning and Assessment Act.

1(e) Any submissions made by the applicant to the Planning Assessment Commission on the matters the subject of this review

Through the course of this review, the Commission has accessed a wide range of documents prepared by the proponent including, but not limited to:

- The proponent's Environment Assessment
- Preferred Project Report, Response to Submissions and Residual Matters Report
- the presentation presented at the meeting with the Commission
- the responses to the Commission's First Review Report
- the responses to the Commission's request for clarification

5.2 CONCLUSION

Water and subsidence are two of the major issues considered in the Commission's first review of this project. The Commission engaged E/Prof Galvin and Dr Mackie to assist in its review of the project. They identified various issues that required further consideration and assessment including the setting up of an integrated risk assessment panel (IRAP). The proponent has provided extensive documentation and plans in response to the recommendations in the First Review including the IRAP assessment results.

In January 2016, this Commission again retained E/Prof Galvin and Dr Mackie to review the additional information provided by the proponent for the second review of the project. Dr Mackie identified a number of significant concerns relating to the revised groundwater modelling. The proponent was provided with an opportunity to clarify these issues including the provision of the numeric model to Dr Mackie. Notwithstanding all the additional information, Dr Mackie still has residual concerns, which are shared by E/Prof Galvin and detailed in their advice in Appendix 6.

This leads to the Commission's doubt and lack of confidence in the proponent's ability to provide scientifically sounded and properly assessed documentations to support this application. For example, the earlier report predicted that fracturing to surface would be unlikely at the end of mining. The recently provided data appear to confirm cracking to surface has already occurred. Yet, this is not confirmed in the recent report. Thus the risk of water loss remains uncertain.

The magnitude of the potential water loss is also contested, ranging from negligible, 15ML per year to 2.6GL per year. As a result of such uncertainty, the potential impacts on upland swamps and Giant Dragonfly are also uncertainty as the swamps depends on the surface and shallow groundwater while the Giant Dragonfly depends on the swamps.

The proponent has placed substantial emphasis on mitigation strategy to deal with residual impacts. However, it is likely that some damage has already occurred before mitigation measures can be initiated and there is considerable uncertainty about the types of mitigation measures and the effectiveness of the measures to be employed. Long term operation and management costs of these measures after mine closure have not been considered.

The project is located in a highly sensitive area, a drinking water catchment area. The environment is also very fragile because of past multi seam underground mining activities. Subsidence induced fracturing is already occurring. The critical issue is where is the tipping point and what is the cumulative impact of long wall mining?

It should be noted that during the current review, the Commission has received a letter from WaterNSW and advices from the experts engaged by the Commission. These documents have not been forwarded to the proponent for a response before this review is finalised. The reason for not providing these final assessments to the proponent is because the proponent has ample opportunities to provide information to the Commission during the first and second review processes. During this current review, the Commission reviewed the proponent's submissions, met with the proponent twice, carried out two site inspections and provided written questions to the proponent to seek clarification on the information provided. Importantly, this review is part of the assessment process, and the proponent will have further opportunity to make submissions prior to any final determination.

Advices from WaterNSW and the Commonwealth's Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development have both identified significant risks with respect to the proponent's water modelling of the predicted impacts. The Commission's experts confirmed the risk of water loss remains uncertain. The magnitude of water loss is uncertain with the projected range from the proponent and Water NSW varying from minimal to 2.6GL/year. The Commission considers this is a high risk situation. The Commission also has regard to the objectives of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*, particularly "*a project will have neutral or beneficial effect on water quality"*. From the evidence currently presented to it, the Commission is of the opinion that the project satisfies neither of these requirements.

On the basis of all the information provided, the Commission is of the view that the social and economic benefits of the project as currently proposed are likely outweighed by the magnitude of impacts to the environment.

Following the release of this review report, the proponent will have the opportunity to respond to this report before the Department finalises the assessment of this project for the consent authority's determination. The proponent will also have the opportunity to meet the consent authority before a decision is made on the application.

5.3 RECOMMENDATION

The Commission recommends that any further consideration of the proposal should have regard to the issues raised in this Review Report.

REFERENCES

Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Response to the Planning Assessment Commission Review Report- Part 2, prepared for Wollongong Coal Limited, September 2015

Hansen and Bailey, 2015, Russell Vale Colliery Underground Expansion Project, Integrated Risk Assessment, prepared for Wollongong Coal Limited, September 2015

Broadleaf, 2015, Final report: Integrated risk assessment for the UEP, prepared by Dr Dale Cooper for Wollongong Coal Limited, September 2015

Biosis, 2015, Underground Expansion Project, Independent Risk Assessment- Addendum Report, prepared for Wollongong Coal Limited and the Independent Risk Assessment Panel, September 2015

Biosis, 2013, NRE No.1 Colliery – Underground Expansion Project: Preferred Project Report – Biodiversity, prepared for Gujarat NRE Coking Coal Ltd September 2013

Planning Assessment Commission, 2015, Russell Vale Colliery – Underground Expansion Project Review Report, April 2015

Planning Assessment Commission, 2014, Russell Vale Colliery Modification to Preliminary Works Project – Longwall 6 (MP 10_0046 MOD 2)

Department of Planning and Environment, 2014, Major Project Assessment: Russell Vale Colliery Underground Expansion Project (MP 09_0013), December 2014

Department of Planning and Environment, 2015, Addendum Report: Major Project Assessment Russell Vale Colliery Underground Expansion Project (MP 09_0013), November 2015

APPENDIX 1 TERMS OF REFERENCE

APPENDIX 2 LIST OF PRESENTERS AT THE PUBLIC HEARING

Meeting Time and Date: 1.00pm, Tuesday 8 December 2015
Meeting Place: WIN Entertainment Centre, corner Harbour and Crown Street, Wollongong

1. Dr Peter Turner (National Parks Association for NSW)	2. Adrian Ingleby
3. Tim Buckley (IEEFA)	4. Margaret Armstrong
5. Deidre Stuart	6. Martin Denny
7. Ann Brown (National Parks Association Illawarra)	8. Desmond Jacobs
9. Robert Garnsey	10. Murray Scott (National Parks Association Southern Sydney)
11. Carolyn Graham (Rivers SOS)	12. Shirley Gladding
13. Debra Murphy (Illawarra Business Chamber)	14. Irene Tognetti (Wollongong Transport Coalition)
15. Daisy Barham (Nature Conservation Council of NSW)	16. Miguel Heatwole (Ecopella)
17. Emma Rooksby	*18.* Dallas de Brabamder
19. Holly Creenaune (Land Water Future)	20. Michael Rynn (Parramatta Climate Action Group)
21. John Wilson	22. Neil Perry
23. Nic Clyde (Lock the Gate)	24. Susan Benham
25. Rod Plant	26. Gavin Workman
27. James Keene (Australia India Business Council)	28. Dr Melissa Haswell (Doctors for the Environment Australia)
29. Taylor Benny	30. Peggy Fisher
31. Ana Gracanin	32. Catherine Blakey
33. Tom Hunt (Wollongong Climate Action Network)	34. A/Prof. Phillip Laird
35. Dr Keith Tognetti	36. Bruce Rowles
37. Cr Jill Merrin	38. Elizabeth Cameron (Oatley Flora & Fauna Conservation Society Inc)
39. Dr Dale Cooper	40. Dominic Tier
41. Gary Caines	42. Kaye Osborn (Illawarra Residents for Responsible Mining)
43. Rhys Brett (Wollongong Coal)	

APPENDIX 3
SUMMARY OF PUBLIC SUBMISSIONS TO THE COMMISSION

Objections to the Proposal

Upland Swamps

- Longwall mining is a key threatening process to swamps and does more damage to swamps and the escarpment than coal seam gas.
- The absence of quantitative water balances, and the inability to include connected swamps within the numerical model, prevents an accurate assessment (i.e. one that does not rely on poorly constrained assumptions) of the hydrological risks and potential impacts of the proposed development.
- Once damaged, swamps cannot be repaired and will increase in bushfire hazard.
- Offset
  - should not be used as there is no exact match and like for like ecology is very limited and will result in a decrease in swamps
  - will not address the impacts of swamp degradation or the potential impact on water resources
  - money into a fund will not protect biodiversity in the area

Water resource

- Ground water modelling is flawed.
  - No direct determination of the height of the drainage zone above overlapping extractions.
  - Inappropriate location of bores to gauge the impact of multi seam extraction.
  - Misinterpretation of piezometer data from bores GW1 and RV20.
  - Groundwater model insufficiently calibrated.
  - Disagreement with predicted losses.
  - Inconsistencies between models for estimated water loss.
  - Piezometers that would provide information on the presence of a water bearing shear plane from Cataract Reservoir is not addressed in the GeoTerra Report.
  - Insufficient information to assess the risk and consequence of a drainage zone intersecting water bearing shear plane.
  - GW1 effectively measures the drainage height for single seam extraction, not multi seam extraction.
  - Groundwater model is not fit for purpose.
- Need to consider cumulative impacts of other mines within the Sydney water catchment
- Water catchment area
  - Water resources and catchment area should be protected in accordance with previous government policy and position
  - Should be protected in accordance with the buffer zones stipulated by Water NSW, which still has outstanding concerns
  - Section 34B "Special provision for development in Sydney water catchment relating to water quality" of the *Environmental Planning and Assessment Act 1979* should be considered
  - No social contract for coal mining in the water catchment area
  - Any loss of water from the catchment due to coal mining should be costed at market rated and paid by the miner
  - If Cataract reservoir is compromised how will water security be guaranteed
  - NSW Chief Scientist and Engineer states *there is insufficient data available to provide a deep and reliable understanding of mining in the catchment*
- A water expert says geochemical tracer tests are needed to better understand the risks regarding the connectivity between Cataract Dam and the mine.
- Potential flooding impacts, including inundation of a school, should there be a connection between the mine and Cataract Reservoir.
- Various studies have indicated different baseflow and stream flow losses.
- Having regard to the Mining SEPP water should be the primary consideration.
- Poor management of runoff will lead to dirty water, which will encourage further pollution through algae growth.

Independent Risk Assessment

- Members of the Independent Risk Panel (IRAP) were not independent but had a historical association with mining. Those appointed to the panel differed from the Commission's recommendation.
- Independent Risk Assessment (IRA) notes that there is a high risk to swamps.
- OEH disagree with the risk assessment undertaken.
- Triple seam mining is risky.
- The IRAP found 29 medium level risks to water quality and quantity. The Department's response was most of these are unavoidable but unlikely to be significant. The Department dismissed the risks identified.
- IRA does not address health impacts. – Other methodologies available to assess risk, for example Health Impact Assessment.

Historical Actions and Reputation of Company

- Previous collapse of longwall at Wongawilli indicates bad mining practices
- The pollution incident on 6 December 2015 at Belambi Creek would not have occurred if the company had complied with the outstanding conditions of consent
- Another outstanding conditions of consent in relation to the coal emplacement area (slag heap), with the potential for slag heap to collapse, combust and catch fire
- Company has misrepresented itself to shareholders in terms of reserves and quality of coal
- The company does not pass the *fit and proper person* test within the meaning of the section 380A of the Mining Act 1992 (NSW)
- Questionable financial capacity to comply approval conditions and technical competence
- Poor reputation of parent company
- Approval of the current application would allow the company to defer its obligation to rehabilitate the site.
- The approval requirements to realign Bellambi Creek and flood mitigations works are yet to be undertaken.

Economic Considerations

- The Company
  - Jindal's (parent company) share price is down 30% in the last year and 87% in the last five years.
  - Wollongong Coal share prices have declined almost 100% over the last five years and its reported net debt has risen by over $100m in the six months to September 2015 reaching $694m.
  - Senior executive turnover and parlous financial state may affect staff safety and the Company does not have the capacity to safely undertake the project or financial capacity to undertake rehabilitation
  - The capacity of Jindal to continue to underwrite and sustain Wollongong Coal Limited is under pressure due to significant deterioration in Jindal's core business in India.
- Cost / Benefit
  - The net present value of the proposal is negative at current export coal prices and currency rates, particularly once rehabilitation costs are incorporated.
  - Global coal market is in structural decline. Links between China and coal demand contribute significantly to the decline.
  - History is the proof that the current system internalise any benefits to foreign companies but externalises much of the clean-up costs to the community.
  - Royalties have diminished with the review of the economic assessment to the extent that the project provides only a small economic benefit.
  - Community will be $2m - $7m worse off should the project proceed
  - The method used for the cost/benefit analysis is inappropriate. Environmental offsets cannot be used as an argument to ignore social costs of environmental impacts. The concept of value is conflated with that of offset costs in the Economic Assessment. Social cost of carbon emissions is understated in the economic assessment. The social cost of the noise and air pollution needs to be calculated in comparison to the "no mining" scenario. Regional economic impact analysis is not relevant. The non-market employment benefits should be ignored and any value to the alternate use of the land should be deducted from the benefits. It is debatable whether the social benefits will outweigh the social costs and therefore the precautionary principle should continue to comply.
- Seaborne coal market is chronically oversupplied where demand is declining. Russell Vale if successful will contribute to this oversupply.
- A Transition Plan is needed to move jobs away from reliance on mining and towards sustainable energy. Encourage the PAC to take a leadership role.

- Offsets are reliant on the company being able to deliver.
- Proposal will create long term damage to water catchments and biodiversity for short term benefits.
- Coal subsidies prop up uneconomic coal extraction and encourage expansion that would otherwise not occur.
- Mining only employs 2.6% in the Illawarra.

Climate Change

- extracting and burning fossil fuels would have adverse impacts on climate change
- The University College of London published a report in January 2015 saying 95% of Australian coal reserves need to stay in the ground for the world to have a 50% chance of staying within 2 degrees Celsius. Developing Russell Vale coal mine flies in the face of this compelling scientific logic.
- Climate change was not addressed in the Commission's first review report even though there were six submissions made on the topic.
- Impacts of climate change on water supply will result in decreases in inflows to reservoirs, reduction in water levels (increase droughts and more frequent hot and extremely hot days), and potential increase in pollution (increase bushfires and runoff) and damage to infrastructure.

Traffic and Transport

- The staff car park should be sealed and line marked.
- No other city is subject to the same high levels of bulk haulage by road.
- Consultation for the Traffic Control Plan should be expanded to include the Council and residents.
- Coal should be transported via conveyor belt rather than road.
- Conditions of consent should restrict coal transport to 1Mtpa. A conveyor belt or the Maldon-Dombarton rail line should be constructed to transport production above this level.
- Previous government position was coal was to be transported by rail with only residual approval to be transported by road and those to be subject to stringent conditions.

Uncertainty and residual Issues

- Uncertainty remains regarding the risk and potential impacts.
- Agencies still have residual concerns including Independent Expert Scientific Committee, OEH and Water NSW
- Emplacements are annex from mine – where is waste to be disposed?

Amenity Impacts

- The predicted noise levels from the mine will exceed the project specific noise levels at certain locations.
- Noise mitigation measures at private residences should be considered.
- Recommended conditions of consent are insufficient as they rely on the applicant identifying what is *reasonable and feasible* in relation to noise and air quality.
- No other mine in Australia is as close to residential areas.
- Visual evidence of coal dust pollution within houses, and outside including on clothes line.
- No assessment of methane generated by the project.
- The Stockpile will be 33 metres high leading to further air pollution and erosion issues.

Health – Particulate Matter

- Impact on the health of miners and others such as black lung.
- Concern about particulate matter including diesel particles and residual issues in relation to dust control.
- Need for community access to information to enable people to take precautionary action such as staying indoors when dust level is high.
- There are local, regional and global health concerns. Local concerns include increased air pollution risks from coal stockpiling, loading and truck transport. Regional health concerns include threats to our water catchment area. Global health concerns include greenhouse gas emissions, climate change and health impacts overseas.
- There are no safe levels of exposure to particulate matter without effect. Risk increases with concentration and duration of exposure.
- Will an independent health expert be helping to ensure that the sampling provides a clear indication of exposure levels in living areas?

- No health impact assessment to identify health loss and guide additional *reasonable and feasible* noise and air quality mitigation measures.
- Question whether the air quality modelling included the impact of the increase truck traffic?
- Russell Vales mine's air pollution is 165 times greater than that of the nearby Dendrobium mine.

Biodiversity
- The installation of piezometers has impacted on vegetation and biodiversity.
- Any permanent changes in water flow and groundwater would impact on vegetation, particularly the threatened species.
- Inadequate standard of surveys and assessments particularly in relation to terrestrial fauna and therefore inconsistent with the Director General's Requirements.

Aboriginal Culture
- Aboriginal community has not granted consent for the mining
- Further consultation with Aboriginal community is needed
- Outdated Pt 3A marginalises Aboriginal heritage.
- REF should give a voice to Aboriginal people

General
- Piecemeal character of this application is indicative of the way mining is assessed throughout NSW.
- Any future application for Wonga West should be refused.
- Approval conditions should include an agreed shutdown schedule to address rehabilitation and transition of jobs.
- The assessment should address the Regional Strategy including the transport of freight by rail rather than road.
- Proposal should be judged by worst case.
- Subsidence impacts are horrific.
- The coal reserve is not of sufficient significance to justify the potential impacts.
- The application is unclear regarding the amount of coal per annum to be extracted.
- Question whether the proposal is best practice, as multi seamed extraction has never occurred in Australia.

In support

Economic
- Mining has been part of the community since late 1800 and supports the community.
- Nearly 10% of jobs in the Illawarra rely on mining and there is continued pressure on jobs within the Illawarra due to downturn. The project would secure 300 jobs.
- The area has a high unemployment (6.7%) and youth unemployment rate (14.1%).
- Economic benefits include royalties, $1.5 billion direct spending from mining and $3 billion total estimated added value by mining in the region.
- 611 businesses in the Illawarra directly service the mining industry.
- The project would result in positive trade relations with India and is important to the reputation of Illawarra and Australia in terms of trade and investment security.
- 172 tonnes of coking coal are used per person per year indicating a need for the project.
- $1 billion dollars has been invested into mining infrastructure.

Environmental and Social
- the company supports many environmental programs in the region including schools and has a positive relationship with the communities and local schools.
- Support and positive relationship with local school.

Risk Assessment Process
- Assessment is aligned with accepted national and international risk management standards.
- Focussed on the risks that might affect the quantity and quality of water in the Cataract Reservoir and the ecological health of upland swamps and creeks.

- A total of 138 risks were identified of which 30 were discarded as either not relevant or duplicated. Of the remaining 108 risks there were only two risks that were considered high. Both of the high risks related to specific upland swamps. Actions have been identified to address these risks.
- The Risk Assessment concluded there was no threat to Cataract Reservoir, and no threat to Sydney's water supply.

APPENDIX 4 NOTES OF MEETING AND SITE VISITS

Sydney Drinking Water Catchment Inspection		
Meeting note taken by Megan Webb	**Date:** Thursday, 28 January 2016	**Time:** 10:00am
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Russell Mount Ousley Road		
Attendees: Planning Assessment Commission Members: Mr Paul Forward and Dr Andrew Stoeckel Planning Assessment Commission expert: E/Prof Jim Galvin Planning Assessment Commission Secretariat: Megan Webb Wollongong Coal representatives: David Clarkson, Devendra Vyas, Brad Mecozzi, Ken Mills (STC Operations), Andrew Wu (Hansen Bailey) and Nathan Garvey (Biosis).		
The purpose of the visit is to inspect the area of the proposed longwalls, particularly the sensitive features identified in the assessment, including CCUS4 and Cataract Creek.		
The group walked along the edge of longwall 4 and 5, noting evidence of mining (rock fractures and holes) and swamp communities in this location. Swamp CCUS4 was traversed, the floristic composition and potential impacts (namely change to the vegetation of the swamp) was discussed. The water monitoring and outflow point was noted. The group then moved into the mined portion of Longwall 6, noting some evidence of mining (pothole). Heading towards Cataract Creek the group traversed part of the proposed longwall 7 and swamp CCUS5. The walk proceeded to Cataract Creek, joining at a point within the full supply level of Cataract Dam and then proceeded upstream on the southern bank. The approximate location of the dyke, and the transition points from claystone to Bulga Sandstone were noted during the walk. The inspection ended at the Cataract Creek culvert at Mount Ousley Road. (The group proceeded back to the parked vehicles on foot, beside Mount Ousley Road).		
Documents tabled at meeting/to be provided:		
Inspection ended at 1:30pm		

Meeting with Department of Planning and Environment – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren	**Date:** Monday, 7 December 2015	**Time:** 4:15pm
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Planning Assessment Commission		
Attendees: PAC Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoeckel PAC Secretariat: Megan Webb and Catherine Van Laeren Department of Planning and Environment – Howard Reed, Sara Wilson		
The purpose of the meeting is for the Department to brief the Commission on the project.		
Issues discussed: • Current approval includes a condition that mining activity to cease at the end of December. The current application is a new application. Mine currently not undertaking mining activity. • Noise – Department advised that noise should not exceed existing levels. • Department advised that truck parking area is adequate with a fleet of 17 trucks proposed. Details are provided in the Department's response to questions. • Department advised that flooding has been resolved with the Council.		
Documents tabled at meeting/to be provided: Department's written response to questions with notice from the Commission.		
Meeting closed at 4.15pm		

Russell Vale Underground Colliery Expansion meeting with the Office of Environment and Heritage		
Meeting note taken by Megan Webb	**Date:** Wednesday, 13 January 2016	**Time:** 1:15pm
Project: Russell Vale Underground Colliery Expansion		
Meeting place: Planning Assessment Commission Offices, Level 13 301 George St, Sydney		
Attendees: Commission Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoekel Commission Secretariat: Megan Webb Office of Environment and Heritage: Derek Rutherford, Gabrielle Pietrini and James Dawson Department of Planning and Environment: Howard Reed		
The purpose of the meeting is to discuss the Office of Environment and Heritage's latest submission on the project and to brief the Commission on the Swamp Offset Policy??		
Meeting details and actions The Commission provided an overview of the assessment process and status of this project within that process. I.e. that the Commission is conducting a second review, that will need to be considered in finalising the assessment, prior to any determination of the application. The status of the draft swamp offset policy was discussed, with OEH noting it forms part of the broader offset policy and indicating it's likely the final policy will be released in the coming weeks. It was noted that the project hasn't been assessed under the broader biodiversity offset policy. Department of Planning and Environment noted that as the project application was submitted back in 2009 it can be argued that the applicable policies are those listed in the Director-General's requirements from that time. The proposed application of part of the policy is allowable in this instance. The policy applies to impacts that cannot be avoided or minimised and it was noted there are limited minimisation options for this project. OEH expects at least seven swamps would experience greater than negligible impacts and that these will need to be offset. The proponent's risk assessment only identifies one swamp at high risk of greater than negligible impacts (CCUS4), one at moderate risk (BCUS4) and all others at low risk of impact. The proponent appears to suggest that impacts to swamps may be reversible in some cases, OEH does not accept this view, noting there is no way to remediate fracturing of rock beneath a swamp. It was noted that the proponent has not tabled any documentation to demonstrate it is able to meet the offset requirements for the swamps and there is some uncertainty about whether the full value of the swamps predicted to be impacted can be found. It was noted that the proponent has indicated that two swamps on its land would be suitable for offsetting, as they are within the Sydney Catchment Special Areas and these could be secured through a biobanking agreement or may be handed over to the reserve system. The potential to find other offsets was said to be limited. OEH explained that the Giant Dragonfly would require its own species credits, and that the species has been identified in other areas in recent times. The Commission asked about the triggers for the offsets and was advised the before and after condition of the swamp would be documented and compared to control swamps. Piezometers are said to observe impacts within days, weeks or months of the event OEH noted that the swamps that are predicted to be impacted by mining currently don't have any performance measure limits within the draft approval conditions. The Department agreed to review this. OEH also noted its preference regarding the wording of definitions in the conditions.		
Documents tabled at meeting/to be provided: Department of Planning and Environment to provide updated conditions.		
Meeting closed at 2:20pm		

Meeting with Water NSW – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren	**Date:** Monday, 7 December 2015	**Time:** 3:00pm
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Planning Assessment Commission		
Attendees: PAC Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoeckel PAC Secretariat: Megan Webb and Catherine Van Laeren Water NSW – Malcolm Hughes, Fiona Smith Department of Planning and Environment – Howard Reed, Sara Wilson		
The purpose of the meeting is to discuss issues in relation to water resources and any issues arising from the Department's Report. .		

Discussion regarding the delineation of draw down zones in relation to the location of long walls.

- Hierarchy of zones – restricted / marginal zones.
- Water NSW does not support longwall mining within the marginal zone – 35 degree angle of draw. Longwall mining appears to extend beyond the marginal zone. There should be no mining in that zone.
- Department agree that no long wall mining should occur into the marginal area. The Department had based their assessment on advice from the Dam Safety Committee (DSC). Department advises that the DSC is satisfied with the location of the longwalls.
- **Action – The Department of Planning and Environment to seek clarification from the DSC and the applicant regarding the location and delineation of the draw down zones in relation to the proposed longwalls**

Draft condition 11 of Schedule 3 outlines a role for the DSC in relation to Longwall 7. Discussion regarding the potential impact of changes in legislation governing DSC and their future ability to fulfil this role. Department advised that it was unaware of any proposal or intention to vary the role of the current DSC in such a way that would impact on the ability of either the current DSC or the future Dams Safety NSW to implement any of the conditions proposed for the project.

Discussion regarding the cost to the company should there be a link between the reservoir and the mine causing flooding. Department advised as the panel is outlined during the first workings geological conditions can be ascertained. The draft conditions of consent address this concern.

Water NSW raised that the predicted loss of water from the catchment to storage should be accounted for under the Water Management Act. Loss of water from the reservoir should be compensated in accordance with the current IPART approved value of $2,276 per ML. IPART has set retail value of water to signal opportunity cost. The Department does not agree with this approach to pricing stating that the wholesale value of water is in the vicinity of $80 per ML. The Department stressed that in the overall scheme the amount of water is very small being in the vicinity of 0.04 ML / year. Water NSW stated that the cumulative impacts need to be considered including the impacts on the swamps.

Discussion concerning the TOR for the Risk Assessment Panel and their ongoing role. Water NSW raised that the TOR focused on the swamps and the scope should include a specific reference to water resources and the panel should include experts employed in water and groundwater modelling. The Department identified that all the high and medium risks related to swamps. The DSC are placed to provide expert advice on water resources. Water NSW maintains that the Risk Assessment Panel should be extended to include water resources expertise.

Water NSW requested that the groundwater and surface water model should be validated every 2 years. The Department agreed to this provision.

Water NSW is concerned regarding the difference in prediction between the baseflow loss of 0.041 ML /day in the groundwater assessment and the stream loss of 7.3ML/day in the surface water assessment. The Department consider that the modelling undertaken is adequate and the differences in predicted outcomes are due to the models servicing different purposes.

Water NSW considers that the impacts to upland swamps should be restricted to negligible. Any offset should be located within the catchment. The Department will support the location of swamps within the catchment as a preferred position not a requirement.

Water NSW is concerned that some of their recommended performance measures for subsidence impacts are not included as conditions of consent. In the Department's report the performance measure were to be further developed as

part of the future Extraction Plans.
Documents tabled at meeting/to be provided: Map and information regarding the delineation of draw down zones
Meeting closed at 4.15pm

Meeting with Wollongong Coal – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren	**Date:** Thursday, 28 January 2016	**Time:** 9:30am
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Russell Vale Colliery		
Attendees: PAC Members:Mr Joe Woodward PSM PAC Secretariat: Catherine Van Laeren PAC Consultant: Dr Colin Mackie Wollongong Coal: Rhys Brett (Operations Manager) Dianne Munro (Hansen Bailey), Andrew Fulton (GES), Andrew Dawkins (GeoTerra)		
The purpose of the meeting was to discuss and review groundwater matters including technical issues regarding the water modelling.		

Andrew Fulton (AF) provided a background regarding the development of the water models for the project:

- 2012 – finite elements model that is no longer used;
- 2014 – model for the PPR;
- 2015 – iteration for project review; and
- 2016 – iteration to respond to question raised by the PAC.

Discussion focussed on the questions (shown in blue below) forwarded to the applicant 18 January 2016.

Question 1: Why are the Wongawilli seam and the overlying layer treated as strictly confined layers where drainable porosity is not taken into account when it is expected that the mined seam and the overlying strata will be completely dewatered during mining? What are the implications for model calibration?

Andrew Fulton (AF) recognised that the layers should be unconfined and this will be reflected in the new iteration.

Question 2: Why has the upper section of the Wongawilli seam been represented as the working section? What are the implications for model calibration?

AF stated that the new iteration will measure to the base of the seam.

Question 3: How was the scaling factor for Kh determined? Given the significant influence of the enhanced material properties on the groundwater systems, what are the likely implications for model calibration and model outcomes if an equivalent porous media approach was adopted?

AF advised that additional groundwater data has allowed calibration and refinement of 2015 model. Sensitivity testing of the model will be undertaken in relation to the weighting of horizontal permeability.

Question 4: Can the proponent provide an explanation as to why the scaling was applied over a stress period and to what extent the modified porosity has affected the estimated mine water influx? What are the implications for model calibration and the volumetric balance?

AF acknowledged issue and advised that it will be addressed in the new iteration.

Question 5 - How were the heads and conductance terms determined for individual cells?

Discussion regarding the potential implications of setting boundary conditions particularly in relation to conductivity. AF advised that the boundary cells are located a sufficient distance from the project to not have any impact.

Question 6 - Can the proponent provide an explanation for the adoption of similar values for widely differing lithologies?

AF advised that the only lithology that needed adjustment was the porosity of the mudstone which will be addressed in the next iteration.

Question 7 – How were the mine water influx estimates derived ?

Discussion regarding data and replication of modelling results. AF advised that outcomes should be clarified in the next iteration.

Question 8 – Were influx estimates only captured at the end of stress periods? If so, what are the implications for model calibration?

CM advised that the model currently indicated that the water influx was estimated at the end of the stress period and

that it needed to be estimated throughout the stress period. AF advised that this would be correcting in the next iteration.

Question 9 – What is the cause of this regionally extensive complete loss of pore pressure and what field observations support this?

Discussion revealed that figures in the report were incorrectly labelled. AF advised that Wongawilli seam had been depressurized from previous Bulli workings. CM expressed remaining concerns regarding the section showing depressurized areas near the escarpment and suggested that those cells be deactivated and instead a seepage face be used.

Question 10 – Are there any factors other than mining that would generate the observed hydraulic gradients?

Review figure 30 to ensure that colour coding is not misleading. AF advised that there are no other explanations for depressurisation.

Question 11 - How does the pressure profile indicate enhancement and what is the enhanced vertical flow rate?

AF advised that further modelling need to be undertaken to provide response.

Question 12 – Why has the rate of 1825 mm/annum been adopted rather than the much lower rates? What are the implications in respect of model calibration and model outcomes?

AF advised that the higher rate had always been adopted but will undertake sensitivity testing.

General

Dr Mackie (CM) advised that the model is a tool to predict impacts and therefore needs to be correct and robust to provide confidence in those predicted impacts. AF advised that he was confident that the outstanding matters would be addressed in the next iteration. Joe Woodward advised that the onus was on the applicant to produce a robust model.

Documents tabled at meeting/to be provided: Nil

Meeting closed at 12:30pm

Meeting with Wollongong Coal – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren	**Date:** Tuesday, 8 December 2015	**Time:** 10:00am
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Russell Vale Colliery		

Attendees:

PAC Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoeckel

PAC Secretariat: Megan Webb and Catherine Van Laeren

Wollongong Coal - Milind Oza (Chief Executive Officer) Rhys Brett (Operations Manager) David Clarkson (Group Environment Manager) Devendra Vyas (Technical Assistant to CEO) Consultants - Nathan Garvey (Biosis) Ken Mills (SCT Operations) Dianne Munro (Hansen Bailey) Andrew Wu (Hansen Bailey)

The purpose of the meeting is to discuss any residual issues and issues arising from the Commission's first review report.

Wollongong Coal (WC) presented a detailed presentation to the Commission. A copy has been included in the Commission's records.

1. WC provided a brief outline of the Underground Expansion Project (UEP). WC believes that due to the requirement for the Integrated Risk Assessment the process has been unprecedented in NSW.
2. WC provided a briefing on the financial position of the company including the reduction in debt.
3. WC addressed the PAC's recommendations from the first review report. – Recommendation 1 Establishment of a risk assessment panel and undertake integrated risk assessment of the project particularly in relation to groundwater and subsidence. Discussion occurred regarding how the *likelihood* was derived. WC advised likelihood determine by panel by consideration of probability of occurrence, predictive models based on anecdotal evidence and understanding of experts on the panel.
4. Recommendation 2 –establishment of a network of piezometers within and surrounding the upland swamps. WC advised that analysis of data has indicated there is no relationship between subsidence and changes in swamps. Most changes are due to changes in climatic conditions.
5. Recommendation 3 – Having regard to any more definitive policy developed regarding triggers for offsets.
6. Recommendation 4 – Offset Policy and draft conditions of consent. WC advised that suitable offsets are still being investigated. Need to be consistent with the policy. The proponent noted that it own tow swamps within the Sydney Catchment Special Areas that are available for offset purposes.
7. Recommendation 5-6 Update of the economic assessment. – WC advised a review had been undertaken, In addition, an independent review had been undertaken by the Centre for International Economics commissioned by the Department.
8. Recommendation 7 – Further consideration of noise and justification of any deviations from the existing noise levels. WC outlined commitments made by the company and advised that they had already spent $1m on noise mitigation. WC indicated that most of the old equipment had left the site and retro fitting of muffling to all underground equipment has been undertaken.
9. Recommendation 8-10 Assessment of PM2.5 levels. WC advised that modelling had been undertaken with no exceedance of the NEPM advisory standard. WC outlined company's commitments.
10. Recommendation 11 - Requirement to realign Bellambi Creek. WC outlined the proposed flood mitigation works.
11. Recommendation 12-13 - truck movement and road maintenance. WC advised that they were negotiating VPA and would limit truck movements to previous approved haulage hours.
12. Recommendation 14 – investigation of noise mitigation for residents along Bellambi Road. WC advised:
    - a truck parking area was proposed with sufficient capacity to ensure that there was no queuing of vehicles on Bellambi Lane prior to trucking commencing each morning;
    - pavement of Bellambi Lane previously upgraded by the RMS; and
    - noise barriers would provide limited and barely discernible reductions.
13. Recommendation 15 – demonstrate the facilities can handle the additional volume without unacceptable impacts for local residents. WC advised that a simulation was run to confirm that the Russell Vale surface

infrastructure can accommodation a throughput of 3 Mtpa.
Documents tabled at meeting/to be provided: Wollongong Coal Presentation
Meeting closed at 12:05pm

Meeting with Wollongong Coal – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren and Megan Webb	**Date:** Thursday, 28 January 2016	**Time:** 1:30pm
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: Russell Vale Colliery		
Attendees: PAC Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoeckel PAC Secretariat: Megan Webb and Catherine Van Laeren PAC Consultants: Dr Colin Mackie and E/Professor Jim Galvin Wollongong Coal - Rhys Brett (Operations Manager); David Clarkson (Group Environment Manager); Devendra Vyas (Technical Assistant to CEO); Brad Mecozzi; Consultants - Nathan Garvey (Biosis); Ken Mills SCT Operations); Andrew Fulton (GES); Andrew Dawkins (GeoTerra); Dianne Munro (Hansen Bailey); and Andrew Wu (Hansen Bailey)		
The purpose of the meeting to discuss any matters arising from the site inspection and groundwater meeting.		

- The proponent's consultant provided a description of different types of upland swamps: headwater swamps, valley side and valley infill. It was suggested that all the swamps at Russell Vale east are headwater swamps. Monitoring was said to indicate that fracturing of the base of the swamps will not lead to the loss of swamps but rather to dryer swamps. If swamps were going to be lost then would have already occurred and be evident in areas that had previous been subject to mining. Likely to see a change in swamp characteristics but all swamps are not reliant on a perched water table. Headwater swamps have a greater reliance on groundwater flows. Further it was suggested that not all swamps contributed to base flows with CCUS4 showing no outflows 9 days after a significant rain event.
- A discussion was held regarding potential impacts on Cataract Creek. The proponent advised the creek would be monitored and the panel layout allowed the longwall to be stopped should movement be greater than expected.
- The potential triggers for any change to the mine plan were noted to be important. The Proponent advised that the guidelines for LW7 could be unacceptable perceivable impacts. Closure is a slow process which will allow time for management.
- E/Prof Galvin questioned the criteria adopted for determining the tolerance of the swamps based on areas where there had been no previous movement. He highlighted that this area had already been subject to movement. The proponent advised that this was a standard OEH requirement rather than a measure specifically applicable to this mining scenario.
- The outcomes of the previous meeting on groundwater were summarised for the whole group. The appropriate method to determine height of free drainage was discussed. The Tammetta method resulted in an overestimation of the height as it is normally applied to single seam mining. In using Tammetta in this situation, the proponent had multiplied the height by three to allow for the multi seam mine which produced an excessive result. Piezometer data indicated a lower level.
- In relation to subsidence, contingencies should the old mine plans prove inaccurate were considered necessary and the proponent noted it has proposed a drilling program to verify the locations of key pillars within the actual workings.
- In response to questions the proponent advised that mining of land around CCUS4 will not have a significant impact on water flows into the swamp. It confirmed that if it avoided the part of longwall 6 beneath swamp CCUS4 this would improve the outcome from the swamp. The subsidence associated with mining other parts of longwall 6 and all of longwall 7 would not affect the topography to a significant extent, so the catchment to the swamp should not be significantly impacted. The proponent reiterated the predicted impact to the swamp, associated with mining all of longwall 6, was a change in the vegetation within the swamp rather than a complete loss of the swamp.
- Proponent advised that it would be an additional 2 weeks to provide information after today's meeting. The Chair, Joe Woodward PSM, stressed that the matter needed to be resolved in a timely manner and the information provided should be robust.

Documents tabled at meeting/to be provided: Wollongong Coal Presentation

Meeting closed at 2.50pm

Meeting with Wollongong Council – Russell Vale Expansion Project Second Review		
Meeting note taken by Catherine Van Laeren	**Date:** Tuesday, 8 December 2015	**Time:** 12:00pm
Project: Russell Vale Colliery Underground Expansion Project		
Meeting place: WIN Entertainment Centre		
Attendees: PAC Members:Mr Joe Woodward PSM, Mr Paul Forward, & Dr Andrew Stoeckel PAC Secretariat: Megan Webb and Catherine Van Laeren Wollongong Council – Ron Ziegly, Mark Reddon		
The purpose of the meeting is to discuss any residual issues that Wollongong Council had with the expansion project for Russell Vale.		
1. Wollongong Council is still in negotiation with Wollongong Coal in relation to the Voluntary Planning Agreement. There was a potential for Bellambi Lane to be a focus for the VPA. 2. Impact on property values. The Council officers could not provide any details regarding land values in the area but stated that the turnover of property was low. 3. Council officers indicated that they had not received many complaints over the last five years but recognised that the mine was not operating at full capacity. 4. Officers indicated that the mine plan should be amended to protect upland swamps. 5. Discussion in relation to breach in development consent for the emplacement area. The Council acknowledged that the Company had breached approximately 18 conditions of consent. The Development Consent operates independently to the mine approval. Wollongong Council is the consent authority and regulator. Action currently being undertaken by Council seeking compliance. 6. Council officers indicated that the draft condition of consent in relation to further investigation of an on-site noise barrier within 6 months of commencement of operations, was satisfactory. 7. Council requested that conditions be imposed to ensure that flood mitigation works are undertaken ensuring the separation of dirty and clean water.		
Documents tabled at meeting/to be provided: Nil		
Meeting closed at 12:30pm		

APPENDIX 5 KEY CORRESPONDENCES

NSW GOVERNMENT | Office of Environment & Heritage

Date: 7 December 2015
Your reference: MP09_0013
Our reference: DOC15/xxx
Contact: Gabrielle Pietrini
4224 4159

Catherine Van Laeren
Planning Assessment Commission
GPO Box 3415
SYDNEY NSW 2001
E-mail: catherine.vanlaeren@planning.nsw.gov.au

Dear Ms Van Laeren

RE: Russell Vale Colliery Underground Expansion Project
Public Hearing, Addendum Report & Draft Project Approval

Thank you for notifying the Office of Environment and Heritage (OEH) of the public hearing for the abovementioned major project on 8 December 2015. OEH has reviewed the DPE addendum and draft project approval conditions and provide the following comments on the draft project approval, supplementary to our submission dated 21 October 2015.

Impacts upon Swamps CRUS1, CCUS1, CRUS6 and CCUS 24

OEH supports the inclusion in Schedule 3, Condition 1 - Table 1 of a detailed and specific definition of *'negligible environmental consequences'* for upland swamps CRUS1, CCUS1, CRUS6 and CCUS24, particularly the inclusion of *"negligible change to the shallow groundwater regime when compared with control swamps"*. OEH considers the shallow groundwater regime to be a key component of the ecological function of the swamp ecosystem and suggests that the definition could be further strengthened by reference to measurable triggers, such as groundwater levels below the lowest recorded baseline period and exceedance of the water level recession rate compared to before mining or un-impacted reference swamps.

Impacts upon Swamps CUS2, CCUS4, CCUS5, CCUS10, CCUS11, CCUS12, BCUS4 and BCUS11

All other upland swamps in the project area are addressed by Schedule 3, Conditions 4 and 5. These conditions address the proposed timing for any required offsets and the payment of a Swamp Offset Bond for the first upland swamp proposed to be undermined (CCUS4).

Conditions 4 and 5 identify no greater than 'negligible environmental consequences' as the threshold under which the bond can be released and for which offsets are not required. OEH considers that it should be explicit that 'negligible environmental consequences' in this context is defined as in Table 1, including *"negligible change to the shallow groundwater regime when compared with control swamps"*. Swamps CCUS2, CCUS4, CCUS5, CCUS10, CCUS11, CCUS12, BCUS4 and BCUS11 have a higher likelihood of significant and irreversible impacts as a result of mining. It is important that the trigger for the provision of offsets is clear and measurable in order to support effective regulation of the mining activity.

OEH considers that all upland swamps affected by the proposed activity should have a specific performance measure defined in Table 1 of the approval. If the definition of 'negligible environmental

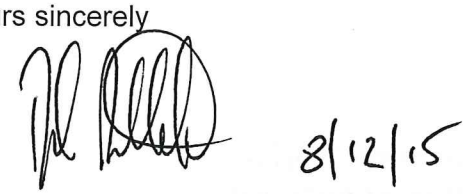
consequences' as defined in Table 1 is not predicted to be achieved for the upland swamps identified in Conditions 4 and 5, an alternate performance measure that reflects an approved level of impact should be specified to enable effective monitoring and regulation.

Impacts upon Biodiversity

OEH considers that the performance measure for biodiversity specified in Table 1 (ie *'negligible environmental consequences'*) is not adequately defined to support effective regulation of the proposed activity. This performance measure should refer to changes in population levels or regional persistence of specific species such as the Giant Dragonfly, and should refer to all swamps.

Please contact Gabrielle Pietrini, Regional Manager Illawarra, on 4224 4159 or gabrielle.pietrini@environment.nsw.gov.au should you have any further queries.

Yours sincerely



8/12/15

DEREK RUTHERFORD
Director, South Branch
Regional Operations

PO Box 323, Penrith NSW 2751
Level 4, 2-6 Station Street
Penrith NSW 2750
1300 722 468
www.waternsw.com.au
ABN 21 147 934 787

Our Ref: D2015/128239

11 December 2015

Catherine Vanlaeren
Planning Assessment Commission
GPO Box 3415
SYDNEY, NSW 2001

Dear Ms Vanlaeren

WOLLONGONG COAL RUSSELL VALE COLLIERY
PREFERRED UNDERGROUND EXPANSION PROJECT NO. MP 09_0013

I refer to the discussion between the Planning Assessment Commission (PAC) and WaterNSW on 7 December 2015 regarding the above proposal. I thank the PAC for providing WaterNSW with an opportunity to provide further comments on the proposal.

WaterNSW notes PAC's first review of the Preferred Underground Expansion Project (UEP) and that the Commission made 15 recommendations requiring additional work and assessment to be carried out prior to a determination. The additional work included the establishment of an Independent Risk Assessment Panel (IRAP) to oversee an Integrated Risk Assessment (IRA), focusing between the subsidence and associated impacts of the mining proposal including on groundwater, surface water and swamps.

As part of IRA process, WaterNSW reviewed the draft and final IRA reports and Wollongong Coal's (WCL) Contingency and Closure Plans of the mine's application to extract Longwalls 6, 7, 9, 10 and 11 in the Cataract Dams Safety Committee (DSC) Notification Area and provided comments to the Department of Planning and Environment (DPE). WaterNSW considers that IRA process for the proposal was thorough and it identified all risks, associated likelihood and consequences.

WaterNSW has reviewed the DPE's Addendum Report and draft Conditions of Approval (dated 2015). WaterNSW has also considered the WCL final reports (Part 1 and Part 2) that addressed recommendations of the PAC Review including a final IRA in preparing this response to the PAC.

WaterNSW's remaining issues of concern related to the Preferred UEP application and the Department's response in the Addendum Report are discussed below. WaterNSW considers that these matters can be addressed via conditions of approval and a minor change to the mine layout.

WaterNSW Concern 1 – Setback of mining from Cataract Reservoir for protecting the stored waters of Cataract Reservoir

WaterNSW is concerned about the extent of intrusion of longwalls, particularly longwall 7, into the Cataract Reservoir Notification Area. WaterNSW notes that the preferred UEP longwall layout is designed to avoid any coal extraction inside the 35° angle of draw, however the calculations by WaterNSW identified that the western end of longwall 7 is within 35° angle of draw. WaterNSW requests clarification regarding this matter. If the clarification identifies that longwall 7 is within Notification Area, WaterNSW recommends the mine layout be amended to exclude the western part of longwall 7 from the marginal zone i.e. outside 35° angle of draw to ensure the protection of Cataract Reservoir which is an essential part of Sydney's drinking water supply system.

In its response to the DPE on the Contingency and Closure Plans (dated 2 November 2015), WaterNSW requested DPE include adequate financial provisions in approvals to compensate WaterNSW for any water losses from Cataract Reservoir that are greater than 1ML/day should the Contingency Plan measures fail.

If the Commission decides to recommend the mining proposal for approval, Water NSW recommends:

- to amend the mine layout to exclude the western part of longwall 7 outside the marginal zone i.e. 35° angle of draw, if longwall 7 is identified to be located within 35° angle of draw
- to amend Condition 2 to include (2d) to adequately compensate WaterNSW for any water losses from Cataract Reservoir that are greater than 1ML/day should the Contingency Plan measures fail.

WaterNSW Concern 2 – Conflicting Estimates of Baseflow Losses in the Groundwater Assessment and Surface Water Modelling

WaterNSW has been concerned regarding the difference in predictions between the baseflow loss of 0.041ML/day in the groundwater assessment and the stream flow loss of 7.3ML/day in the surface water assessment.

WaterNSW has previously requested that the consent should only permit mining up to a point where the valley closure is predicted to be 200mm, consistent with the TARP for LWs 5 and 6.

The Addendum Report states that WaterNSW continues to express its dissatisfaction with the surface and groundwater modelling, particularly in respect of predicted baseflow losses; requesting further modelling and limiting baseflow loss of 0.05ML/day in conditions of approval in its final submissions in response to the IRA dated 2 and 6 November 2015.

The Addendum Report also states that:

- it is the Department's view that the additional long-term modelling as proposed by WaterNSW would serve no useful purpose. All surface water impacts of the project are required to be accounted for though water licensing. The Department considers that good baseline monitoring and impact monitoring would be more accurate than any predictive modelling. The Department also considers that there is no policy basis for restricting baseflow losses to an arbitrary (and exceedingly low) limit. Instead, the policy framework for dealing with baseflow losses across the State (including all mining operations and all water catchment areas) is one of licensing water take under the Water Management Act 2000

- the existing conditions of approval require a program to validate the surface water and groundwater models for the project, and compare monitoring results with baseline data and modelled predictions (Condition 10(h) of Schedule 3).

WaterNSW notes no timeframe for validating the models has been specified in the condition as was required for the recently approved Springvale mine extension project. Given the short longwalls and rapid mining progress likely to be undertaken at Russell Vale, WaterNSW requests that this condition be amended to include a timeframe for updating these models to every two years.

WaterNSW disagrees with the DPE's assertion that the predicted extreme water loss is negligible. Water loss of 7.3 ML/day is unacceptable to WaterNSW, particularly during dry periods.

WaterNSW notes the DPE's statement that the baseflow loss estimates provided by groundwater modelling represent a "likely" estimate, i.e. of 0.04 ML/day (15 ML/year). WaterNSW does not support this conclusion for a number of reasons.

As pointed out in the Addendum report, the estimated baseflow losses are related to the regional aquifer only. WaterNSW considers a significant proportion of baseflow in this area is likely to be from perched and transient hill-slope aquifers following wet periods, and these are likely to be significantly reduced by near-surface subsidence cracking. Whilst WaterNSW understands that it may not be strictly appropriate that it be used in this way, the surface-water modeller's base-flow index of 0.317 (Table 4.1, WRM 14 August 2015) gives an approximate value of base-flow (though not considering that provided by swamps and other local storages). This value of approximately 30% is consistent with assessments made by WaterNSW (refer our submission D2013/29381, dated 12 April 2013) in other stream base-flow component estimates in the Special Areas, and could be reasonably used as a non-conservative, approximate guide to the volume of baseflow which might be lost from the stream reaches predicted to be subsidence-impacted reaches of Cataract Creek, Cataract River and Bellambi Creek. This estimate would suggest a "likely" baseflow loss significantly higher than 0.04ML/day.

WaterNSW accepts that there is little value in undertaking significant additional modelling for the purposes of deciding whether or not to approve the application. If the Commission decides to recommend the mining proposal for approval, Water NSW recommends that the conditions of approval include requirements for:

- limits on total baseflow loss from all streams of no more than 10% of pre-mining (i.e. pre-UEP) flows, with suitable performance triggers and assessment system to be identified within a Water Management Plan, developed in consultation with WaterNSW.
- amend Condition 10(h), dot point 5 to require baseline data on surface flows include an assessment of baseflow components using an agreed methodology, that trigger levels for baseflow losses do not exceed 10% of pre-mining baseflow components, that include predictions of baseflow losses from streams and water storages at 1, 10, 50, 100 and 200 year timeslices be set out in the Water Management Plan, and these estimates be updated and validated at least every two years.

WaterNSW Concern 3 – Upland Swamps

WaterNSW reiterated its concern in its most recent response to the DPE about predicted impacts on upland swamps causing environmental consequences greater than negligible and considered this is an unacceptable level of environmental consequence.

The Addendum Report states that the Department accepts that:

- the current mine plan for the Preferred UEP would result in impacts to some upland swamps, particularly CCUS4 and the Department accepts that WCL has employed all feasible and reasonable measures to avoid swamp impacts during the development of the mine plan, and has avoided mining under several large swamps near the proposed longwalls
- some impacts on swamps are an unavoidable consequence of longwall mining, and that these impacts should be carefully weighed against the social and economic benefits of the project, and offset if they are greater than negligible. The Department's proposed approach to offsetting impacts to upland swamps (including CCUS4) is consistent with the Government's current draft Swamp Offsets Policy
- there is uncertainty in predicting subsidence and environmental outcomes for upland swamps. However, the Department considers it unlikely that this issue can be resolved through further technical work or analysis and that there is a need to accept there could be some variability in predicting impacts on swamps. Therefore, the Department considers that it would be unreasonable to hold WCL strictly liable for precise impacts on swamps. However, it is vital that there is strict monitoring of the impacts on swamps and an obligation to offset all such impacts. If offsets cannot be obtained, then WCL would have to adapt the mine plan to avoid greater than negligible impacts on swamps. To ensure there is a consistent approach to managing both uncertainty and impacts, the Department proposes that the project approval be revised to:
    - strengthen monitoring conditions, requiring expansion of the existing network of piezometers in and around the upland swamps; and
    - reflect the draft Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence.
- WCL has committed to ensuring land- based offsets are located within the local catchment, where possible. The Department accepts that this may not be possible, and notes that the draft Swamp Offset Policy does not place any such restriction on the provision of offsets. Instead, it takes a broader perspective and requires the impact to be offset within the range or distribution of the relevant endangered ecological community or swamp community.
- while the Department agrees with WaterNSW that the additional piezometers should be installed as soon as practicable, it does not think this can be achieved within 3 months, particularly if the installation of these piezometers is to be informed by the advice of the proposed Independent Monitoring Panel. The Department has therefore recommended a condition requiring piezometers to be installed as soon as practicable after approval, to the satisfaction of the Secretary. The Department notes that all future installation of piezometers would be subject to further consultation with key agencies and would be described in future Extraction Plans. The Department has also recommended a condition requiring all raw piezometer and other monitoring data to be made available to the Department, OEH and an independent monitoring panel, on request.

WaterNSW supports the DPE's assessment that if offsets cannot be obtained, then WCL would have to adapt the mine plans to avoid greater than negligible impacts on swamps.

If the Commission decides to recommend the mining proposal for approval, Water NSW recommends that:

- Define the determination of the 'negligible environmental consequences' as per the OEH draft Swamp Offset Policy.

- The impacted swamps are within the Metropolitan Special Areas and any offset proposal should therefore be applied within the Special Areas. If a like-for-like offset cannot be secured within the Special Areas, other options under the various 'rules' or supplementary measures that may be considered should be applied within the Special Areas.
- Swamps within the Metropolitan and Woronora Special Areas are managed and substantially owned by WaterNSW. The conditions should therefore explicitly include a requirement for consultation with WaterNSW in the development and implementation of an offset strategy including a variation to a strategy.
- Amend Condition 10(j, dot point 7) to include WaterNSW for the provision of swamp monitoring data.

WaterNSW Concern 4 - Subsidence Impact Performance Measures and Corresponding Monitoring Triggers

WaterNSW is concerned that the some of our recommended performance measures have not been included in the draft Conditions of Approval (see amended Table 1).

The Addendum Report states that the Department confirms that the recommended approval includes subsidence impact performance measures which are considered to be adequate to protect water resources, swamps, biodiversity, cliffs and steep slopes. The conceptual monitoring triggers proposed by WaterNSW are generally seen as useful. However, such triggers would normally be developed and included in future Extraction Plans. The Department supports careful review of these proposed triggers, in consultation with WaterNSW and other key agencies, during the preparation of future Extraction Plans.

WaterNSW has further refined performance measures for the mine proposal (see amended Table 1). If the Commission decides to recommend the mining proposal for approval, Water NSW recommends that DPE adopt all of the performance measures in Table 1.

WaterNSW Concern 5 - Socio Economic

WaterNSW notes the cost benefit analysis (CBA) in the Economic Assessment Report has been updated to reflect a loss of stream base flow of 15 ML/year, based on updated groundwater modelling by GeoTerra, to a high-end estimate of $430,000 in net present value terms.

As noted above (Concern 2) however, WaterNSW remains of the view that the groundwater-modelled value for stream base flow of 15 ML/year is not conservative and that real surface water reductions are likely to lie within the range of 15 ML/year and 2.6 GL/year (the worst case scenario value derived by assuming that all surface flows above the subsidence impacted areas will be lost from stream flow).

WaterNSW notes the use of a value of $2,000 per ML in the economic analyses, which is suggested to be based on the current (2010) Metropolitan Water Plan. The current IPART approved value of Long Run Marginal Cost is in a range that includes the current Sydney Water retail price of $2.276 per kL or $2,276 per ML ($2015/16). IPART has set retail water prices to signal opportunity cost, and any resource decisions, either made by water consumers or by other parties such as miners, should be consistent with this value. WaterNSW is aware that both IPART and Sydney Water have revised this calculation, and that a different usage price on this basis may be set by IPART for Sydney Water by June 2016. In any case, the opportunity cost should be set at the retail price so that all resource decisions are on a level playing field.

The base-flow index of 0.317 (Table 4.1, WRM 14 August 2015) could be used as a guide to the volume of baseflow which might be lost from the stream reaches predicted to be subsidence-impacted (max 2.6 GL/year), i.e. a value of 824 ML/year (or 10% of baseflow loss from groundwater contribution). If the current replacement value of water of $2,276/ML is used, a potential cost to WaterNSW (who does not own the water and does not therefore benefit from any compensation or licence fees paid to the NSW Government) of approximately $22.1M could ensue, which is not significantly different from the threshold value of the project given by Gillespie of $23M.

WaterNSW Concern 6 – Ongoing Role of the Independent Risk Assessment Panel

The Addendum Report states that WaterNSW indicated its strong support for an ongoing role of the IRAP during the operational stages of the UEP, and considered that this should be a conditional requirement.

The Addendum Report states that

- the Department agrees that an independent panel should continue to provide expert advice to WCL, the Department and relevant agencies on the environmental consequences of mining associated with the UEP.
- the Department has recommended a condition requiring the establishment of an Independent Monitoring Panel for the project (see condition 12 of Schedule 3). The panel is to be appointed by the Department, funded by Wollongong Coal and comprise suitably qualified experts in the fields of mining subsidence, groundwater and upland swamps."

WaterNSW notes that the role of IRAP in Condition 12 has a focus on upland swamps. WaterNSW believes that the role of the panel must extend to water resources such as surface water and groundwater. In light of this, WaterNSW recommends amendments to Condition 12 to include water resources (see below).

Comments related to Draft Conditions of Approval:

Definitions

WaterNSW be included in definitions.

Schedule 3

- Condition 1, Table 1 – WaterNSW recommended performance measures have not been adopted. WaterNSW should recommend that its performance measures in table 1 be adopted.

- Condition 2b – there should be a time limit on when a report is required for an impact exceeding a performance measure. Reports should be required no later than 3 months after the performance measure has been exceeded or otherwise as directed by the Secretary.

- Condition 2 – there should be a requirement to compensate WaterNSW for any losses of water from Cataract Reservoir caused by mining where these losses exceed 1ML/d and where the contingency plan has failed to address these losses. This should be reflected in new point (d).

- Condition 3 – as any offsets are required as a result of an impact within the Special Area and as it is likely the impact relates to land or an asset owned by WaterNSW there should be a requirement for the proponent to consult with WaterNSW when they develop offsets.

- Condition 10 – (h) dot point 5 – requires a program to validate the surface and groundwater models for the project. This validation should be required every two years and if required the models should be updated.

- Condition 10 – (j) dot point 7 – WaterNSW requests that it also receive the raw piezometer and other monitoring data related to swamps.

- Condition 10(p) - Contingency planning shall result in a plan which can be implemented effectively over the short, medium and long term to maintain impacts within acceptable limits.

- Condition 12 – The Independent Monitoring Panel has a focus on swamps. The role of the panel must extend to water resources. The panel therefore needs to include suitably qualified experts in the field of water resources.
  Condition 12b - also include water resources
  Condition 12c - also include Surface and Groundwater Monitoring Program
  Condition12d – also include surface water

Schedule 4

- Condition 27(a) – WaterNSW should be included for consultation for the preparation of the Rehabilitation Plan.

Schedule 6

- Condition 6 – If there is a need to do more than a minor update to a strategy, plan or program required then there should be a requirement to consult with WaterNSW where WaterNSW has an interest.

Conclusion

If the Commission decides to recommend the mining proposal for approval, WaterNSW requests that its concerns be addressed by modifying the mine layout and via appropriate Conditions of Approval including:

1. Modify the proposed mining layout to exclude western part of longwall 7 from marginal zone i.e. 35 degree angle of draw, if longwall 7 is identified to be located within 35 degree angle of draw.
2. The consent should only permit mining up to a point where the valley closure is predicted to be 200mm, consistent with the TARP for LWs 5 and 6.
3. WaterNSW's performance criteria developed for the proposed mining area (Table 1) be adopted including for Cataract Reservoir, biodiversity and cliffs.
4. Adequate financial provisions are included in any approval granted to mine within the Cataract Dam Notification Area to compensate WaterNSW for any water losses from Cataract Reservoir should the measures in the Contingency Plan fail.
5. WaterNSW's other concerns related to DPE's draft Conditions of Approval specifically Schedule 3, Conditions 1, 2, 2b, 3, 10(h)-dot point 5; 10(j)–dot point 7, 10(p), 12, 12b, 12c, 12d; Schedule 4 Condition 27(a) and Schedule 6 Condition 6 be addressed. WaterNSW requests that, if the project is approved the amended conditions laid out in the attached submission be adopted.

Further queries about our submission can be directed to Malcolm Hughes, Manager Environment & Planning, who can be contacted on 4724 2452 or via e-mail malcolm.hughes@waternsw.com.au.

Yours sincerely

FIONA SMITH
Executive Manager,
Water Quality, Catchment Protection and People and Culture

Table 1: WaterNSW Recommended subsidence impact performance measures and corresponding triggers – Russell Vale Preferred Underground Expansion Project – December 2015

Environment	Performance Measures	Indicative/Conceptual Monitoring Triggers
Cataract Reservoir	Negligible environmental consequences including: • negligible reduction in the quantity or quality of inflows to the reservoir, • negligible leakage from the reservoir, and • negligible mine inflows sourced from the reservoir.	Performance triggers may be set using the following approaches: • Quantity of stream flows entering the reservoir (gauged at Cataract Creek, Cataract River and Bellambi Creek) is not significantly different post-mining compared to pre-mining • Baseflow losses (assess by baseflow analysis using hydrograph separation approach) from Cataract Creek, Cataract River and Bellambi Creek reaching the reservoir be restricted to no more than 10% of pre-mining baseflows • Quality of water entering the reservoir is not significantly different post-mining compared to pre-mining • Groundwater levels and hydraulic gradients between existing and proposed mine workings and reservoir remain within limits derived from assessment of natural baseline variability • Monitored mine inflows, calculated mine water balance and mine inflow sources (by fingerprinting including tritium dating) not exceeding groundwater model predictions

Environment	Performance Measures	Indicative/Conceptual Monitoring Triggers
Streams: Cataract Creek, Cataract River and tributaries	Negligible environmental consequences including: • negligible diversion of flows or changes in the natural drainage behaviour of pools, • negligible gas releases and iron staining, • negligible increase in water cloudiness, • negligible increase in bank erosion, and • negligible increase in sediment load.	Performance triggers may be set using the following approaches: • Stream flow continuity (e.g. by visual observation/mapping of surface cracking, stream sections with no flow, and differential stream flow gauging) is not significantly different post-mining compared to pre-mining • Water quality is not significantly different post mining compared to pre-mining (e.g. turbidity, suspended solids, total iron) • The extent iron staining in streams (by visual observation/mapping of stream sections with iron precipitates) is not significantly different post-mining compared to pre-mining • Natural pools drainage behaviour (e.g. by visual observation/mapping of rock bar cracking, monitoring of pool water levels) is not significantly different post-mining compared to pre-mining
Ecologically Significant Swamps: CCUS2 CCUS4 CCUS5 CCUS10 CCUS11 CCUS12 BCUS4 and BCUS11	Negligible environmental consequences including: • negligible change in the size of swamps • negligible erosion of the surface of swamps • negligible change in the ecological functioning of swamps • negligible change to the composition or distribution of species within swamps, • negligible change to the structural integrity of any controlling rockbar; and negligible drainage of water from	Performance triggers may be set using the following approaches: • Groundwater levels in the peat substrate and sandstone bedrock (based on nested piezometers in combination with monitoring of subsidence effects) are not significantly different post-mining compared to pre-mining • Groundwater recession rates in the peat substrate are not significantly different post-mining compared to pre-mining, • Swamp water balance and outflow rates are not significantly different post-mining compared to pre-

Environment	Performance Measures	Indicative/Conceptual Monitoring Triggers
	swamps, or redistribution of water within swamps.	mining • Swamp conditions based on survey/mapping of the extent, peat thickness and/or cracking, vegetation conditions and proportion of bare land, integrity of controlling rockbars) are not significantly different post-mining compared to pre-mining • The extent, distribution, diversity of key ecological groups/species are not significantly different post-mining compared to pre-mining • Abundance of flora and fauna species (e.g. by surveys of threatened or vulnerable species, invasive species) is not significantly different post-mining compared to pre-mining
All other swamps: mapped in the PPR	No significant environmental consequences beyond predictions in the EA	Performance triggers may be set using the same approaches as listed for the ecologically significant swamps above
Biodiversity: Threatened species, threatened populations, or endangered ecological communities	Negligible environmental consequences, including negligible reduction in biodiversity	Performance triggers may be set using the following approaches: • Diversity and abundance of swamp fauna (e.g. by periodic surveys of threatened species) is not significantly different post-mining compared to pre-mining
Cliffs and Steep Slopes	Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 3% of the total face of such cliffs within any longwall mining	Performance triggers may be set using the following approaches: • Survey and visual observation/mapping of rock falls and surface cracks

NSW GOVERNMENT | Planning & Environment

RECEIVED
4 JAN 2016
BY:

15/18281

Mr Joe Woodward PSM
Member
Planning Assessment Commission
GPO Box 3415
Sydney NSW 2001

Dear Mr Woodward

I refer to your letter to the Secretary, dated 11 December 2015, about the Russell Vale Colliery Underground Expansion Project. The Secretary has asked me to reply to your letter on her behalf.

Thank you for your advice on the outcomes of the public hearing held in Wollongong on 8 December 2015.

I note the Commission has now engaged subsidence and groundwater experts to provide additional independent advice on Wollongong Coal's Integrated Risk Assessment. Further, that the Commission is seeking additional clarification on certain issues from the Department and other government agencies, and that, for these reasons, the Commission will be unable to provide its review report to the Department by 16 December 2015.

In light of the matters raised by the Commission, the end of year period and the Commission's comprehensive review of the proposal to date, the Secretary has requested that the Commission complete its review by no later than 15 January 2016.

Should you have questions about this timeframe, please contact Howard Reed, Director Resource Assessments, on 9228-6308.

Yours sincerely

Marcus Ray
Deputy Secretary
Planning Services
18/12/2015

From: Howard Reed
Sent: Friday, 22 January 2016 5:16 PM
To: Megan Webb
Cc: David Kitto; Sara Wilson; Derek Rutherford
Subject: Russell Vale - amended draft conditions

Hi Megan,

As indicated earlier, herewith is an amended set of recommended conditions for the Russell Vale UEP. The amendments made since the Department's Addendum Report was referred to the PAC are shown in yellow highlight. As you would expect, most of these relate to the discussions held with the Commission members and OEH representatives on Wed 13 January. These amendments proved simpler to draft than I initially anticipated.

Kind regards,

Howard Reed
Director Resource Assessments
NSW Department of Planning & Environment
GPO Box 39 Sydney NSW 2001
(02)9228 6308

Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

As delegate for the Minister for Planning, the Planning Assessment Commission approves the project application referred to in Schedule 1, subject to the conditions in Schedules 2 to 6.

These conditions are required to:
- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

Member of the Commission	**Member of the Commission**	**Member of the Commission**

Sydney 2015

SCHEDULE 1

Project Application:	09_0013
Proponent:	Wollongong Coal Limited
Approval Authority:	Minister for Planning
Land:	See Appendix 1
Project:	Russell Vale Colliery Underground Expansion Project

TABLE OF CONTENTS

DEFINITIONS

Adaptive management	Adaptive management includes monitoring subsidence effects and impacts and, based on the results, modifying the mine plan as mining proceeds to ensure that the effects, impacts and/or associated environmental consequences remain within the predicted and/or designated ranges and in compliance with the conditions of this approval
Annual Review	The review required by condition 11 of Schedule 6
Approval	This Project Approval
Approved Mine Plan	The mine plan depicted in the figure in Appendix 2
BCA	Building Code of Australia
Built features	Includes any building or work erected or constructed on land, and includes dwellings and infrastructure such as any formed road, street, path, walk, or driveway; and any pipeline, water, sewer, telephone, gas or other service main
CCC	Community Consultative Committee
Conditions of this approval	Conditions contained in Schedules 2 to 6 inclusive
Construction	The demolition of buildings or works, carrying out of works and erection of buildings covered by this approval
Council	Wollongong City Council
Day	The period from 7 am to 6 pm on Monday to Saturday, and 8 am to 6 pm on Sundays and Public Holidays
Department	Department of Planning and Environment
DPI	Department of Primary Industries
DPI-Water	Department of Primary Industries – Water
DRE	Division of Resources and Energy within the Department of Industry
DSC	Dams Safety Committee
EA	Environmental Assessment prepared for NRE No. 1 Colliery Underground Expansion Project entitled *NRE No. 1 Colliery Project Application (09_0013) Environmental Assessment* (dated February 2013) including the Preferred Project Report and associated Response to Submissions (dated September 2013), the Residual Matters Report (dated June 2014) and the following additional information: - *Bellambi Gully Flood Study* (25 November 2014) undertaken by Cardno Pty Ltd; - letter report from Wollongong Coal Ltd (26 September 2014) to the Department providing additional information in relation to total groundwater inflow; and - *Noise Impact Assessment* (September 2014) undertaken by Wilkinson Murray Pty Ltd.
Environmental consequences	The environmental consequences of subsidence impacts, including: damage to built features; loss of surface water flows to the subsurface; loss of standing pools; adverse water quality impacts; cliff falls; rock falls; damage to Aboriginal heritage sites; impacts on aquatic ecology; and ponding.
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPL	Environment Protection Licence issued under the *Protection of the Environment Operations Act 1997*
Evening	The period from 6 pm to 10 pm
Feasible	Feasible relates to engineering considerations and what is practical to build or to implement
First workings	Extraction of coal from bord and pillar workings and development of main headings, longwall gate roads, related cut throughs and the like
Incident	A set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in this approval
INP	*NSW Industrial Noise Policy* (NSW EPA, 2000)
Land	As defined in the EP&A Act, except where the term is used in the noise and air quality conditions in Schedule 4 of this project approval where it is defined to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this approval
Material harm to the environment	Harm to the environment is material if it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial
Mining operations	Extraction, processing, handling and storage of coal on the site
Minister	Minister for Planning, or delegate
Mitigation	Activities associated with reducing the impacts of the project prior to or during those impacts occurring

MSB	Mine Subsidence Board
Negligible	Small and unimportant, such as to be not worth considering
Night	The period from 10 pm to 7 am, Monday to Saturday, 10 pm to 8 am on Sundays and Public Holidays
OEH	Office of Environment and Heritage
PKCT	Port Kembla Coal Terminal
POEO Act	*Protection of the Environment Operations Act 1997*
Privately-owned land	Land that is not owned by a public agency, or a mining company (or its subsidiary)
Project	Russell Vale Colliery Underground Expansion Project as described in the EA
Proponent	Wollongong Coal or any other person or persons who rely on this approval to carry out the project that is subject to this approval
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Reasonable costs	The costs agreed between the Department and the Proponent for obtaining independent experts to review the adequacy of any aspects of the extraction plan, or where such costs cannot be agreed, the costs determined by a dispute resolution process
ROM coal	Run-of-mine coal
RMS	Roads and Maritime Services
Safe, serviceable & repairable	Safe means no danger to users who are present, serviceable means available for its intended use, and repairable means damaged components can be repaired economically
Second workings	Extraction of coal from longwall panels, mini-wall panels or pillar extraction
Secretary	Secretary of the Department, or nominee
Site	Land to which the project approval applies (see Appendix 1)
Statement of Commitments	The commitments by Wollongong Coal set out in Appendix 3
Subsidence	The totality of subsidence effects and impacts and their associated environmental consequences
Subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, including both vertical and horizontal displacement, tilt, strain and curvature
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depressions or troughs
Surface facilities site	The Russell Vale site; all ventilation shaft sites; sites used for gas drainage or for other mining purposes infrastructure; and any other site subject to existing or proposed surface disturbance associated with the project
Wollongong Coal	Wollongong Coal Limited

SCHEDULE 2
ADMINISTRATIVE CONDITIONS

OBLIGATION TO MINIMISE HARM TO THE ENVIRONMENT

1. In addition to meeting the specific performance criteria established under this approval, the Proponent shall implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation, or rehabilitation of the project.

TERMS OF APPROVAL

2. The Proponent shall carry out the project:
   (a) generally in accordance with the EA;
   (b) in accordance with the project layout plans and the Statement of Commitments; and
   (c) in accordance with the conditions of this approval.

   Notes:
   - *The project layout plans are shown in Appendix 2.*
   - *The Proponent's Statement of Commitments is shown in Appendix 3.*

3. If there is any inconsistency between the above documents, the more recent document shall prevail to the extent of the inconsistency. However, the conditions of this approval shall prevail to the extent of any inconsistency.

4. The Proponent shall comply with any reasonable requirement/s of the Secretary arising from the Department's assessment of:
   (a) any strategies, plans, programs, reviews, audits, reports or correspondence that are submitted in accordance with this approval;
   (b) any reviews, reports or audits undertaken or commissioned by the Department regarding compliance with this approval; and
   (c) the implementation of any actions or measures contained in these documents.

LIMITS ON APPROVAL

Mining Operations

5. The Proponent may carry out mining operations on the site until 31 December 2021.

   Note: Under this Approval, the Proponent is required to rehabilitate the site to the satisfaction of DRE. Consequently this approval will continue to apply in all other respects other than the right to conduct mining operations until the site has been rehabilitated to a satisfactory standard.

Coal Extraction

6. The Proponent shall not extract more than 3 million tonnes of ROM coal from the site per calendar year.

Hours of Operation

7. The Proponent may undertake mining operations 24 hours a day, 7 days a week.

COMMENCEMENT OF DEVELOPMENT UNDER THIS APPROVAL

8. The Proponent:
   (a) shall notify the Secretary in writing of the proposed date of commencement of development under this approval; and
   (b) may only commence development under this approval once the Secretary has agreed in writing that all prerequisites to the commencement of that development have been met.

SURRENDER OF EXISTING PROJECT APPROVAL

9. By 31 December 2016, or as otherwise agreed by the Secretary, the Proponent shall surrender the existing project approval for the site in accordance with Section 104A of the EP&A Act.

   Prior to the surrender of the existing project approval, the conditions of this approval shall prevail to the extent of any inconsistency with the conditions of the existing project approval.

STRUCTURAL ADEQUACY

10. The Proponent shall ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Notes:
- *Under Part 4A of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for the proposed building works; and*
- *Part 8 of the EP&A Regulation sets out the requirements for the certification of the project.*

DEMOLITION

11. The Proponent shall ensure that all demolition work is carried out in accordance with *Australian Standard AS 2601-2001: The Demolition of Structures*, or its latest version.

PROTECTION OF PUBLIC INFRASTRUCTURE

12. Unless the Proponent and the applicable authority agree otherwise, the Proponent shall:
    (a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the project; and
    (b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the project.

Note: This condition does not apply to any damage to public infrastructure subject to compensation payable under the Mine Subsidence Compensation Act 1961, or to damage to roads caused as a result of general road usage.

OPERATION OF PLANT AND EQUIPMENT

13. The Proponent shall ensure that all plant and equipment used on site is:
    (a) maintained in a proper and efficient condition; and
    (b) operated in a proper and efficient manner.

CONTRIBUTIONS TO COUNCIL

14. Within 6 months of the date of this approval, the Proponent shall reach agreement with Council on the annual contribution to be paid to Council for the maintenance of Bellambi Lane. Should agreement not be reached within that timeframe, the matter may be referred to the Secretary by either party for resolution. The Secretary's decision in regard to contributions shall be final.

SCHEDULE 3
ENVIRONMENTAL CONDITIONS – UNDERGROUND MINING

SUBSIDENCE

Performance Measures – Natural and Heritage Features

1. The Proponent shall ensure that the project does not cause any exceedance of the performance measures in Table 1, to the satisfaction of the Secretary.

Table 1: Subsidence Impact Performance Measures

Water resources	
Cataract Creek Cataract River	Negligible environmental consequences including: • *negligible* diversion of flows or changes in the natural drainage behaviour of pools; • *negligible* gas releases and iron staining; • *negligible* increase in water cloudiness; • *negligible* increase in bank erosion; • *negligible* increase in sediment load; and • *negligible* reduction in the volume of water reporting to the reservoir.
Cataract Reservoir	Negligible leakage from the reservoir and negligible reduction in the water quality of the reservoir.
Other watercourses	No greater subsidence impact or environmental consequences than predicted in the EA.
Swamps	
Upland Swamps CRUS1, CCUS1, CRUS6 and CCUS24	Negligible environmental consequences including: • *negligible* change to the shallow groundwater regime when compared with control swamps; • *negligible* erosion of the surface of the swamp; • *negligible* change in the size of the swamp; • *negligible* change in the ecosystem functionality of the swamp; • *negligible* change to the composition or distribution of species within the swamp; and • *negligible* change to the structural integrity of the bedrock base or any controlling rockbar/s of the swamp.
Land	
Cliffs	No greater subsidence impacts or environmental consequences than predicted in the EA.
Biodiversity	
Threatened species or populations	Negligible environmental consequences.
Heritage Features	
Aboriginal heritage sites 52-2-0083, 52-2-0233, 52-2-0310, 52-2-0311, 52-2-0312, 52-2-0313, 52-2-0314, 52-2-0317, 52-2-0319, 52-2-0322, 52-2-0323, Wonga East 4 and Wonga East 5	Negligible impact or environmental consequences.
Aboriginal heritage sites 52-2-0099, 52-2-0229, 52-2-0603, 52-2-3939, 52-2-3940, 52-2-3941, 52-2-0320 and 52-3-0325.	No greater subsidence impact or environmental consequences than predicted in the EA.
Historic heritage sites	Negligible impact or environmental consequences.

Notes:
1) *The Proponent will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this approval (see eg condition 10 below).*
2) *Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.*
3) *The requirements of this condition only apply to the impacts and consequences of mining operations, construction or demolition undertaken following the date of this approval.*
4) *The definition of 'negligible environmental consequences' applicable to the four upland swamps listed in Table 1 is also to be used in applying conditions 4, 5 and 6 of Schedule 3 to the eight upland swamps subject to those conditions.*

2. The Proponent must assess and manage project-related risks to ensure that there are no exceedances of the performance measures in Table 1. Any exceedance of these performance measures constitutes a breach of this approval and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation, notwithstanding actions taken pursuant to paragraphs (a)-(c) or condition 3 below. Where any exceedance of these performance measures has occurred, the Proponent must, at the earliest opportunity:
   (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
   (b) consider all reasonable and feasible options for remediation and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
   (c) implement remediation measures as directed by the Secretary,

   to the satisfaction of the Secretary.

Offsets

3. If the Proponent exceeds the performance measures in Table 1, or causes greater than 'negligible environmental consequences' to any upland swamp subject to condition 4 or condition 5 below, and the Secretary determines that:
   (a) it is not reasonable or feasible to remediate the impact or environmental consequence; or
   (b) remediation measures implemented by the Proponent have failed to satisfactorily remediate the impact or environmental consequence;

   then the Proponent shall provide a suitable offset to compensate for the impact or environmental consequence, to the satisfaction of the Secretary.

   The offset must give priority to like-for-like physical environmental offsets, but may also consider payment into any NSW Offset Fund established by OEH, or funding or implementation of supplementary measures such as:
   - actions outlines in threatened species recovery programs;
   - actions that contribute to threat abatement programs;
   - biodiversity research and survey programs; and/or
   - rehabilitating degraded habitat.

   Note: Any offset required under this condition must be proportionate with the significance of the impact or environmental consequence.

Swamp Offset Bond for First Swamp Undermined

4. Prior to the re-commencement of second workings in Longwall 6, unless otherwise agreed by the Secretary, the Proponent shall lodge a Swamp Offset Bond of $500,000 with the Department.

   If, after 12 months of completion of all mining under this approval within 400 metres of swamp CCUS4, monitoring demonstrates that no greater than 'negligible environmental consequences' have resulted to the swamp from mining under this approval, to the satisfaction of the Secretary, then the Secretary will release the Bond.

   If monitoring demonstrates that greater than 'negligible environmental consequences' have resulted to swamp CCUS4 from mining under this approval, and that these consequences have stabilised for a period of at least 12 months, then the Proponent must offset the environmental consequences to that swamp to the satisfaction of the Secretary within any period specified by the Secretary.

   The offset liability will be set by the Secretary in consultation with OEH, following consideration of:
   (a) the estimated liability using the Framework for Biodiversity Assessment in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*; and
   (b) advice from the Independent Expert Panel that will be established by the Secretary for the project.

   Once the Proponent has offset the environmental consequences to the satisfaction of the Secretary, the Bond will be returned to the Proponent.

   Note: Alternative funding arrangements, such as provision of capital and management funding as agreed by OEH as part of a Biobanking Agreement or transfer to conservation reserve estate, can be used as part of the Swamp Offset Bond. A bank guarantee can be lodged in place of a cash bond.

Swamp Offsets for all Other Upland Swamps

5. Prior to the commencement of mining operations under an approved Extraction Plan which are predicted to cause greater than 'negligible environmental consequences' to any of Upland Swamps CCUS2, CCUS5, CCUS10, CCUS11, CCUS12, BCUS4 or BCUS11, the Proponent shall demonstrate that it can satisfy the maximum predicted offset liability for the total area of swamp(s) predicted to be impacted under that Extraction Plan.

   If, after 12 months of completion of all mining under this approval within 400 metres of any of these swamps, monitoring demonstrates that no greater than 'negligible environmental consequences' have resulted to the swamp

from mining under this approval, to the satisfaction of the Secretary, then the Proponent will not be required to secure the offset or retire the credits relating to that swamp.

If monitoring demonstrates that greater than 'negligible environmental consequences' have resulted to any of these swamps from mining under this approval, and that these consequences have stabilised for a period of at least 12 months, then the Proponent must offset the environmental consequences to that swamp (other than 'negligible environmental consequences') to the satisfaction of the Secretary within any period specified by the Secretary.

The offset liability will be set by the Secretary in consultation with OEH, following consideration of:

(a) the estimated liability using the Framework for Biodiversity Assessment in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*; and

(b) advice from the Independent Expert Panel that will be established by the Secretary for the development.

Note: Alternative funding arrangements, such as provision of capital and management funding as agreed by OEH as part of a Biobanking Agreement or transfer to conservation reserve estate, can be used as part of the Swamp Offset.

6. As part of each Extraction Plan for mining within 400 metres of the swamps subject to condition 5 above, the Proponent must:

(a) calculate the maximum predicted offset liability for any environmental consequences (other than 'negligible environmental consequences') on these swamps that may result from the proposed mining using the Framework for Biodiversity Assessment in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*; and

(b) demonstrate that it has suitable arrangements in place to deal with these liabilities quickly in the event that offsets are required.

Performance Measures – Built Features

7. The Proponent shall ensure that the project does not cause any exceedances of the performance measures in Table 2, to the satisfaction of the Secretary.

Table 2: Subsidence Impact Performance Measures

Built Features	
Key public infrastructure: Mount Ousley Road; Picton Road Interchange; 330 and 132 kV power transmission lines and associated towers; and telecommunication infrastructure on Brokers Nose.	Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.
Access road to Vent Shaft No. 4, fire trails, other public infrastructure, other built features	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public safety	
Public Safety	No additional risk

Notes:

1) The Proponent will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in Built Features Management Plans or Public Safety Management Plan (see condition 10 below).

2) Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.

3) The requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of this approval.

4) Any breach of this condition is taken to be a breach of this approval, and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

5) Requirements regarding safety or serviceability do not prevent preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.

8. Any dispute between the Proponent and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 2 is to be settled by the Secretary, following consultation with the MSB and DRE. Any decision by the Secretary shall be final and not subject to further dispute resolution under this approval.

First Workings

9. The Proponent may carry out first workings within the underground mining area, other than in accordance with an approved Extraction Plan, provided that DRE is satisfied that the first workings are designed to remain stable and non-subsiding in the long-term, except insofar as they may be impacted by approved second workings.

Note: The intent of this condition is not to require an additional approval for first workings, but to ensure that first workings are built to geotechnical and engineering standards sufficient to ensure long term stability, with negligible resulting direct subsidence impacts.

Extraction Plan

10. The Proponent shall prepare and implement an Extraction Plan for all second workings on site to the satisfaction of the Secretary. Each extraction plan must:
    (a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Secretary;
    (b) be approved by the Secretary before the Proponent carries out any of the second workings covered by the plan;
    (c) include detailed plans of existing and proposed first and second workings and any associated surface development;
    (d) include detailed performance indicators for each of the performance measures in Tables 1 and 2;
    (e) provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since this approval;
    (f) describe the measures that would be implemented to ensure compliance with the performance measures in Tables 1 and 2, and manage or remediate any impacts and/or environmental consequences;
    (g) include a Built Features Management Plan, which has been prepared in consultation with DRE and the owners of affected infrastructure, to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which:
        - addresses in appropriate detail all items of key public infrastructure, other public infrastructure and all classes of other built features;
        - has been prepared following appropriate consultation with the owner/s of potentially affected feature/s;
        - recommends appropriate remedial measures and includes commitments to mitigate, repair, replace or compensate all predicted impacts on potentially affected built features in a timely manner; and
        - in the case of all key public infrastructure, and other public infrastructure except roads, trails and associated structures, reports external auditing for compliance with ISO 31000 (or alternative standard agreed with the infrastructure owner) and provides for annual auditing of compliance and effectiveness during extraction of longwalls which may impact the infrastructure;
    (h) include a Water Management Plan, which has been prepared in consultation with WaterNSW and DPI-Water, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on watercourses and aquifers, including:
        - detailed baseline data on:
            - surface water flows and quality in water bodies that could be affected by subsidence, including Cataract Creek, Cataract River and all major associated tributaries ;
            - groundwater levels, yield and quality in the region;
        - surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources or water quality;
        - a surface water monitoring program to monitor and report on:
            - stream flows and water quality (including both dissolved iron and filterable iron oxides/hydroxides);
            - stream and riparian vegetation health;
            - channel and bank stability;
        - a groundwater monitoring program to monitor and report on:
            - groundwater inflows to the underground mining operations;
            - leakage from Cataract Reservoir;
            - the height of groundwater depressurisation in the area between Longwalls 6 and 7 and the Cataract Reservoir;
            - background changes in groundwater yield/quality against mine-induced changes;
            - permeability, hydraulic gradient, flow direction and connectivity of the deep and shallow groundwater aquifers;
            - impacts of the project on upland swamps and other groundwater dependent ecosystems;
        - a program to validate the surface water and groundwater models for the project, and compare monitoring results with modelled predictions; and
        - a plan to respond to any exceedances of the surface water and groundwater assessment criteria;

(i) include a Biodiversity Management Plan, which has been prepared in consultation with OEH, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats; endangered ecological communities; upland swamps and other groundwater dependent ecosystems;

(j) *Swamp Monitoring Program* which has been prepared in consultation with OEH, DPI-Water and WaterNSW, and which includes:

- measures to record the nature and condition of terrestrial and aquatic flora and fauna within all upland swamps;
- measures to characterise soils or peat layers within the upland swamps to determine:
  - porosity;
  - a basis for relating water levels to rainfall and evapotranspiration; and
  - the presence, or absence, of clay materials at the interface with the underlying bedrock;
- a program for monthly review of the water balance of all monitored swamps based on recorded rainfall, estimated evapotranspiration and recorded surface and shallow groundwater levels and outflow measurements;
- detailed performance indicators for the relevant performance measures in Table 1, including performance indicators relating to surface and shallow groundwater levels and outflow measurements;
- consideration of a minimum of 2 years of baseline data for swamp hydrology and swamp vegetation;
- hydrological and vegetative monitoring which fully satisfies Before After Control Impact (BACI) design principles;
- provision of raw piezometer and other monitoring data to the Department, OEH and the Independent Monitoring Panel, if requested; and
- incorporation of any relevant findings from swamp research projects into the swamp monitoring program;

(k) include a Land Management Plan, which has been prepared in consultation with any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed second workings on land in general;

(l) include a Heritage Management Plan, which has been prepared in consultation with OEH and relevant stakeholders for both Aboriginal and historic heritage, to manage the potential environmental consequences of the proposed second workings on both Aboriginal and non-Aboriginal heritage items. This plan must reflect all requirements under condition 19 of Schedule 4;

(m) include a Public Safety Management Plan, which has been prepared in consultation with DRE, to ensure public safety in the mining area;

(n) include a Subsidence Monitoring Program, which has been prepared in consultation with DRE, to:

- describe the on-going subsidence monitoring program;
- provide data to assist with the management of the risks associated with subsidence;
- validate the subsidence predictions;
- analyse the relationship between the predicted and resulting subsidence effects and predicted and resulting impacts under the plan and any ensuing environmental consequences; and
- inform the contingency plan and adaptive management process;

(o) include Trigger Action Response Plans, or equivalent, to address potential subsidence impacts and environmental consequences that may result from mining subsidence;

(p) include a Contingency Plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Tables 1 and 2, or where any such exceedance appears likely;

(q) include a Mine Workings Closure Plan, prepared in consultation with WaterNSW and the DSC, that effectively provides for the sealing and isolation of affected mine workings if there are unacceptable inflows to the mine from the Cataract Reservoir;

(r) proposes appropriate revisions to the Rehabilitation Management Plan required under condition 27 of Schedule 3; and

(s) include a program to collect sufficient baseline data for future Extraction Plans.

Notes:

- *To identify the longwall mining domains referred to in this condition, see Appendix 2;*
- *Extraction of Longwall 6 may be undertaken under a Subsidence Management Plan or Extraction Plan which satisfies the conditions of MP 10_0046 and was prepared prior to the date of this approval.*

Geological Structures

11. The Proponent shall:

(a) implement the following prior to the extraction of Longwall 7, to the satisfaction of the DSC:

- undertake inspections of the Bulli Seam workings overlying Longwall 7 to confirm the accuracy of the record tracings (subject to ability to safely access these workings); and

- drill exploration boreholes to confirm the accuracy of the record tracings for the Bulli Seam workings overlying Longwall 7.

(b) if required by the DSC, truncate the panel length of Longwall 7 if the Corrimal Fault is intersected during development of the gateroads for Longwall 7;

Independent Monitoring Panel

12. An Independent Monitoring Panel for the project will be established by the Secretary, and be comprised of suitably qualified experts in the fields of mining subsidence and upland swamps. The role of the Panel is to provide timely, accurate and focussed advice to the Proponent and the Secretary regarding the:
    (a) collection of relevant data to predict and monitor the potential subsidence impacts and environmental consequences of second workings;
    (b) achievement of performance measures in Table 1 in respect of Swamps, Land and Biodiversity, having regard to relevant performance indicators, including avoidance of impacts where reasonable and feasible, rather than relying on remediation and offsets;
    (c) preparation, revision and implementation of Extraction Plans, particularly their Swamp Monitoring Program, Biodiversity Management Plan and Land Management Plan components;
    (d) implementation of the swamp and groundwater monitoring programs (including the installation of piezometers) and adaptive management regime throughout the life of the project; and
    (e) calculation of swamp offset liabilities and verification of calculated swamp offset liabilities under conditions 4 and 5 of Schedule 3.

Installation of Piezometers

13. As soon as practicable following the date of this approval, the Proponent shall complete the installation of its network of piezometers to monitor shallow groundwater and upland swamps, to the satisfaction of the Secretary. This network must include:
    (a) installation of upslope and downslope piezometers in all upland swamps, in order to better understand the down-slope movement of shallow groundwater; and
    (b) installation of flow monitoring points in all upland swamps.

PAYMENT OF REASONABLE COSTS

14. The Proponent shall pay all reasonable costs incurred by the Department to:
    (a) engage suitably qualified, experienced and independent persons to review the adequacy of any aspect of an Extraction Plan; and
    (b) establish and operate the Independent Monitoring Panel for the development.

SCHEDULE 4
ENVIRONMENTAL CONDITIONS – GENERAL

NOISE

Noise Criteria

1. The Proponent shall ensure that the noise generated by the project does not exceed the criteria in Table 3 at any residence on privately-owned land.

Table 3: Noise Criteria dB(A)

Location		***Day***	***Evening***	***Night***	
Area	***Receiver Number***	$L_{Aeq\ (15\ min)}$	$L_{Aeq\ (15\ min)}$	$L_{Aeq\ (15\ min)}$	$L_{A1\ (1\ min)}$
16 West Street, Russell Vale	R1	53	53	43	50
30 West Street, Russell Vale	R2	54	53	44	51
13 West Street, Russell Vale	R3	53	53	44	50
13 Broker Street, Russell Vale	R4	53	53	43	50
4 Broker Street, Russell Vale	R5	53	53	41	52
659 Princes Highway, Russell Vale	R6	53	53	41	52
34 Princes Highway, Corrimal	R7	53	53	44	52
95 Midgley Street, Corrimal	R8	53	53	46	52
109 Midgley Street, Corrimal	R9	46	46	43	48
6 Lyndon Street, Corrimal	R10	44	44	43	48
22 Lyndon Street, Corrimal	R11	43	43	40	48
46 Lyndon Street, Corrimal	R12	42	42	39	48
6 Taylor Place, Corrimal	R13	46	46	42	48
15 Taylor Place, Corrimal	R14	46	46	40	48
All other privately-owned land		63	53	48	52

Note: To interpret the land referred to in Table 3 see the applicable figures in Appendix 4.

Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy (as may be updated from time-to-time). Appendix 5 details the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Proponent has an agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Operating Conditions

2. The Proponent shall:
   (a) implement best management practice to minimise the operational and coal transport noise generated by the project, including any restrictions on the loading and transport of coal described in conditions 14 to 16 below;
   (b) implement the following measures to the satisfaction of the EPA:
      - fit polymer rollers to conveyors RC1 and RC3 prior to the commencement of coal extraction under this approval;
      - conduct trials to minimise the height of falling on the stockpile with tripper automation within 6 months of the commencement of operations at the pit top site under this approval; and
      - undertake further investigations in relation to an on-site noise barrier within 6 months of the commencement of operations at the pit top site, including:

- conduct real time *in-situ* noise monitoring to verify the results of the modelling and assess the need for a noise barrier;
- discuss the results with the affected residents to determine their views on the construction of a noise barrier; and
- present the findings to the EPA for its final position on whether the noise barrier should be constructed;

(c) not operate dozers or front end loaders between the hours of 10 pm and 7 am Monday to Friday, or between the hours of 10 pm and 8 am on Saturdays, Sundays and Public Holidays. Start-up checks may be undertaken up to 30 minutes prior to operations, where this is undertaken in a designated area selected to minimise noise impacts;

(d) ensure that delivery of known igneous dyke or sill material to surface stockpiles only occurs between the hours of 7 am and 6 pm;

(e) ensure that seam floor and roof material and any unmapped igneous dyke or sill material delivered to surface stockpiles between the hours of 10 pm and 7 am comprises less than 10% of the ROM product by volume;

(f) not operate Trippers 2 or 3 between the hours of 10 pm and 7 am, unless the Trippers are re-engineered to demonstrably achieve the criteria in Table 3;

(g) ensure the existing Bulli Conveyor is only operated between 7 am and 6 pm and is decommissioned after completion of the driveage of the Wonga Mains;

(h) only use noise-attenuated mobile fleet on the surface stockpile site;

(i) operate a comprehensive noise management system that uses real-time noise monitoring data to guide day to day planning of mining operations and the implementation of both proactive and reactive noise mitigation measures to ensure compliance with the relevant conditions of this approval;

(j) minimise the noise impacts of the project during meteorological conditions when the noise limits in this approval do not apply (see Appendix 5); and

(k) carry out regular monitoring to determine whether the project is complying with the relevant conditions of this approval and, if necessary, adjust the scale of operations on site to meet the criteria in this approval.

to the satisfaction of the Secretary.

Note: During emergencies (see condition 15 below), the Proponent may exceed the restrictions in condition 2 above with the written approval of the Secretary.

Noise Management Plan

3. The Proponent shall prepare and implement a Noise Management Plan for the project to the satisfaction of the Secretary. This plan must:

(a) be prepared in consultation with EPA, and submitted to the Secretary for approval prior to the delivery of igneous dyke material to surface stockpiles;

(b) describe the noise mitigation measures that would be implemented to ensure compliance with the relevant conditions of this approval;

(c) outline procedures to manage responses to any complaints or issues raised by the owners of affected residences;

(d) describe the proposed noise management system in detail; and

(e) include a noise monitoring program that:

- evaluates and reports on:
  - the effectiveness of the noise management system;
  - compliance against the noise criteria in this approval; and
  - compliance against the operating conditions in condition 2 above;
- includes a program to calibrate and validate the real-time noise monitoring results with the attended monitoring results over time (so the real-time noise monitoring program can be used as a better indicator of compliance with the noise criteria in this approval and trigger for further attended monitoring); and
- defines what constitutes a noise incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any noise incidents.

AIR QUALITY

Air Quality Criteria

4. The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed, or contribute to exceedances of, the criteria listed in Tables 4, 5 or 6 at any residence on privately-owned land.

Table 4: Long term impact assessment criteria for particulate matter

Pollutant	Averaging period	[d] Criterion
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 5: Short term impact assessment criterion for particulate matter

Pollutant	Averaging period	[d] Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3

Table 6: Long term impact assessment criteria for deposited dust

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables 4-6:

[a] *Total impact (i.e. incremental increase in concentrations due to the complex plus background concentrations due to all other sources);*

[b] *Incremental impact (i.e. incremental increase in concentrations due to the complex on its own);*

[c] *Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method; and*

[d] *Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents, illegal activities or any other activity agreed by the Secretary.*

Operating Conditions

5. The Proponent shall:
   (a) implement all reasonable and feasible measures to minimise the:
      - odour, fume and dust emissions of the project; and
      - release of greenhouse gas emissions from the project;
   (b) implement the following mitigation measures by 31 December 2016:
      - new truck loading facility;
      - secondary sizer building;
   (c) upgrade of the fleet of coal transport trucks from 34 to 44 tonne capacity progressively over 24 months from the date of this approval;
   (d) implement the following mitigation measures prior to quarterly production rates reaching the equivalent of 2.7 million tonnes per annum:
      - two new conveyors with enclosures;
      - underground reclaim;
   (e) implement the following mitigation measures within 12 months of the commencement of mining operations:
      - trial the use of chemical wetting agents on haul roads and stockpiles;
      - seal the haul roads through the stockpile area;
      - install water sprays on the moving tipper(s);
   (f) minimise any visible off-site air pollution generated by the project;
   (g) minimise the surface disturbance of the site;
   (h) operate a comprehensive air quality management system that uses a combination of predictive meteorological forecasting and real-time air quality monitoring data to guide the day to day planning of mining operations and the implementation of both proactive and reactive air quality mitigation measures to ensure compliance with the relevant conditions of this approval; and
   (i) minimise the air quality impacts of the project during adverse meteorological conditions and extraordinary events (see Note d above under Table 6),

   to the satisfaction of the Secretary.

Air Quality & Greenhouse Gas Management Plan

6. The Proponent shall prepare and implement an Air Quality Management Plan for the project to the satisfaction of the Secretary. This plan must:
   (a) be prepared in consultation with the EPA, and submitted to the Secretary within 6 months of the date of this approval, unless the Secretary agrees otherwise;
   (b) describe the measures that would be implemented to ensure compliance with the relevant conditions of this approval;
   (c) describe the measures that would be implemented to minimise the release of greenhouse gas emissions from the site;
   (d) describe the air quality management system;

(e) include an air quality monitoring program that:
- uses a combination of real-time and supplementary monitors to evaluate the performance of the project against the air quality criteria in this approval;
- adequately supports the air quality management system;
- evaluates and reports on the:
  - the effectiveness of the air quality management system;
  - compliance with the air quality criteria;
  - compliance with the operating conditions in condition 5 above; and
- defines what constitutes an air quality incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any air quality incidents.

Meteorological Monitoring

7. For the life of the project, the Proponent shall ensure that there is a meteorological station operating in the vicinity of the site that:
   (a) complies with the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* guideline; and
   (b) is capable of continuous real-time measurement of temperature lapse rate in accordance with the NSW Industrial Noise Policy, unless a suitable alternative is approved by the Secretary following consultation with the EPA.

WATER

Water Supply

8. The Proponent shall ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of operations on site to match its available water supply.

   Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Proponent is required to obtain the necessary water licences for the project.

Water Pollution

9. Unless an EPL authorises otherwise, the Proponent shall comply with section 120 of the POEO Act.

Water Management Performance Measures

10. The Proponent shall comply with the performance measures in Table 7 to the satisfaction of the Secretary.

Table 7: Water Management Performance Measures

Feature	***Performance Measure***
Water Management – General	• Minimise the use of clean water on site • Minimise the use of make-up water from external sources
Construction and operation of infrastructure	• Design, install and maintain erosion and sediment controls generally in accordance with the series Managing Urban Stormwater: Soils and Construction including Volume 1, Volume 2A – Installation of Services and Volume 2C – Unsealed Roads • Design, install and maintain the infrastructure within 40 m of watercourses generally in accordance with the *Guidelines for Controlled Activities on Waterfront Land (DPI 2007)*, or its latest version • Design, install and maintain creek crossings generally in accordance with the Policy and Guidelines for *Fish Friendly Waterway Crossings* (NSW Fisheries, 2003) and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* (NSW Fisheries 2003), or their latest versions
Clean water diversion & storage infrastructure	• Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on site
Sediment Dams	• Design, install and maintain the dams generally in accordance with the series Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries
Mine water storages	• Design, install and maintain mine water storage infrastructure to ensure no unlicensed or uncontrolled discharge of mine water off-site • New on-site storages (including tailings dams, mine infrastructure dams, groundwater storage and treatment dams) are suitably lined to comply with a permeability standard of $< 1 \times 10^{-9}$ m/s
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standards

Aquatic and riparian ecosystems	• Maintain or improve baseline channel stability • Develop site-specific water quality objectives in accordance with ANZECC 2000 and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* procedures (DECC 2006), or its latest version
Bellambi Gully Channel and Diversion	• Design, install and maintain the main channel and culvert to convey the 100 year ARI flood or greater using Council's 'policy based' conduit blockage criteria • Design, install and maintain the swale alongside the stockpile access road to convey the 100 year ARI flood or greater

Bellambi Gully Creek Works

11. The Proponent shall implement each of the recommended mitigation measures detailed in Section 6 of the *Bellambi Gully Flood Study* (Cardno Pty Ltd, January 2012) within 12 months of the date of this approval, to the satisfaction of the Secretary.

Water Management Plan

12. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:
    (a) be prepared in consultation with DPI-Water and the EPA, by suitably qualified and experienced persons whose appointment has been approved by the Secretary;
    (b) be submitted to the Secretary for approval within 6 months of the date of this approval, unless the Secretary agrees otherwise;
    (c) include reference to the National Water Quality Management Strategy;
    (d) include detailed performance criteria and describes measure to ensure that the Proponent complies with the Water Management Performance Measures (see Table 7);
    (e) in addition to the standard requirements for management plans (see condition 2 of Schedule 6), this plan must include a:
        (i) Site Water Balance that:
            - includes details of:
                - sources and security of water supply, including contingency planning for future reporting periods;
                - water use and management on site;
                - reporting procedures, including the preparation of a site water balance for each calendar year;
            - describes the measures that would be implemented to minimise clean water use on site;
        (ii) Surface Water Management Plan, that includes:
            - detailed baseline data on water flows and quality in the waterbodies that could be affected by the surface facilities associated with the project, including Bellambi Creek and Lizard Creek;
            - a detailed description of the water management systems on site, including the pit top and all shaft sites and associated facilities;
            - detailed plans, including design objectives and performance criteria;
            - detailed performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the project:
                - the water management system;
                - downstream surface water quality;
                - downstream flooding impacts; and
                - stream and riparian vegetation health for Bellambi Creek and Lizard Creek;
            - a program to monitor and report on:
                - the effectiveness of the water management system;
                - surface water flows and quality, stream and riparian vegetation health in the watercourses that could be affected by the surface facilities associated with the project;
                - the seepage/leachate from on-site water storages; and
                - downstream flooding impacts;
            - reporting procedures for the results of the monitoring program; and
            - a plan to respond to any exceedances of the performance criteria, and mitigate any adverse surface water impacts of the project.

TRANSPORT

Monitoring of Coal Transport

13. The Proponent shall:
    (a) keep accurate records of the amount of coal transported from the site (on a daily basis);

(b) make these records publicly available on its website at the end of each calendar quarter.

Road Transport Restrictions

14. The Proponent shall only load coal or coal reject onto trucks, or transport it off site by road between 7 am to 10 pm, Monday to Friday and between and 8 am to 6 pm on Saturdays, Sundays and public holidays.

15. During emergencies, the Proponent may exceed the restrictions in condition 14 above with the written approval of the Secretary.

Note: The kind of circumstances which may constitute an emergency include major traffic disruptions on the transport route and major loading equipment failure or critical port need at PKCT.

16. The Proponent shall ensure that any truck leaving the site:
(a) does not carry dirt or mud onto public roads; and
(b) is free of material that may fall on the road and create a road safety hazard or public nuisance,
to the satisfaction of the Secretary.

Traffic Management Plan

17. The Proponent shall prepare and implement a Traffic Management Plan for the project to the satisfaction of the Secretary. This Plan must:
(a) be prepared in consultation with RMS, EPA, Council and PKCT;
(b) be submitted for approval to the Secretary within 6 months of the date of this approval, unless the Secretary agrees otherwise;
(c) aim to minimise the traffic impacts of the project on the residential areas surrounding the surface facilities site, and in particular the residences located along Bellambi Lane;
(d) include a traffic management protocol, which must consider:
- appropriate speed limits;
- truck separation distances;
- minimisation of compression braking and other noisy practices, especially on the approach to Port Kembla Road/Springhill Road traffic lights when entering or exiting PKCT;
- reporting of vehicle faults; and
- reporting of all traffic incidents; and

(e) include a Traffic Noise Management Strategy, which must consider, but is not limited to:
- the selection and maintenance of vehicle fleets;
- movement scheduling to reduce noise impacts during sensitive times of the day; and
- procedures to minimise impacts at identified sensitive areas along the haulage routes; and

(f) include a drivers' code of conduct to minimise the impacts of project-related trucks on local residences and road users; and
(g) describe the measures that would be put in place to ensure compliance with the drivers' code of conduct.

HERITAGE

Protection of Aboriginal Heritage Items

18. Unless otherwise authorised under the *National Parks and Wildlife Act 1974*, the Proponent shall ensure that the project does not cause any direct or indirect impact on the identified Aboriginal heritage items located outside the approved disturbance area of the project.

Note: Identified Aboriginal heritage items are listed in Appendix 6.

Heritage Management Plan

19. The Proponent shall prepare and implement a Heritage Management Plan for the project to the satisfaction of the Secretary. This Plan must:
(a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Secretary;
(b) be prepared in consultation with OEH, Council, any relevant local historical organisations and Aboriginal stakeholders;
(c) be submitted to the Secretary for approval within 6 months of the date of this approval, unless the Secretary agrees otherwise;
(d) include a description of the measures that would be implemented for:
- managing the discovery of human remains or previously unidentified heritage items on site; and
- ensuring any workers on site receive suitable heritage inductions prior to carrying out any development on site, and that suitable records are kept of these inductions;

(e) include the following for the management of Aboriginal Heritage:

- a description of the measures that would be implemented for:
  - protecting, monitoring and/or managing (including any proposed archaeological investigations and/or salvage measures) the heritage items identified in Table 1;
  - managing the discovery of previously unidentified Aboriginal items on site;
  - conserving the sites outside the surface disturbance area (see Appendix 6), including measures that would be implemented to secure, analyse and record the sites at risk of subsidence;
  - maintaining and managing reasonable access for Aboriginal stakeholders to heritage items on site;
  - ongoing consultation with the Aboriginal stakeholders in the conservation and management of Aboriginal cultural heritage on site; and
- a strategy for the storage of any heritage items salvaged on site, both during the project and in the long term;

(f) include the following for the management of cultural heritage items:

- a description of the measures that would be implemented for:
  - protecting, monitoring and managing the heritage items identified in Appendix 7;
  - managing the discovery of previously unidentified cultural heritage items on site;
  - undertaking archival and photographic recording of the site, including the 1887 portal and all moveable heritage items; and
  - ensuring for the long-term storage of moveable heritage items.

VISUAL

Visual and Lighting

20. The Proponent shall:
    (a) implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the project;
    (b) ensure no fixed outdoor lights shine above the horizontal or above the building line or any illuminated structure;
    (c) ensure that all external lighting associated with the project complies with *Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting*, or its latest version;
    (d) take all practical measures to shield views of mining operations from users of public roads and privately-owned residences,

    to the satisfaction of the Secretary.

WASTE

21. The Proponent shall:
    (a) implement all reasonable and feasible measures to minimise the waste generated by the project;
    (b) ensure that the waste generated by the project is appropriately stored, handled and disposed of; and
    (c) monitor and report on effectiveness of the waste minimisation and management measures each calendar year,

    to the satisfaction of the Secretary.

Underground Tailings Storage Trials

22. The Proponent may conduct trials of underground emplacement and storage of coal tailings, subject to the prior approval of the Secretary.

BUSHFIRE MANAGEMENT

23. The Proponent shall:
    (a) ensure that the project is suitably equipped to respond to any fires on site; and
    (b) assist the Rural Fire Service and emergency services as much as possible if there is a fire in the surrounding area.

PROJECT SURFACE INFRASTRUCTURE MANAGEMENT

Service Boreholes Management Plan

24. The Proponent shall prepare and implement a Service Boreholes Management Plan in respect of construction and use of future service boreholes (ie any service boreholes not subject to approval at the date of this instrument) to the satisfaction of the Secretary. This plan must be submitted to the Secretary for approval prior to the construction of any future service borehole and must include commitments regarding:
    (a) community consultation;
    (b) landholder agreements;

(c) assessment of noise, air quality, traffic, biodiversity, heritage, public safety and other impacts in accordance with approved methods;
(d) avoidance of significant impacts and minimisation of impacts generally;
(e) achievement of applicable standards and goals;
(f) mitigation and/or compensation for significant noise, air quality and visual impacts; and
(g) rehabilitation of disturbed sites.

REHABILITATION

Rehabilitation Objectives

25. The Proponent shall rehabilitate the site to the satisfaction of DRE. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EA, and comply with the objectives in Table 8.

Table 8: Rehabilitation Objectives

Feature	***Objective***
Mine site (as a whole)	• Safe, stable & non-polluting. • Final landforms to: - use compatible with surrounding land uses; - be designed to minimise the visual impacts of the project; - be in keeping with the natural terrain features of the area; and - avoid straight run drainage drop structures.
Project surface infrastructure	• To be decommissioned, and subject to the Heritage Management Plan, removed (unless DRE agrees otherwise).
Portals and vent shafts	• To be decommissioned and made safe and stable. • Retain habitat for threatened species (eg bats), where practicable
Watercourses of 2nd order or higher subject to subsidence impacts	• Hydraulically and geomorphologically stable.
Cliffs	• No additional risk to public safety compared to prior to mining
Other land affected by the project	• Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprised of local native plant species (unless the Secretary, NSW Trade & Investment agrees otherwise).
Built features damaged by mining operations	• Repair to pre-mining condition or equivalent unless the: - owner agrees otherwise; or - damage is fully restored, repaired or compensated for under the *Mine Subsidence Compensation Act 1961*.
Community	• Ensure public safety. • Minimise the adverse socio-economic effects associated with mine closure.

Notes:

- *These rehabilitation objectives apply to all subsidence impacts and environmental consequences caused by mining taking place after the date of this approval; and to all project surface infrastructure part of the project, whether constructed prior to or following the date of this approval.*
- *Rehabilitation of subsidence impacts and environmental consequences caused by mining which took place prior to the date of this approval may be subject to the requirements of other approvals (eg an existing project approval, mining lease, or Subsidence Management Plan approval) or the Proponent's commitments.*

Progressive Rehabilitation

26. The Proponent shall rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot yet be permanently rehabilitated.

Rehabilitation Management Plan

27. The Proponent shall prepare and implement a Rehabilitation Management Plan for the project to the satisfaction of DRE. This plan must:
(a) be prepared in consultation with the Department, DPI-Water, OEH, Council and the CCC;
(b) be submitted to DRE for approval within 6 months of the commencement of development under this approval;
(c) be prepared in accordance with any relevant DRE guidelines;
(d) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);

(e) describe the measures that would be implemented to ensure compliance with the relevant conditions of this approval, and address all aspects of rehabilitation including mine closure, final landform, and final land use;
(f) provide for detailed mine closure planning, including measures to minimise socio-economic effects due to mine closure, to be conducted prior to the site being placed on care and maintenance;
(g) include interim rehabilitation where necessary to minimise the area exposed for dust generation;
(h) include a program to monitor and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and
(i) build to the maximum extent practicable on the other management plans required under this approval.

SCHEDULE 5
ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS

1. As soon as practicable after obtaining monitoring results showing:
   (a) an exceedance of any relevant criteria in Schedule 4, the Proponent shall notify the affected landowners in writing of the exceedance, and provide regular monitoring results to these landowners until the project is again complying with the relevant criteria; and
   (b) an exceedance of any relevant air quality criteria in Schedule 4, the Proponent shall send a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time) to the affected landowners and/or existing tenants of the land (including the tenants of any mine-owned land).

INDEPENDENT REVIEW

2. If an owner of privately-owned land considers the project to be exceeding the relevant criteria in Schedule 4, then he/she may ask the Secretary in writing for an independent review of the impacts of the project on his/her land.

   If the Secretary is satisfied that an independent review is warranted, then within 2 months of the Secretary's decision the Proponent shall:
   (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Secretary, to:
      - consult with the landowner to determine his/her concerns;
      - conduct monitoring to determine whether the project is complying with the relevant criteria in Schedule 4;
      - if the project is not complying with these criteria then identify the measures that could be implemented to ensure compliance with the relevant criteria; and
   (b) give the Secretary and landowner a copy of the independent review.

SCHEDULE 6
ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. The Proponent shall prepare and implement an Environmental Management Strategy for the project to the satisfaction of the Secretary. This strategy must:
   (a) be submitted to the Secretary for approval within 6 months of the date of this approval, unless the Secretary agrees otherwise;
   (b) provide the strategic framework for the environmental management of the project;
   (c) identify the statutory approvals that apply to the project;
   (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the project;
   (e) describe the procedures that would be implemented to:
      - keep the local community and relevant agencies informed about the operation and environmental performance of the project;
      - receive, handle, respond to, and record complaints;
      - resolve any disputes that may arise during the course of the project;
      - respond to any non-compliance;
      - respond to emergencies; and
   (f) include:
      - copies of any strategies, plans and programs approved under the conditions of this approval; and
      - a clear plan depicting all the monitoring required to be carried out under the conditions of this approval.

Management Plan Requirements

2. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:
   (a) detailed baseline data;
   (b) a description of:
      - the relevant statutory requirements (including any relevant approval, licence or lease conditions);
      - any relevant limits or performance measures/criteria;
      - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;
   (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
   (d) a program to monitor and report on the:
      - impacts and environmental performance of the project;
      - effectiveness of any management measures (see c above);
   (e) a contingency plan to manage any unpredicted impacts and their consequences;
   (f) a program to investigate and implement ways to improve the environmental performance of the project over time;
   (g) a protocol for managing and reporting any:
      - incidents;
      - complaints;
      - non-compliances with statutory requirements; and
      - exceedances of the impact assessment criteria and/or performance measures; and
   (h) a protocol for periodic review of the plan.

   Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.

Application of Existing Management Plans

3. Prior to the approval of management plans under this project approval, the Proponent shall manage development undertaken pursuant to this project approval in accordance with any equivalent or similar management plan/s required under approval MP10_0046.

Relationships between Management Plans

4. The Water and Heritage Management Plans required by conditions 12 and 19 of Schedule 4, respectively, are to be prepared in respect of all parts of the project that are not covered by an Extraction Plan approved under condition 10 of Schedule 3. In particular, those management plans should address all areas subject to existing or proposed surface disturbance associated with the project.

Revision of Strategies, Plans and Programs

5. Within 3 months of:
   (a) the submission of an incident report under condition 9 below;
   (b) the submission of an annual review under condition 11 below;
   (c) the submission of an audit under condition 12 below; or
   (d) any modification to the conditions of this project approval (unless the conditions require otherwise),

   the Proponent shall review the strategies, plans, and programs required under this approval, to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted for the approval of the Secretary.

   Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.

Updating & Staging Strategies, Plans or Programs

6. The Proponent must regularly review the strategies, plans and programs required under this consent and ensure that these documents are updated to incorporate measures to improve the environmental performance of the development and reflect current best practice in the mining industry. To facilitate these updates, the Proponent may at any time submit revised strategies, plans or programs for the approval of the Secretary. With the agreement of the Secretary, the Proponent may also submit any strategy, plan or program required by this approval on a staged basis.

   With the agreement of the Secretary, the Proponent may prepare a revision of or a stage of a strategy, plan or program without undertaking consultation with all parties nominated under the applicable condition in this approval.

   Notes:
   - *While any strategy, plan or program may be submitted on a staged basis, the Proponent will need to ensure that the existing operations on site are covered by suitable strategies, plans or programs at all times.*
   - *If the submission of any strategy, plan or program is to be staged; then the relevant strategy, plan or program must clearly describe the specific stage/s of the project to which the strategy, plan or program applies; the relationship of this stage/s to any future stages; and the trigger for updating the strategy, plan or program.*

Adaptive Management

7. The Proponent shall assess and manage project-related risks to ensure that there are no exceedances of the criteria and/or performance measures in Schedules 3 and 4. Any exceedance of these criteria and/or performance measures constitutes a breach of this approval and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

   Where any exceedance of these criteria and/or performance measures has occurred, the Proponent must, at the earliest opportunity:
   (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
   (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
   (c) implement remediation measures as directed by the Secretary,

   to the satisfaction of the Secretary.

Community Consultative Committee

8. The Proponent shall operate a Community Consultative Committee (CCC) for the project to the satisfaction of the Secretary. This CCC must be operated in accordance with the *Guidelines for Establishing and Operating Community Consultative Committees for Mining Developments* (Department of Planning, 2007), or its latest version or replacement.

   Notes:
   - *The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Proponent complies with this approval;*
   - *In accordance with the guideline, the Committee should be comprised of an independent chair and appropriate representation from the Proponent, Council, recognised environmental groups and the local community;*
   - *The Department will accept the continued representation from existing CCC members.*

REPORTING

Incident Reporting

9. The Proponent shall immediately notify the Secretary and any other relevant agencies of any incident. Within 7 days of the date of the incident, the Proponent shall provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

Regular Reporting

10. The Proponent shall provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval, and to the satisfaction of the Secretary.

ANNUAL REVIEW

11. By the end of March each year, unless the Secretary agrees otherwise, the Proponent shall review the environmental performance of the development to the satisfaction of the Secretary. This review must:
    (a) describe the project (including any rehabilitation) that was carried out in the past calendar year, and the project that is proposed to be carried out over the current calendar year;
    (b) include a comprehensive review of the monitoring results and complaints records of the project over the past calendar year, which includes a comparison of these results against the:
        - the relevant statutory requirements, limits or performance measures/criteria;
        - the monitoring results of previous years; and
        - the relevant predictions in the EIS;
    (c) identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;
    (d) identify any trends in the monitoring data over the life of the project;
    (e) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and
    (f) describe what measures will be implemented over the next year to improve the environmental performance of the project.

INDEPENDENT ENVIRONMENTAL AUDIT

12. Within 1 year of the commencement of development under this approval, and every 3 years thereafter, unless the Secretary directs otherwise, the Proponent shall commission and pay the full cost of an Independent Environmental Audit of the project. This audit must:
    (a) be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary;
    (b) include consultation with the relevant agencies;
    (c) assess the environmental performance of the project and assess whether it is complying with the requirements in this approval and any relevant EPL or Mining Lease (including any assessment, plan or program required under these approvals);
    (d) review the adequacy of strategies, plans or programs required under the abovementioned approvals; and
    (e) recommend appropriate measures or actions to improve the environmental performance of the project, and/or any assessment, plan or program required under the abovementioned approvals.

    Note: This audit team must be led by a suitably qualified auditor and include experts in any fields specified by the Secretary.

13. Within 6 weeks of the completion of this audit, or as otherwise agreed by the Secretary, the Proponent shall submit a copy of the audit report to the Secretary, together with its response to any recommendations contained in the audit report.

ACCESS TO INFORMATION

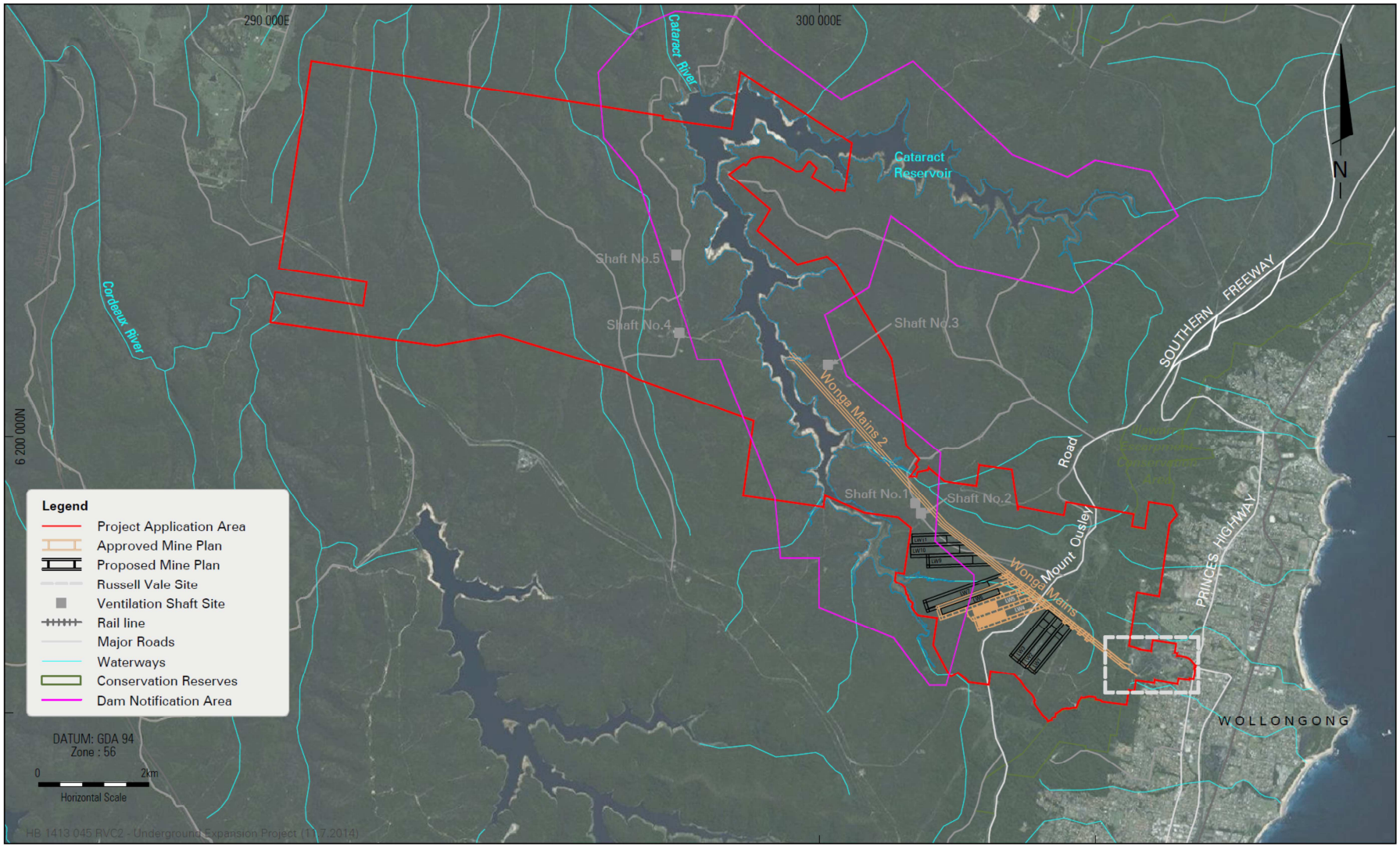
14. From the commencement of development under this approval, the Proponent shall:
    (a) make copies of the following publicly available on its website:
        - the EA;
        - current statutory approvals for the project;
        - approved strategies, plans and programs required under the conditions of this approval;
        - a comprehensive summary of the monitoring results of the project, reported in accordance with the specifications in any conditions of this approval, or any approved plans and programs;
        - a complaints register, which is to be updated monthly;
        - minutes of CCC meetings;
        - the annual reviews of the project (for the last 5 years, if applicable);
        - any independent environmental audit of the project, and the Proponent's response to the recommendations in any audit;
        - any other matter required by the Secretary; and
    (b) keep this information up-to-date,

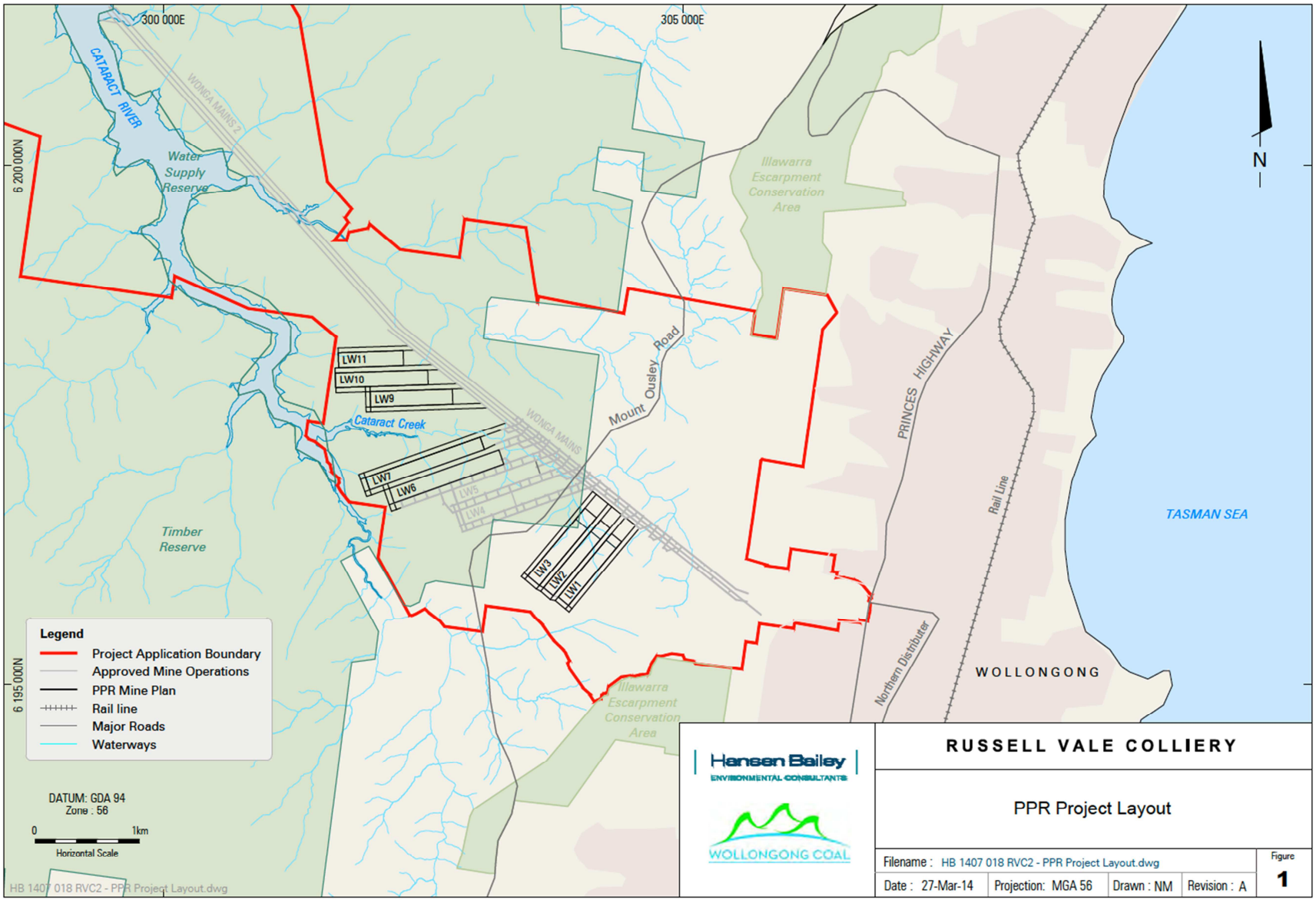
    to the satisfaction of the Secretary.

APPENDIX 1: SCHEDULE OF LAND

Property ID / Lot Number	DP Plan Number	Owner
Auto Consol 1833-110		Wollongong Coal Ltd
Auto Consol 1644-66		Wollongong Coal Ltd
Auto consol 5333-243 includes:		Wollongong Coal Ltd
Lot 3	DP 60975	Wollongong Coal Ltd
Lot 30 to 32	DP 751301	Wollongong Coal Ltd
Lot 63&68 -71	DP 751301	Wollongong Coal Ltd
Lot 1-2	DP 1046069	Wollongong Coal Ltd
Lot 1	DP 1046070	Wollongong Coal Ltd
Lot 130	DP 751301	Wollongong Coal Ltd
Lot 31	DP 1006012	Wollongong Coal Ltd
Lot 1	DP 630761	Wollongong Coal Ltd
Lot 1	DP 986675	Wollongong Coal Ltd
Lot 1	DP 986676	Wollongong Coal Ltd
Lot 1	DP 534522	Wollongong Coal Ltd
Lot 95 to 96	DP 4414	Wollongong Coal Ltd
Lot 97	DP 4414	The Council of the City of Wollongong
Lots 1 to 4	DP 225021	Wollongong Coal Ltd
Lot 34	DP 751301	Wollongong Coal Ltd
Lot 6	DP 793358	Wollongong Coal Ltd
Lot 66	DP 751301	Wollongong Coal Ltd
Lot 67	DP 751301	Wollongong Coal Ltd
Lot 1	DP 652833	Wollongong Coal Ltd
Lot 6001	DP 1077301	Wollongong Coal Ltd
Lot 1	DP 77407	Wollongong Coal Ltd
Lot 1	DP 1052074	Wollongong Coal Ltd
Lot 2	DP 1052074	Wollongong Coal Ltd
Lot 151	DP 667029	Wollongong Coal Ltd
Part Lot 6000	DP 1077301	Illawarra Land Pty Ltd
Lot 6500	DP 1083715	Illawarra Land Pty Ltd
Lot 6502	DP 1083715	Ronald Edward Devitt & Jane Wilson
Part Lot 6501	DP 1083715	Barbara Jean Williams
Lot 12	DP 736121	Integral Energy Australia
Lot 32	DP 1138149	Sydney Catchment Authority

APPENDIX 2: PROJECT LAYOUT PLANS




300 000E
305 000E
6 200 000N
6 195 000N
CATARACT RIVER
WONGA MAINS 2
Water Supply Reserve
Illawarra Escarpment Conservation Area
N
LW11
LW10
LW9
Cataract Creek
WONGA MAINS
Mount Ousley Road
PRINCES HIGHWAY
Rail Line
TASMAN SEA
LW7
LW6
LW5
LW4
LW3
LW2
LW1
Timber Reserve
Northern Distributer
WOLLONGONG
Illawarra Escarpment Conservation Area
Legend
Project Application Boundary
Approved Mine Operations
PPR Mine Plan
Rail line
Major Roads
Waterways
DATUM: GDA 94
Zone : 56
0
1km
Horizontal Scale
HB 1407 018 RVC2 - PPR Project Layout.dwg
Hansen Bailey
ENVIRONMENTAL CONSULTANTS
WOLLONGONG COAL
RUSSELL VALE COLLIERY
PPR Project Layout
Filename : HB 1407 018 RVC2 - PPR Project Layout.dwg
Date : 27-Mar-14
Projection: MGA 56
Drawn : NM
Revision : A
Figure
1

Pit Top Surface Facility

APPENDIX 3: STATEMENT OF COMMITMENTS

Additional SoC's from the Response to PAC Report Parts 1 and 2 are shown in **bold**.

Ref	Commitment
General	
1.	WCL will conduct regular community consultation and provide updates to the community during operation of the UEP.
2.	WCL will regularly review and revise (if necessary) the existing Environmental Management System and its supporting management plans and procedures. This will be undertaken in consultation with relevant regulators.
3.	The existing Environmental Monitoring Program shall be revised and updated in consultation with relevant regulators in consideration of operations and impacts. The monitoring program will be included in Extraction Plans.
4.	WCL will provide regular and relevant training to all employees and contractors to ensure that environmental outcomes are achieved.
5.	WCL will continue to coordinate the Community Consultative Committee for the Russell Vale Colliery.
6.	All environmental management and monitoring outcomes will be reported in an Annual Review.
7.	**Consult with the IRAP (or equivalent expert panel) during the development of management plans (following approval of the Project).**
Subsidence	
8.	Establish a technical committee comprising representatives from Wollongong Coal, the power utility company and government regulators to monitor and manage potential impacts of mining on the power transmission towers.
9.	All secondary workings will be undertaken in accordance with approved Extraction Plans developed in consultation with relevant regulatory authorities and infrastructure owners.
10.	The Extraction Plan will include Trigger Action Response Plans (TARPs) to allow WCL to respond to impacts as they arise and to facilitate adaptive management over the life of the Project. TARPs will be developed for built features and natural features.
11.	The Extraction Plan will include a protocol for monitoring of subsidence effects. Monitoring will be conducted before, during and after secondary extraction.
12.	If necessary, adaptive management measures will be undertaken to reduce impacts on Cataract Creek and swamps of special significance. Adaptive management measures will determined in consultation with relevant regulators.
13.	**If required by the DSC, the panel length of LW 7 will be truncated if the Corrimal Fault is intersected during the development of the gateroads for LW 7.**
14.	**Undertake inspections of the Bulli Seam workings overlying LW 7 to confirm the accuracy of the record tracings (subject to the ability to safely access these workings).**
15.	**Conduct drilling of underground exploration boreholes where necessary to confirm the accuracy of the record tracings for the Bulli Seam workings overlying LW 7.**
Water	
16.	WCL will revise the Water Management Plan (including a TARP and water monitoring program) in consultation with the relevant regulators.
17.	WCL will revise the existing water monitoring program in consultation with the relevant authorities. This will include monitoring of streams, swamps and groundwater systems.
18.	Monitoring of stream flows will be conducted to determine the potential for connectivity of surface water and groundwater systems.

Ref	Commitment
19.	To assess mine water make, WCL will continue to monitor volumes of water pumped into and out of the underground mine workings.
20.	WCL will continue to treat stormwater and mine water prior to discharge via LDP2. Treated water will continue to be discharged to Bellambi Creek in accordance with WCL's EPL.
21.	An Erosion and Sediment Control Plan will be implemented during construction activities at the Russell Vale Site.
22.	WCL will obtain and hold water licences as required.
23.	**Undertake detailed design of the dry sediment dam to ensure that there is sufficient treatment capacity.**
Air Quality and Greenhouse Gas	
24.	WCL will review and revise the existing Air Quality Management Plan in consultation with the relevant authorities. The Plan will include feasible and reasonable air quality controls.
25.	The existing air quality monitoring network will be reviewed.
26.	**Implement the following dust mitigation measures:** • **Trial the use of chemical wetting agents on unsealed roads and stockpiles, and report the results of the trial in the Annual Review;** • **Sealing of the proposed haul road circuit to and from the truck loading bins; and** • **Install water sprays on the tripper gantries.**
27.	**Regularly report on the:** • **Annual average and 24 hour average PM_{10} criteria;** • **Annual average and 24 hour average $PM_{2.5}$ criteria; and** • **Adaptive management and ongoing improvements implemented to reduce dust emissions throughout the reporting period.**
Acoustics	
28.	WCL will review and revise the existing Noise Management Plan in consultation with the relevant authorities. The Plan will include feasible and reasonable noise controls.
29.	The environmental monitoring program will include continuous monitoring of operational noise, including attended monitoring of road traffic noise.
30.	Construction activities will be limited to between 7 am to 6 pm on weekdays and 8 am to 1 pm on Saturdays.
31.	The site noise model will be revised (in consultation with relevant regulators) once site specific sound power levels have been measured after construction and commissioning.
32.	**Implement the following noise mitigation measures:** • **Fitting surface conveyors with poly rollers (with the exception of high wear sections) prior to the commencement of coal extraction;** • **Maintain a volume of coal in bins at all times to minimise noise;** • **Undertake a trial to determine the efficiency of tripper automation to reduce noise produced by falling material; and** • **Undertake real time noise monitoring to confirm if any noise barriers (as shown on Figure 7-7 of the 'Response to Noise Issues Raised by the PAC' (Wilkinson Murray, July 2015) provide a net benefit to neighbours.**
33.	**Any large scale construction activity will include a noise management plan prepared in accordance with DECCW's Interim Construction Noise Guidelines.**
34.	**Any new machinery bought onto site will have non-tonal reverse alarms fitted.**
35.	**Any new loaders and dozers used on site will be fitted with noise attenuation prior to use on site.**
Biodiversity	

Ref	Commitment
36.	The existing Biodiversity Management Plan (BMP) will be reviewed and revised in consultation with the relevant authorities.
37.	Monitoring of the swamps will be undertaken in consultation with relevant regulators in accordance with the BMP.
38.	**WCL will install a number of additional shallow groundwater piezometers in all upland swamps within 400 m of the longwalls (secondary extraction). This will include the installation of approximately 30 additional shallow groundwater piezometers. Where feasible, this will include the installation of open standpipes or shallow groundwater piezometers around upland swamps CCUS1 and CRUS3 to assess the inflow to these upland swamps from surrounding surficial and shallow groundwater aquifers. Installation will be subject to further consultation and approval by relevant regulators.**
39.	**WCL will implement offsets for impacts to swamps in accordance with the final Swamp Offset Policy (with precedent given to conditions of Project Approval).**
40.	**Where offsets for impacts to swamps are required, WCL will endeavour to preferentially locate offsets within the local catchment the swamps were located.**
Heritage	
41.	A Heritage Management Plan (HMP) will be developed in consultation with the relevant authorities and Aboriginal stakeholders. The Plan will include management strategies for identified Aboriginal items.
42.	Photographic recordings of the existing site will be conducted prior to the proposed infrastructure upgrades. Moveable items of heritage significance will be documented, collated and catalogued. All recording work will be conducted to Heritage Archival Recording standards.
Visual and Lighting	
43.	Colour treatments for surface facilities will minimise visual contrast with the surrounding environment.
44.	Lighting will be directed away from nearby residences through the use of directional lightning and shielding.
Waste	
45.	The existing Waste Management System will be reviewed and revised (if necessary) to promote waste avoidance and resource recovery.
Hazards & Roads	
46.	To protect public safety, WCL will continue to manage public access to the site using boundary fences, warning signs, surveillance and security personnel.
47.	A driver code of conduct will be enforced to avoid risks to public safety arising from coal transportation including complying with the 60 km/hr speed limit along Bellambi Lane.
48.	**Consult with Wollongong City Council regarding WCL's contribution to the maintenance of Bellambi Lane.**
Rehabilitation and Mine Closure	
49.	A Mine Closure Plan will be developed in consultation with the relevant authorities. The mine closure strategy will consider previous land uses, land zonings and potential uses for the existing infrastructure at the site.
50.	Areas that are no longer required for operations will be progressively rehabilitated.

APPENDIX 4: RECEIVER LOCATION PLAN

APPENDIX 5
NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in Table 3 of Schedule 4 are to apply under all meteorological conditions except the following:
   (a) wind speeds greater than 3 m/s at 10 metres above ground level; or
   (b) stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
   (c) stability category G temperature inversion conditions.

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be that recorded by the meteorological station located on the site.

Compliance Monitoring

3. Attended monitoring is to be used to evaluate compliance with the relevant conditions of this approval.

4. This monitoring must be carried out at least 4 times a year, unless the Secretary directs otherwise.

5. Unless otherwise agreed with the Secretary, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the *NSW Industrial Noise Policy* (as amended from time to time), in particular the requirements relating to:
   (a) monitoring locations for the collection of representative noise data;
   (b) meteorological conditions during which collection of noise data is not appropriate;
   (c) equipment used to collect noise data, and conformance with Australian Standards relevant to such equipment; and
   (d) modifications to noise data collected, including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.

APPENDIX 6: ABORIGINAL HERITAGE SITES

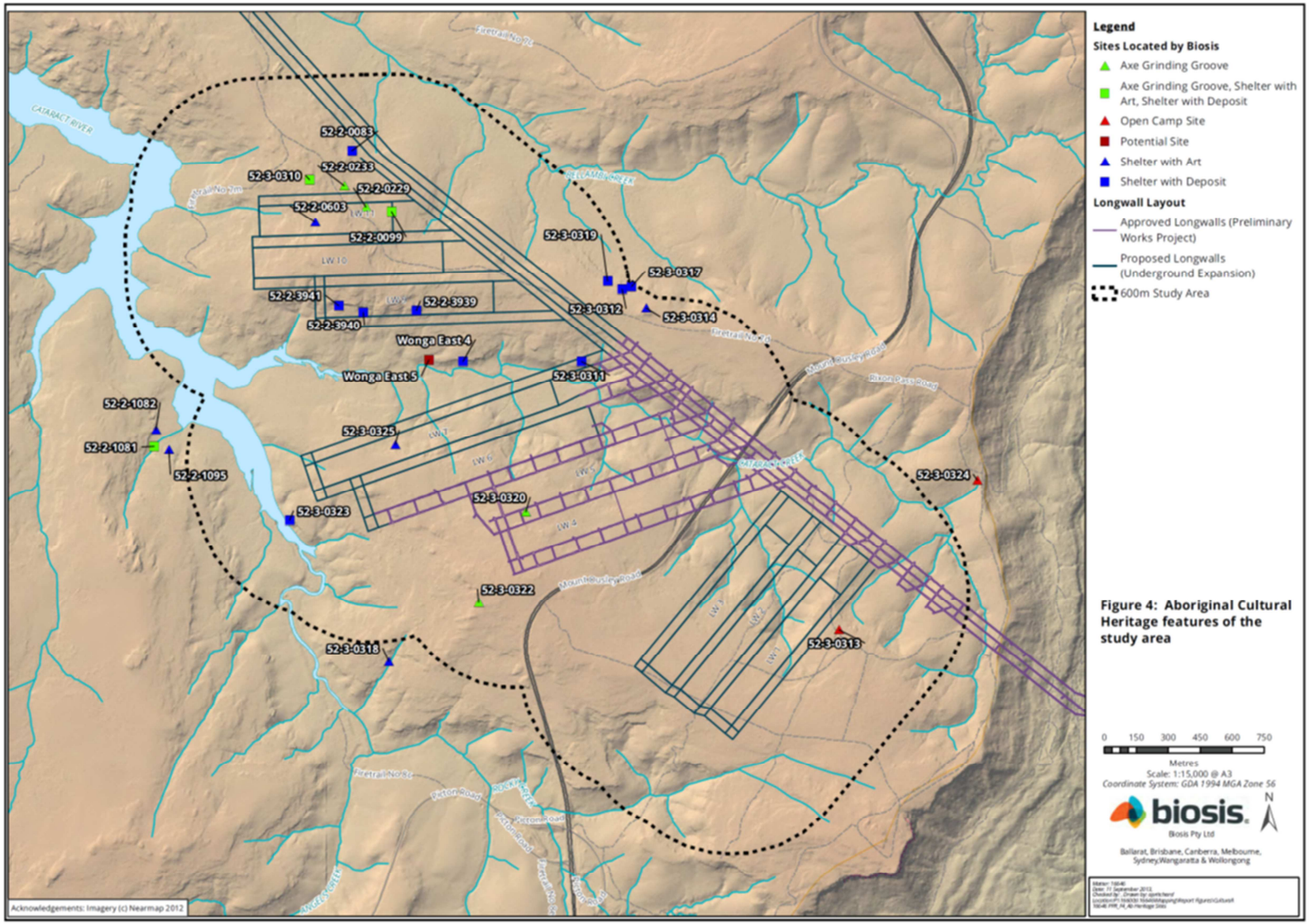
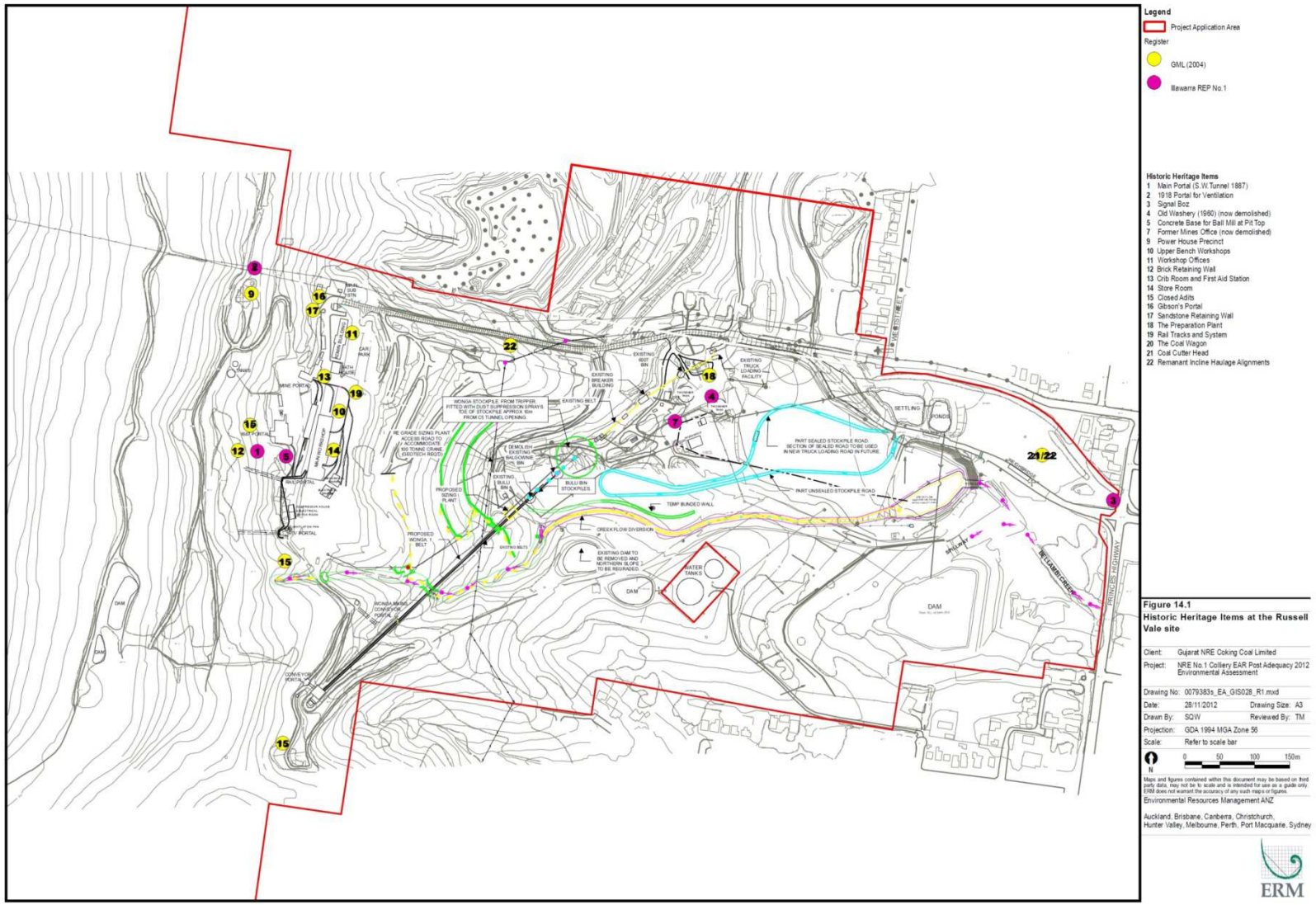


Figure 4: Aboriginal Cultural Heritage features of the study area

APPENDIX 7: CULTURAL HERITAGE SITES



NSW GOVERNMENT | Planning Assessment Commission

Ms Carolyn McNally
Secretary
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

15 January 2016

Dear Ms McNally

Subject: Timeframe for PAC Second Review of the Russell Vale Colliery Underground Expansion Project, Wollongong and Wollondilly LGAs

I refer to the Minister's request to the Planning Assessment Commission, to review the above project, my previous letter of 11 December 2016 regarding the need for some additional time to complete the review and your Department's response granting an extension until Friday 15 January 2016.

The Commission is progressing with its review as quickly as possible, although this has been hampered by the availability of people over the holiday period. This week the Commission met with the NSW Office of Environment and Heritage and separately with the subsidence and groundwater experts it has engaged, Emeritus Professor Jim Galvin and Dr Colin Mackie.

The Commission, together with the subsidence and groundwater experts, is working to resolve the outstanding questions that remain. Doing this now as part of the review, with the expertise available to the Commission, seems a logical and efficient way to progress the assessment of the matter.

The Commission is intending to provide some further questions to the Proponent and will be seeking a written response as well as a further meeting with the Proponent, in late January, to work through any outstanding issues of contention. Expert reports from E/Prof Galvin and Dr Mackie are then expected to be provided in the first weeks of February 2016. The Commission will then finalise its review and provide its report. The Commission expects the review will be completed before the end of February 2016, and as always, it will be working as quickly and efficiently as possible and will deliver its report sooner, if possible.

I trust this arrangement is acceptable to you. Should your Department have any questions, I have arranged for Ms Megan Webb or Ms Catherine Van Laeren of the Commission Secretariat to assist, on 9383 2113 or 9383 2102.

Yours sincerely

Joe Woodward

Mr Joe Woodward PSM
Member,
Planning Assessment Commission

COMMISSION SECRETARIAT
Level 13, 301 George Street SYDNEY, NSW 2000
GPO BOX 3415, SYDNEY, NSW 2001
TELEPHONE (02) 9383 2100 FAX (02) 9299 9835
pac@pac.nsw.gov.au

NSW GOVERNMENT | Planning Assessment Commission

Contact: Megan Webb
Phone: 02 9383 2113
Fax: 02 9299 9835
Email: megan.webb@planning.nsw.gov.au

David Clarkson
Group Environment Manager
Wollongong Coal Ltd
PO Box 281
FAIRY MEADOW NSW 2519

15 January 2016

Dear Mr Clarkson

Subject: Russell Vale Underground Expansion Project, request for clarification and site inspection

Thank you for the latest documents, dated 18 December 2015, provided in response to the Public Hearing. As you are aware, the Commission has engaged E/Prof Jim Galvin and Dr Colin Mackie to review the latest subsidence and groundwater predictions. As part of this review, the two experts have identified a number of questions and are seeking some clarification on these. Questions on subsidence and regarding options to avoid or minimise impacts to Swamp CCUS4 are attached. Questions about groundwater are currently being drafted and will be provided to you on Monday morning.

The Commission would appreciate a written response on these issues. It would also like to arrange a site inspection (of relevant areas of the catchment) and a meeting to further discuss any outstanding questions with the relevant subsidence and groundwater consultants. The Commission proposes that E/Prof Galvin and Dr Mackie will accompany it, attending both the inspection and meeting. This is proposed to occur on Thursday 28 January 2016.

To arrange the site inspection and meeting, or should you have any questions, please contact Megan Webb or Catherine Van Laeren of the Commission Secretariat on (02) 9383 2113 or (02) 9383 2102.

Yours sincerely

Joe Woodward PSM
Member
NSW Planning Assessment Commission

POINTS OF CLARIFICATION

Russell Vale Colliery Underground Expansion Project

1. Height of depressurisation

Please clarify the approach being adopted to predicting the height of depressurisation. Please include a consideration of the following matters and questions in the clarification.

i. Galvin & Associates review of 3/3/15 undertaken for the PAC questioned the reliance placed in the EA on the Tammetta prediction methodology and expressed and, based on the information reviewed, questioned the confidence that can be placed in the height of depressurisation not reaching the surface.

ii. SCT Report No. WCRV 4440 (12/8/15) states that:

'based on SCT's experience of monitoring groundwater depressurisation directly above extracted longwall panels at multiple sites, the [Tammetta] approach appears to give a very reasonable estimate of the height of depressurisation. The outcome is not surprising given the Tammetta approach is derived from a broad database of hydrogeological experience in single seam mining situations...

.....A key point, however, is that the Tammetta approach is likely to provide a lower limit on the height of depressurisation given that the presence of multi-seam mining is expected to increase the height of depressurisation compared to an equivalent single seam situation.'

Q. What is the upper limit and how is this determined?

iii. GeoTerra/GES 2014 utilised a modified Tammetta equation based on single seam extraction to estimate the height of depressurisation.

iv. GeoTerra/GES Report No. NRE12 – RIB (September 2015) reports that:

'Two empirical based methods for the height of fracturing (Tammetta, 2012) as well as Ditton and Merrick (2014), and by association, the height of groundwater depressurisation, have been proposed using the height of single seam longwall extraction, width of extraction and the depth of cover(as well as a geological factor in Ditton and Merrick (2014) over the centre of single seam longwall panels.

No reliable comparison between the theoretically predicted and observed Russell Vale East in-situ height of depressurisation was able to be established from VWP data over the Russell Vale East multiple seam workings...

Neither of the two theoretical approaches are applicable to the Russell Vale East triple seam extraction environment...'

The modellers appear to have addressed this situation by developing a conceptual model of caving and fracturing and by developing a new function for calibrating their model to piezometer data.

Q. What is the level of confidence, or risk, associated with the reliability of this alternative approach?

Q. Why was the height of the caved zone increased in areas of multi-seam mining when subsidence behaviour suggests that minimal additional voids result from the extraction of second and subsequent seams that are in close proximity (that is, incremental subsidence approximates the extracted height of second and subsequent seams)?

v. OEH Preliminary Comments on Russell Vale UEP Risk Assessment – email of 2 September 2015.

Q. Please address matters raised in the following extract.

- SCT (2015; Ken Mills) has stated *"based on SCT's experience of monitoring groundwater depressurisation directly above extracted longwall panels at multiple sites, the* [Tammetta] *approach appears to give a very reasonable estimate of the height of depressurisation. This outcome is not surprising given the Tammetta approach is derived from a broad database of hydrogeological experience in single seam mining situations. At Russell Vale East, the Tammetta approach is not so applicable because of the multi-seam interactions that may be occurring. A key point however, is that the Tammetta approach is likely to provide a lower limit on the height of depressurisation given that the presence of multi-seam mining is expected to increase the height of depressurisation compared to an equivalent single seam situation"*

  Tammetta (Coffey 2013 GEOTLCOV24840AA-AB) has already assessed the potential for depressurisation (surface to seam connective fracturing) above the earlier Russell Vale East proposal (the mine layout hasn't really changed all that much compared to what is currently proposed and predicted subsidence is still very similar) indicating that the height of depressurisation was predicted to extend to the surface over many areas of the proposed mine plan. Tammetta (Coffey 2013 GEOTLCOV24840AA-AB) concluded that *"Figure 9 shows the protrusion of the interpreted potential drainage thickness above ground surface for Wonga East. Outlines of significant swamps are also shown. Complete drainage is calculated to occur over parts of LW3 to LW8."*

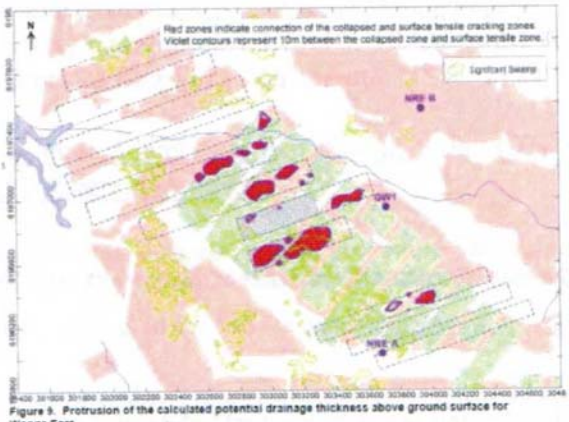


Figure 9. Protrusion of the calculated potential drainage thickness above ground surface for Wonga East.

"A serious risk to Cataract Creek is present in the area where Cataract Creek, Balgownie LW11, a Bulli pillar extraction block, and Wongawilli panels LW7 and LW8 coincide (see Figures 9 and 1a). The interpretation indicates that the collapsed zone and surface tensile fracturing zones will connect in this area, and lead to creek drainage into the mined void. The calculated baseflow of Cataract Creek is 11.7 ML/day (see above), which is 6% of the average water volume generated by Lake Cataract between 2006 and 2012 (from the SCA water balance reports web page)."

Continues over page

- If Tammetta's assessment of depressurisation is likely to underestimate the degree of depressurisation due to the presence of **multi-seam mining which is expected to increase the height of depressurisation compared to an equivalent single seam situation** (SCT 2015), then the UEP risk assessment is clearly out of step with statements and predictions from their own subsidence engineer, Coffey 2013 and the IESC.

2. Cracking of Cataract Creek

i. Response to Planning Assessment Commission Review report – Part 2, page 26 re:

'The main channel of Cataract Creek is hosted sequentially downstream within the Hawkesbury Sandstone, Newport and Garie Formation, Bald Hill Claystone and Bulgo Sandstone. The Newport and Garie Formations, Bald Hill Claystone and Bulgo Sandstone are more ductile than the Hawkesbury Sandstone.

Q. How was ductility determined?

Q. What are the respective ductility values?

3. Pillar Stability Inbye of Longwall 7

i. The Independent Risk Assessment Panel has raised the reliability of mine plans in the Bulli Seam workings at the start of Longwall 7. SCT letter report of 12 September 2015 (Appendix G of part 2 of Response to Planning Assessment Review Report) presents a number of factors that might give confidence in the accuracy of the mine plans.

Comment: It is a fundamental principle in mine management, unfortunately borne out by incidents, to never, ever, trust a mine plan, even of areas only recently mined. There are numerous examples of inaccurate recording of mine workings driven in NSW in the last two decades. Unless entry can be safely obtained to the old workings, it can be very difficult from a technical perspective and expensive and time consuming to remotely verify the degree of reliability of old mine plans.

Q. What contingency is proposed in the event that the reliability of the record tracing cannot be determined?

ii. SCT Report No. WCRV 4440 (12/8/15) addresses pillar stability on the basis of an *averaged size pillars with a nominal geometry of 22 m by 33 m, a roadway width of 6 m and a pillar height of 2.2 m.* As the Independent Risk Assessment Panel has identified, some pillars are a narrow as 12 m. The irregular pillar size and the presence of abutment stress associated with adjacent pillar extraction workings is likely to result in irregular pillar load throughout the workings. Furthermore, it is noted that many of the smaller pillars in the panel abut against a goaf edge.

Q. What are the implications of this situation on the likelihood of pillar failure?

Q. What are the implications if, as in the extreme case of Crandall Canyon pillar failure, failed coal has a much lower void content than 50% assumed in the SCT analysis?

4. Options to avoid or minimise impacts to Swamp CCUS4

The Risk Assessment has identified a high risk of impacts to Swamp CCUS4. Avoidance of longwall mining beneath this swamp does not appear to have been considered.

Q. What are the implications for Swamp CCUS4, both positive and negative, of not mining the (approximately 300m) section of longwall 6 below the swamp?

Q. The Commission understands that the first 365 m of Longwall 6 were mined in 2015, what impact has this had on Swamp CCUS4 to date?

QUESTIONS RELATING TO GROUNDWATER – January 2016

RUSSELL VALE PROJECT

Model related questions arising from the review to-date are as follows:

Comment 1 – Model layers 1 to 15 have been treated as variably unconfined (laycon=43) while model layers 16 through 19 have been installed as strictly confined (laycon=40). Layer 17 is the Wongawilli seam which is the target seam for extraction while layer 16 is overburden which will freely drain to layer 17. Conversion to confined/unconfined will affect the depressurisation of layers 16 through 19 and the volume of water reporting to the proposed mine.

Question 1: Why are the Wongawilli seam and the overlying layer treated as strictly confined layers where drainable porosity is not taken into account when it is expected that the mined seam and the overlying strata will be completely dewatered during mining? What are the implications for model calibration?

Comment 2 – The Wongawilli seam is designed to dewater in the model through the use of drain cells. The seam is 10 m thick and it is stated in the report that the bottom 3m section of the seam is the intended working section but the top section has been simulated in the model by assigning the drainage elevation to 5 m above the floor (contrary to 0.1 m stated in the report). Changing the drain cell elevations to represent the working section at the lower elevation will affect the depressurisation of layers 16 through 19 and the volume of water reporting to the proposed mine plan.

Question 2: Why has the upper section of the Wongawilli seam been represented as the working section? What are the implications for model calibration?

Comment 3 – Hydraulic conductivities within the subsidence zone have been enhanced during the model simulation period to account for bed separation (Kh) and vertical fracturing (Kv). Post subsidence horizontal conductivities (Kh) have been changed by applying a scaling factor of 2 to all layers while vertical conductivities have widely varying scaling factors. Considering Kh, a normal approach would establish the likely apertures of horizontal fractures and then determine the enhanced conductivity for specific layers as a porous media equivalent. A scaling factor would then be calculated from the pre and post subsidence values. Adopting a scaling factor of 2 for all layers seems to be largely conjectural.

Question 3: How was the scaling factor for Kh determined? Given the significant influence of the enhanced material properties on the groundwater systems, what are the likely implications for model calibration and model outcomes if an equivalent porous media approach was adopted?

Comment 4 – The subsidence zone (including the cave zone) have been represented using the TMP package available within Modflow Surfact. This package facilitates a temporal change in material properties at nominated times during a simulation. Inspection of the relevant data file reveals the hydraulic conductivities (Kh, Kv) and specific yield (Sy) are changed at the commencement of certain stress periods that align with panel extraction. However changes appear to be applied without consideration of the manner in which the model code treats these changes. Specifically, if increases are applied at the start of a stress period, then a linear interpolation is applied from the start of the stress period to the next nominated time which by inspection of the data files is commonly the start of the next stress period. This means that for Kh and Kv, full upscaling is achieved only by the end of the stress period. It also means that upscaling of Sy is occurring before the targeted model cells are dewatered thus artificially introducing water into the model.

Question 4: Can the proponent provide an explanation as to why the scaling was applied over a stress period and to what extent the modified porosity has affected the estimated mine water influx ? What are the implications for model calibration and the volumetric balance?

Comment 5 – General head boundary conditions have been employed along the active model perimeter. These conditions support a head/flux relationship that can control depressurisation by introducing or removing groundwater from the model.

Question 5: How were the heads and conductance terms determined for individual cells?

Comment 6 – Model layers 1 to 10 appear to have the same or very similar values of drainable porosity (1%) even though the lithologies vary from sandstone to claystone and the hydraulic conductivities vary over several orders of magnitude.

Question 6: Can the proponent provide an explanation for the adoption of similar values for widely differing lithologies?

Comment 7 – It has not been possible to replicate the mine water inflows provided in Figure 84 of Appendix H[1] from the cell by cell flow data file provided by the proponent.

Question 7 – How were the mine water influx estimates derived ?

Comment 8 – The reported mine water influx estimates have been generated at the end of each stress period with stress periods varying from 30 to 184 days duration. Capturing the influx at the end of stress periods overlooks higher rates associated with higher pressure heads that will occur at the start of stress periods. Consequently there is a high probability that the reported (and calibrated) mine water influx rates are incorrect. Model output needs to also capture influx at early times in a stress period (say 1, 3, 9, 27 and 81 days) in order to derive reasonably accurate influx rates[2].

Question 8 – Were influx estimates only captured at the end of stress periods? If so, what are the implications for model calibration?

Comment 9 – There are extensive areas surrounding the proposed longwall extractions that are depressurised from surface to seam before the commencement of mining. This is particularly evident from the verrtical sections provided as Figures 33 and 34 where complete dewatering (zero or negative pore pressures) in all layers from surface down to layer 15, extends from the coastal escarpment inland for distances of more than 1 kilometre. Figure 76 also suggests dewatering of the Wongawilli seam over large areas of the model before the commencement of mining.

Question 9 – What is the cause of this regionally extensive complete loss of pore pressure and what field observations support this?

General questions associated with studies supporting the modelling effort:

Comment 10 – Section 8.3 provides a summary of observed piezometric elevations in boreholes equipped with vibrating wire pore pressure transducers. These transducer arrays facilitate determination of hydraulic gradients that are associated with strata depressurisation. The following Table provides a summary of statements regarding depressurisation:

Report	Piezometer	Report statement (Proponent)	Review comment
Section 8.3.1	GW1	The height of depressurisation lies between 140 and 165 mbgl.	Fig. 15 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer, suggesting measurable depressurisation extends upwards to 18 mbgl

[1] see GeoTerra, GES Appendix H, Russell Vale East Revised Groundwater Assessment, September 2015, page 112

[2] See Mackie, 2014. Post processing of zone budgets to generate improved groundwater influx estimates associated with longwall mining. Ground Water Journal Vol.52 Issue 4

Section 8.3.2	RV20	The height of depressurisation … lies between 105 and 134 mbgl.	Fig. 16 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer suggesting measurable depressurisation extends upwards to 35 mbgl
Section 8.3.3	RV17	The height of depressurisation … has not been identified as the drill hole was not deep enough ..	Fig. 17 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer suggesting measurable depressurisation extends upwards to 20 mbgl
Section 8.3.5	RV16	The height of depressurisation … lies between 197 and 242 mbgl.	Fig. 19 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer suggesting measurable depressurisation extends upwards to 21.8 mbgl
Section 8.3.6	NRE B	The bore does not extend deep enough to assess the height of depressurisation…..	Fig. 20 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer suggesting measurable depressurisation extends upwards to 27.5 mbgl
Section 8.3.6	RV23	The height of depressurisation … lies between 197 and 242 mbgl.	Fig. 22 supports a vertical hydraulic gradient from the shallowest to the deepest piezometer suggesting measurable depressurisation extends upwards to 90 mbgl

Vertical hydraulic gradients are present in all of the above noted piezometers. These gradients support a downwards flow regime.

Question 10 – Are there any factors other than mining that would generate the observed hydraulic gradients?

Comment 11 – Piezometer RV20 is situated above longwall 5 where triple seam extraction has occurred. It is stated that 'The pressure profile indicates that the vertical flow rate is likely to be enhanced at this location'.

Question 11 - How does the pressure profile indicate enhancement and what is the enhanced vertical flow rate?

Comment 12 – The mean annual pan evaporation rate is stated to be 1420 mm/annum.. Normally the pan rate is multiplied by a (crop) factor to establish field estimates of actual evaporation. The factor is typically 0.7 to 0.8, yielding field evaporation rates of 994 to 1136 mm/annum. The model adopts a value of 1825 mm/annum to control groundwater levels[3] and groundwater recharge to the model.

Question 12 – Why has the rate of 1825 mm/annum been adopted rather than the much lower rates? What are the implications in respect of model calibration and model outcomes?

[3] see GeoTerra, GES Appendix H, Russell Vale East Revised Groundwater Assessment, September 2015, page 12

27 January 2016

GeoTerra

Wollongong Coal Ltd
PO Box 281
Fairy Meadow NSW 2519

Attention: Dave Clarkson

Dave,

RE: Russell Vale Colliery – Underground Expansion Project Planning Assessment Commission – January 2016 – Response to Questions

Please find enclosed our ***DRAFT*** response to selected questions that were provided by the January 2016 PAC review.

Q10 - Are there any factors other than mining that would generate the observed hydraulic gradients?
A10 – There are no other factors that would generate the hydraulic gradients observed within the Study Area. The overburden has been significantly depressurised as a result of coal extraction in up to 3 seams and the associated overburden subsidence fracturing and delamination above past workings in the Balgownie, Bulli and Wongawilli Seams at Russell Vale Colliery.

The phreatic surface within the overburden strata above the mining area is significantly below the level of the Cataract River and Cataract Creek. The only credible gradient is downward toward the mining horizons.

The depressurisation also extends over a significant regional extent associated with extraction in adjoining mines within the Bulli Seam to the east, south and north of Russell Vale Colliery.

GeoTerra PTY LTD ABN 82 117 674 941
Suite 204, 1 Erskineville Road, NSW
PO Box 530 Newtown NSW 2042
Phone: 02 9519 2190 Mobile 0417 003 502 Email: geoterra@iinet.net.au

Q11 - How does the pressure profile indicate enhancement and what is the enhanced vertical flow?

A11 – RV20 is a borehole located over Longwall 4 in an area where triple seam mining has caused significant strata fracturing, delamination and associated groundwater depressurisation. The head vs depth pressure profile of the piezometric array shown below indicates that all the strata from 35 – 65m below surface in the Hawkesbury Sandstone and then from 65- 85 m in the Bald Hill Claystone is highly depressurised. There is evidence of a head pressure rise at 105 mbgl in the top of the Bulgo Sandstone. However, the piezometer at 134 mbgl in the Bulgo Sandstone is depressurised as shown in **Figure 1**.

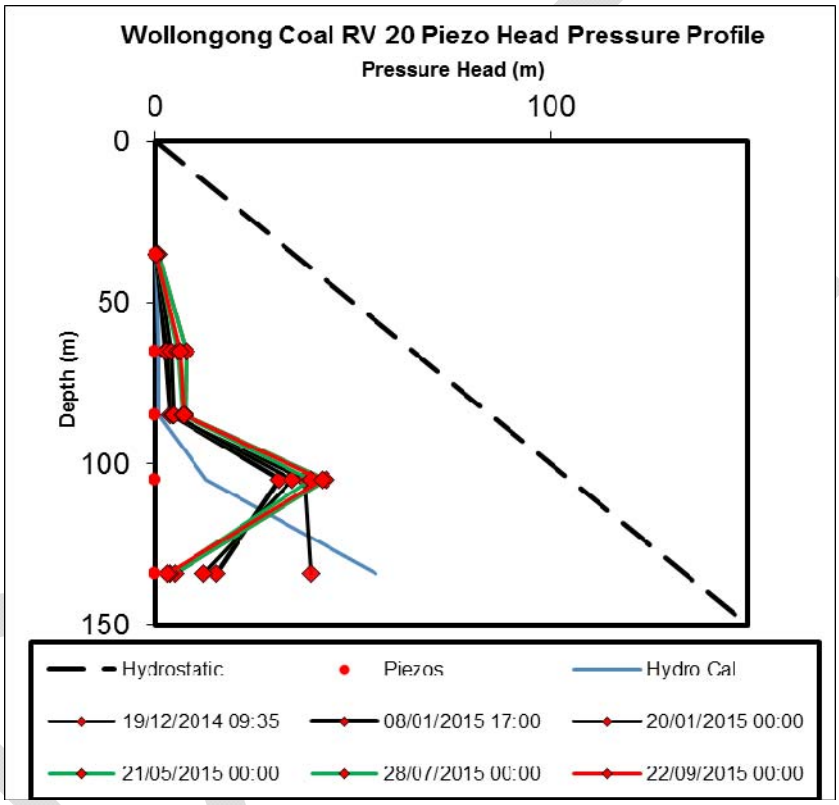


Figure 1 RV20 Pressure Head vs Depth Profile

The enhanced vertical flow rate, in terms of hydraulic conductivity, has not been directly measured, however the quantum of inflow into the underground workings is separated into inflows into Longwalls 4 and 5 and these inflows are consistent with downward flow through the overburden strata via a tortuous fracture network. The non-hydrostatic nature of the piezometric profile indicates the tortuous / discontinuous nature of the fracture network.

Q13 – What is the upper limit (of the height of depressurisation) and how is this determined?
A13 – The maximum height of depressurisation was derived based on vibrating wire piezometer (VWP) data over the various workings at Russell Vale Colliery. The maximum height of depressurisation varies depending on whether there has been 1, 2 or 3 phases of seam extraction, and on the interaction of the various adjoining mines, overlying fracture networks and strata delamination that has occurred as a result of mine subsidence.

The greatest height of strata depressurisation measured within the Russell Vale Colliery VWP network is within RV20, which is within a triple seam mined area overlying Longwall 4 in the Wongawilli Seam. At this location, the height of depressurisation extends to between 105mbgl and 134mbgl (approximately 220-240 m above the mining horizon), with a perched horizon that maintains up to about 40 m of head as represented by the 105mbgl VWP intake. The low piezometric heads measured above the 105mbgl VWP at the 35, 65 and 85mbgl VWPs indicate this zone is highly fractured and hydraulically connected and does not support a positive piezometric profile.

The height of depressurisation calculated using Tammetta (2012) is 148m for the Wongawilli Seam alone, assuming a 3.2 m mining height and 150 m wide panel at 350 m depth. The calculated height of depressurisation for all three seams is 290 - 340 m, assuming an equivalent seam thickness of 5.4 - 5.8 m.

The measured height of depressurisation (220 - 240 m) used in the model is significantly greater than the calculated values for mining the Wongawilli Seam alone, but less than the calculated value for the combined height of mining all three seams. The Tammetta equation is intended for single seam mining only, but the measured values are consistent with the range that would be expected.

Q14 – What is the level of confidence, or risk, associated with the reliability of this alternative approach?
A14 – The conceptual model of caving, fracturing and associated strata depressurisation used in the groundwater model was principally based on the observed VWP head versus pressure data within the Russell Vale Colliery overburden.

The relevant site data was initially incorporated into the Tammetta (2012) strata fracturing / strata depressurisation theory that was developed for single seam mining over an extracted longwall panel. However, the derived theoretical values did not correlate with the observed in-situ VWP depressurisation profile/s.

Where multiple seam extraction was conducted, the Tammetta (2012) theory was then modified by adding the cumulative thickness of all workings. This approach overestimated the height of depressurisation measured by the piezometers.

Subsequently, the Ditton and Merrick (2014) theory of strata fracturing / strata depressurisation (which was also developed for single seam mining over a longwall panel) was compared to the observed VWP data, and this theory also did not reliably predict the observed height of depressurisation using a RAMP function with a linear decline of enhanced vertical conductivity (weighted layer thickness) that did not match the observed groundwater pressures in the site VWPs, primarily in the Bulgo Sandstone.

As a result, the model utilised a modified version of a vertical conductivity RAMP function enhancement whereby a greater degree of enhancement was made within the Lower and Mid Bulgo Sandstone as shown in **Figure 2**.

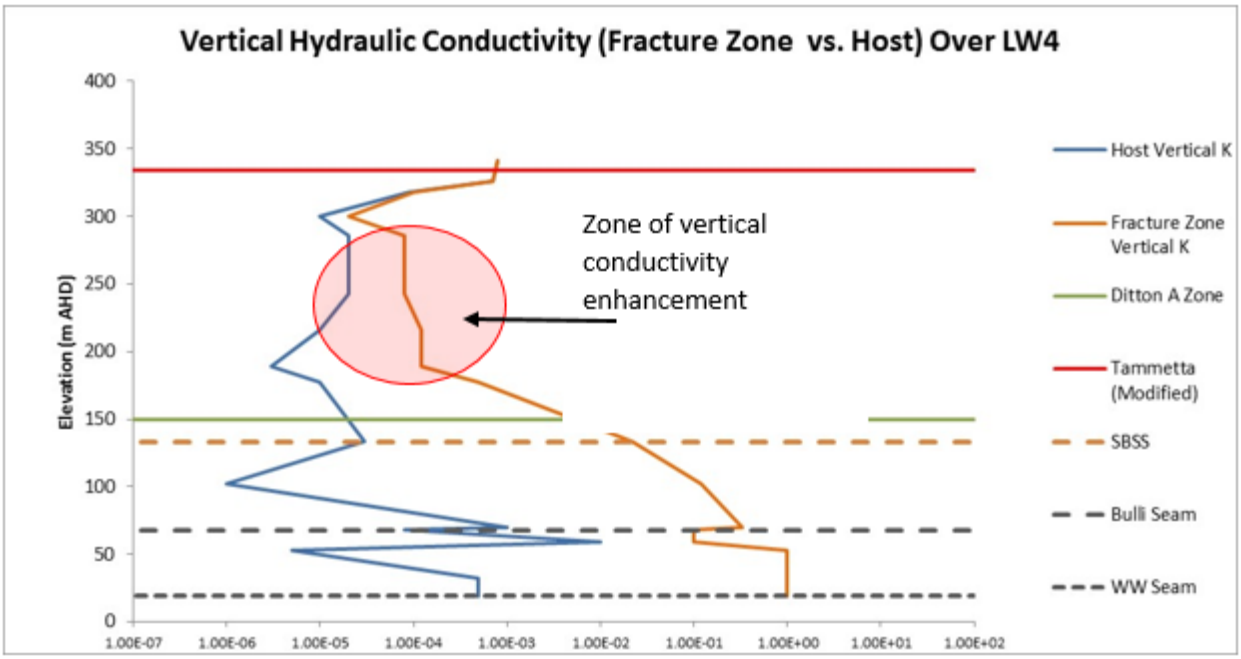


Figure 2 **Vertical Hydraulic Conductivity (Fracture Zone vs Host) Over LW4**

Q15 – Why was the height of the caved zone increased in areas of multi-seam mining when subsidence behaviour suggest that minimal additional voids result from extraction of second and subsequent seams that are in close proximity (that is, incremental subsidence approximates the extracted height of second and subsequent seams)

A15 – See response for A14.
In essence, the measured depressurisation from the suite of VWPs was used in the groundwater model set up and calibration, however they did not correlate well to the modified Tammetta (2012) (using cumulative seam thickness) theory, whilst the Ditton Merrick (2014) approach was less conservative and also was not used for this reason.

Q16
Paragraph 1 – (OEH comment – Tammetta equation provides a lower limit to prediction of the height of depressurisation)

Answer - see Q15 answer

Paragraph 2 – (OEH comment – height of depressurisation was predicted to extend to the surface over many areas)

Answer - surface to seam depressurisation was initially predicted over parts of LW3 – LW7 within the June 2014 Preferred Project groundwater modelling assessment (GeoTerra/ GES, 2014).

Following installation of the latest VWPs in July to December 2014 (RV16, 17, 22, 23, and particularly RV20) and subsequent detailed interpretation of the VWP steady state data, which was not available during the previous assessment, adherence to the previously modified (i.e., cumulative) Tammetta (2012) theory was assessed to be inappropriate.

The revised (GeoTerra / GES, 2015) groundwater report for the Preferred Project Report subsequently assessed that surface to seam depressurisation was not predicted to potentially occur at the end of the proposed mining of the Wongawilli Seam at Russell Vale East.

Depressurisation from surface to seam was predicted to occur in the southern tributary of Cataract Creek 100 years after mining Longwalls 1-3. The larger, northern tributary of Cataract Creek is not predicted by the groundwater model to experience surface to seam depressurisation.

The 2015 Integrated Risk Assessment concluded that due to the 700mm of closure predicted in the southern tributary of Cataract Creek over LW1-3 (SCT 2014) that the tributary would be potentially cracked, with potentially no connective overland flow over Longwalls 1-3. Therefore the underlying surface to seam strata depressurisation predicted by the groundwater model 100 years after completion of LWs 1 - 3 will have no additional detrimental effect on overland stream flow in the subsided and fractured tributary reach.

Although surface to seam depressurisation is predicted 100 years after cessation of mining over LWs 1-3, the actual annual flow loss from the stream in the latest version due to strata depressurisation, which incorporates the comments and model revisions provided in the January 2016 PAC suite of questions, is very low and is essentially indistinguishable from the previous (GeoTerra / GES, 2015) June 2015 assessment.

Depressurisation to surface is not predicted at the end of mining. However it is predicted to occur 100 years after mining to the east of Cataract Creek, adjacent

to, but not over, LW5. This is because the Hawkesbury Sandstone has been eroded through to the Bulgo Sandstone along this reach of the creek.
The predicted groundwater model stream baseflow losses associated with the potential surface to seam depressurisation adjacent to LW5 from Cataract Creek are XX ML/year and therefore not a significant proportion of total flows.

Paragraph 3 – (OEH comment) there is a serious risk to Cataract Creek from surface to seam hydraulic connection where Balgownie LW11, a Bulli Pillar extraction block and Wongawilli LW7 and LW8 coincide)

Answer – the assessment of potential areas of surface to seam depressurisation was based on a previous version of the groundwater modelling / reporting (GeoTerra / GES 2014) which utilised an analytical calculation of the revised (cumulative seam thickness) version of Tammetta (2012).

Subsequent to receipt, interpretation and incorporation in the study of additional VWP data after late 2014, and utilising a ramping depressurisation function in the (GeoTerra / GES, 2015) model, which was based on in-situ VWP pressure head distributions, the "risk" of the LW7 region in or near Cataract Creek depressurising to surface was no longer predicted. The potential risk of surface to seam depressurisation was present in GeoTerra / GES (2015), however, in a small area to the west of Cataract Creek and east of LW5, and over LWs1 -3 as explained in the previous (paragraph 2) answer.

Paragraph 4 – (OEH comment) Tammetta's assessment of depressurisation underestimates the potential depressurisation due to multi seam mining, therefore the UEP risk assessment is out of step with statements and predictions by SCT / Coffey / IESC.

Answer – As outlined above, the latest version (GeoTerra / GES 2015) moved away from using the modified (multi-seam cumulative extraction thickness) Tammetta (2012) approach as the current suite of VWP data does not support the Tammetta (2012) theory in the multi-seam extraction environment at Russell Vale Colliery.

The latest assessment (GeoTerra / GES, 2015), which has been collaboratively derived between GeoTerra, GES and SCT Operations, is in joint agreement.

References

Ditton, S Merrick, N., 2014 A New Subsurface Fracture Height Prediction Model for Longwall Mines in the NSW Coalfields. Geological Society of Australia, 2014 Australian Earth Sciences Convention (AESC), Sustainable Australia. Abstract No.03EGE-03 (p.136) of the 22nd Australian Geological Convention, Newcastle, NSW

GeoTerra / GES, 2014 Russell Vale Colliery Underground Expansion Project Preferred Project Report Wonga East Groundwater Assessment, June 2014

GeoTerra / GES, 2015 Russell Vale Colliery Underground Expansion Project Russell Vale East Revised Groundwater Assessment, September 2015

Hansen Bailey, 2015 Russell Vale Colliery Underground Expansion Project Independent Risk Assessment Panel – Risk Assessment Supporting Technical Information, September 2015

SCT 2014 Update of Subsidence Assessment for Wollongong Coal Preferred Project Report Russell Vale No 1 Colliery, June 2014

SCT 2015 Assessment of Corrimal Fault and Dyke D8 at Russell Vale East as Risks to the Stored Waters of Cataract Reservoir, August 2015

Tammetta. P, 2012 Estimation of the Height of Complete Groundwater Drainage Above Mined Longwall Panels. Groundwater - Vol. 51, No. 5. (pp/723–734)

WRM Water & Environment, 2014 Russell Vale Colliery Wonga East Underground Expansion Project Surface Water Modelling, May 2014

WRM Water & Environment, 2015 Russell Vale Colliery Underground Expansion Project Surface Water Modelling: Response to Planning Assessment Commission, August 2015

regards

GeoTerra Pty Ltd

Andrew Dawkins
Director (AuSIMM CP-Env)

Question 22

What are the implications for Swamp CCUS4, both positive and negative, of not mining (the approximately 300m) section of Longwall 6 below the swamp?

The risks to swamp CCUS4 were assessed in the Integrated Risk Assessment. Mining of Longwall 6 will generate strains that have the potential to result in fracturing of the underlying bedrock or the controlling rockbar. Such fracturing may result in impacts to the perched water table. The Tea-tree Thicket and Cyperoid Heath sub-communities, which are present within the central area of CCUS4, are reliant on near surface expression of the perched water table. Fracturing of the bedrock or controlling rockbar may result in transitioning from wetter sub-communities to drier sub-communities. At present, the majority of swamp CCUS4 consists of the Banksia Thicket sub-community, which is not reliant on the perched water table.

Avoidance of mining the section of Longwall 6 beneath swamp CCUS4 will reduce the magnitude of the strains that the swamp will experience. Although the swamp will experience some subsidence from mining of the adjacent longwall panels, the avoidance of mining directly beneath the swamp will reduce the risk of impacts to its ecological values. The cost of avoiding mining directly beneath swamp CCUS4 is the value of the coal foregone and the cost of relocating the longwall miner. The cost of this avoidance measure is estimated at $10M.

Question 23

The commission understands that the first 365m of Longwall 6 were mined in 2015, what impact has this had on swamp CCUS4 to date?

To date, WCL has mined the first 340 m of Longwall 6. WCL has installed four piezometers in swamp CCUS4 to monitor water levels, moisture profiles and water quality. The data collected from these piezometers has indicated that mining of Longwall 6 (to date) has not observably affected swamp water levels, water storage or water quality. A detailed report (GeoTerra, 2015) is provided in Appendix O of the *Russell Vale Colliery Underground Expansion Project (EPBC2014/7268) Environmental Impact Statement* (Hansen Bailey, 2015).

NSW GOVERNMENT | Planning & Environment

Mr Joe Woodward
Member
Planning Assessment Commission
GPO Box 3415
Sydney NSW 2001

Dear Mr Woodward

I refer to the email from the Planning Assessment Commission dated 27 January 2016 in relation to the proposed Russell Vale Underground Expansion Project (MP 09_0013).

As requested, the Department has provided a response to the Commission's request for additional information regarding the benchmarking of noise levels for the proposed pit top operations.

Should you have any enquiries regarding this response, I have arranged for Mr Howard Reed, Director Resource Assessments, to assist you. Mr Reed can be contacted on telephone number 9228 6308.

Yours sincerely,

Howard Reed

David Kitto 4.2.16
Executive Director
Resource Assessments & Business Systems

RUSSELL VALE COLLIERY
UNDERGROUND EXPANSION PROJECT (MP 09_0013)
RESPONSE TO PLANNING ASSESSMENT COMMISSION'S INFORMATION REQUEST DATED 27 JANUARY 2015

Applicability of the Voluntary Land Acquisition and Mitigation Policy

PAC's Comments:
As a result of concerns about intrusive noise in public submissions and also at the Public Hearing, the PAC is seeking clarification regarding the benchmarking of noise levels in the Department's addendum report and the subsequent inability to apply the provisions of the Voluntary Land Acquisition and Mitigation Policy (VLAMP).

I understand the existing noise levels as described on page 19 in the Department's addendum report are actually a modelled noise level based on the existing practices. These noise levels are adopted as the benchmark and when compared to the noise levels produced by modelling the existing practice with mitigation (ie the existing mitigated), there is understandably a negligible or beneficial outcome. Hence, the Department's report states the mitigation or acquisition provisions of the VLAMP do not apply.

The NSW Government's new *Voluntary Land Acquisition and Mitigation Policy* (VLAMP, November 2014) specifically states that a consent authority cannot grant voluntary mitigation and acquisition rights to reduce operational noise impacts for:

> *"existing developments with legacy noise issues, where the modification would have beneficial or negligible noise impacts. In such cases, these legacy noise issues should be addressed through site-specific pollution reduction programs under the Protection of the Environment Operations Act 1997".*

The Russell Vale Colliery's pit-top operations fit into this category. The pit top site is an existing development that has been operated as a colliery pit top since 1887. As a result of long occupation of the site, until recently much of the plant and equipment as well as work practices were dated and did not represent best practice. From the 1960s until 2003 a coal washery and coal preparation plant operated on site. Washeries are traditionally a significant source of noise annoyance and often the source of complaints regarding low frequency noise and tones.

Whilst the old washery has been demolished, the Department identified a number of noise sources that it believed could be mitigated. Consequently, a number of noise surveys were undertaken to identify areas for improvement and noise mitigation works have been implemented at the site to reduce noise to residents living in the vicinity of the site.

Table 1 below presents a summary of historical night-time noise levels in the vicinity of the pit top operations and compares these to the current and proposed operational scenarios. This information was presented in Table 6 of Section 6.7.1 of the *Secretary's Environmental Assessment Report* (December 2014) and expanded in Table 2 of Section 3.6.1 of the *Secretary's Addendum Report* (November 2015).

Table 1: *Historical Noise Levels Compared to Current and Proposed Nights*

Receiver Id	Location	Noise Level dB(A)		
		Historical	Existing Night	Proposed Night
R1	16 West St, Russell Vale	56	45	43
R2	30 West St, Russell Vale	52 - 59	47	44
R4	13 Broker St, Russell Vale	48	45	43
R9	109 Midgley St, Corrimal	NA	42	43
R12	46 Lyndon St, Corrimal	Low 40's - 47	40	39

The actual and predicted noise levels presented in **Table 1** show that the noise levels in the vicinity of the pit top operations have been reducing from historic levels, and are predicted to continue to reduce under the proposed Underground Extraction Project (UEP). The Department considers it clear that the:

- pit top site is an existing operation with legacy noise issues; and
- proposed UEP would have beneficial or negligible noise impacts.

The Department therefore maintains that, under existing Government policy (ie the VLAMP), the consent authority should not grant voluntary mitigation and acquisition rights in response to the operational noise impacts of the UEP.

Noise Audit 2012

PAC's Comments:
The result of the noise audit from 2012 show lower noise levels than the modelled existing noise levels. If the 2012 noise levels are used as the benchmark rather than the modelled noise levels, then at night, there is a deterioration of noise amenity for a number of receivers. This deterioration may then allow the provisions of the VLAMP to apply. Having regard to the short term of the 5 year approval, the existing status of the mine and the intrusion of the residences into the mining area, it may be argued that the application of mitigation works at the receivers rather than acquisition would be appropriate.

In accordance with the existing Preliminary Works Project Approval (MP10_0046), the previous owner of Russell Vale Colliery (Gujarat NRE Coking Coal Ltd) engaged Pacific Environmental Limited (PEL) to undertake a noise audit, which was conducted on-site in late 2012.

As identified by the PAC, the night-time noise levels measured at a number of receivers (refer to Appendix B of the *Noise Audit*) were lower than the modelled existing noise levels presented in the *Noise Assessment* undertaken by Wilkinson Murray in 2014.

However, the Department does not consider this to be an unexpected or unusual result. Noise measured during the audit presents a single snapshot of the mining operations and weather conditions that were in place at the particular time during which attended monitoring was undertaken (ie on 28 November 2012). The audit did not coincide with nor represent the colliery operating at full production (even under the existing approval), nor did it necessarily represent adverse noise enhancing meteorological conditions for all receivers. That is, it is very likely that the audit sampled noise emissions which were substantially less than worst-case current emissions and impacts.

Current noise policy requires noise level objectives to apply under "worst-case operational and meteorological conditions". The Department therefore does not consider that it is realistic or applicable to use noise levels measured during the short timeframe of the noise audit as 'benchmark' noise levels.

Modelled Vs Actual Noise Levels

PAC's Comments:
The EPA in its letter dated the 20 August 2015 suggests that there is an avenue for the PAC to consider the imposition of mitigation at the receivers where the noise exceeds the PSNL.

It is acknowledged that the mine operations have fluctuated over the history of the mine and that the noise levels during the time of the washery were higher, however the washery ceased operation in 2003. The PAC is questioning the use of a modelled benchmark adopted in the report rather than using the actual noise levels. Does the VLAMP or the Industrial Noise Policy provide guidance for the establishment of the benchmark to determine if the project has beneficial noise outcomes? Could the Department please review this and provide any additional justification for the proposed approach.

Due to operational constraints, the Russell Vale Colliery has not operated at its approved production level of 1 million tonnes per annum (Mtpa) for a long time. At no point in time has the Colliery operated at the level of production proposed under the UEP (ie 3 Mtpa), in conjunction with the existing and/or proposed noise mitigation measures in place.

This means that the collection of robust empirical data that are directly relevant to the proposed production is not possible. However, the modelling techniques typically used by acoustic consults to compare noise impacts over time are generally considered to be well-advanced and scientifically sound. In most cases the modeling technique is preferable to empirical monitoring, particularly where the differences are likely to be small and/or difficult to measure.

It is important to note the during June 2015, Wilkinson Murray undertook additional noise measurements at the pit-top site to verify noise levels of activities and equipment following implementation of recently installed mitigation measures (see Appendix B of the *Response to Planning Assessment Commission Review Report – Part 1*, Hansen Bailey, 23 July 2015). The results were consistent with those set out in Wilkinson Murray's 2014 *Noise Assessment*.

In situations where the VLAMP is not applicable, the *NSW Industrial Noise Policy* (INP) states that "*decisions of this nature will be determined on a case-by-case basis, taking into account various factors, for example, feasible and reasonable mitigation works, the absolute level of noise and existing measures of community impact including complaints.*"

The EPA and the Department both accept that all reasonable and feasible noise mitigation measures have been adopted by Wollongong Coal for the project. In addition, as discussed in Section 3.6.4 of the *Addendum Report*, Wollongong Coal would be required to investigate any additional improvements associated with the operation of the tripper and noise barriers and, if considered beneficial, they would also be implemented.

As stated in the *Environmental Assessment Report*, the Russell Vale pit top site is the only industrial noise source in the catchment and as a consequence of current land use zoning no further industrial noise sources can be established nearby. Therefore, in the knowledge that there can be no further increase in industrial noise, the Department believes it is reasonable to limit noise from the Russell Vale pit top site to levels that do not exceed the Acceptable Amenity Criteria for the area. This approach is in line with the draft *Industrial Noise Guideline*, which states that '*the recommended amenity noise levels represent the objective for total industrial noise at a receiver location*'.

It should also be noted that both the INP and the draft ING allow the Amenity Noise Criteria to increase by a further 5 dB where there is an existing interface with an industrial facility. Whilst the nearest receivers to the Russell Vale Colliery would be classified as being in an industrial interface zone (thereby bringing this additional 5 dB into play), it was not necessary for the Department to pursue this line of assessment given that the more stringent threshold was not expected to be exceeded under the project.

Predicted noise levels represent worst-case scenarios that would only occur less than 10% of the time. Although the predicted noise levels mostly exceed the PSNLs, in no case would the predicted levels exceed the Acceptable Amenity Criteria. Furthermore, stringent operational restrictions recommended in the draft project approval would mean that the operations would be quieter during the most sensitive time-periods.

Finally, it should be noted that under the proposed draft *Industrial Noise Guideline*, the PSNLs for industries that have operated for a long period of time in one location, such as the Russell Vale Colliery, will no longer be treated the same as for greenfield sites. In these cases, the PSNLs will increase substantially.

In summary, the Department believes that the methodology undertaken is the most reasonable and applicable option, considering:

- the pit top site is an existing operation that predates all of the surrounding receivers;
- the proposed noise limits represent significant reductions on historical levels;
- the proposed noise limits are realistic and consistent with best practice for the site;
- the proposed noise limits are below the acceptable INP's industrial noise amenity levels for a suburban land use adjoining an industrial site; and
- intrusive noise criteria for the site, if generated in accordance with the draft *Industrial Noise Guideline*, would increase substantially.

---

5 February 2016

Dave Clarkson
Group Environment and Approvals Manager
Wollongong Coal
PO Box 281
FAIRY MEADOW NSW 2519

Dear Dave,

Response to PAC Questions

Our Ref: Matter 19508

In January 2016 correspondence was received from the NSW Planning Assessment Commission (PAC) requesting clarification on some items and further information for the assessment of Wollongong Coal's Underground Expansion Project (UEP). These questions were forwarded to Biosis from Hansen Bailey on 18 January 2016. Two of these questions related to upland swamps.

This letter provides a response to these questions, integrating information from SCT Operations, Wollongong Coal and Biosis.

Question 22

What are the implications for Swamp CCUS4, both positive and negative, of not mining (the approximately 300m) section of Longwall 6 below the swamp?

The risks to swamp CCUS4 were assessed in the Integrated Risk Assessment. Mining of Longwall 6 will generate strains that have the potential to result in fracturing of the underlying bedrock or the controlling rockbar. Such fracturing may result in impacts to the perched water table. The Tea-tree Thicket and Cyperoid Heath sub-communities, which are present within the central area of CCUS4, are reliant on near surface expression of the perched water table. Fracturing of the bedrock or controlling rockbar may result in transitioning from wetter sub-communities to drier sub-communities. At present, the majority of swamp CCUS4 consists of the Banksia Thicket sub-community, which is not reliant on the perched water table.

To assess the implications for CCUS4 if the swamp was not mined beneath subsidence modelling was undertaken by SCT Operations assuming a maingate cut through (C/T) would be required for longwall face installation and lining up the start of 6B with the nearest outbye C/T. This resulted in an approximately 230 metre section of CCUS4 not being mined beneath.

Avoidance of mining the section of Longwall 6 beneath swamp CCUS4 will reduce the magnitude of the strains that the swamp will experience. Although the swamp will experience some subsidence from mining of the adjacent longwall panels, the avoidance of mining directly beneath the swamp will reduce the risk of fracturing of bedrock and changes in flow pathways into and through the swamp, and subsequent impacts to its ecological values.

It should be recognised that Wollongong Coal has undertaken a substantial body of work to avoid and minimise impact to upland swamps, including best-practice LiDAR mapping of upland swamp, and changes in the mine plan, resulting in the avoidance and minimisation of impacts to swamps CCUS1, CRUS3, CCUS5 and CCUS10. Wollongong Coal advises that this has resulted in it foregoing 1.8 million tonnes of coal and $80 M of revenue.

The cost of further avoiding mining directly beneath swamp CCUS4 is the value of the coal foregone and the cost of relocating the longwall miner. The cost of this avoidance measure is estimated at $10M and is considered by Wollongong Coal to outweigh its benefits. Wollongong Coal advises that if longwall mining has to avoid the remainder of LW6 , this would require an additional $10 M capital expense and increased working capital requirements.

Question 23

The commission understands that the first 365m of Longwall 6 were mined in 2015, what impact has this had on swamp CCUS4 to date?

To date, Wollongong Coal has mined the first 340 metres of Longwall 6. Wollongong Coal has installed four piezometers in swamp CCUS4 to monitor water levels, moisture profiles and water quality. The data collected from these piezometers has indicated that mining of Longwall 6 (to date) has not observably affected swamp water levels, water storage or water quality. A detailed report (GeoTerra, 2015) is provided in Appendix O of the Russell Vale Colliery Underground Expansion Project (EPBC2014/7268) Environmental Impact Statement (Hansen Bailey, 2015).

Please contact me if you have any enquiries.

Yours sincerely

Nathan Garvey
Senior Consultant Ecologist

SCT Operations Pty Ltd
ABN 23 078 328 853
www.sct.gs

Head Office
Cnr Kembla & Beach Streets Wollongong NSW 2500 Australia
PO Box 824 Wollongong NSW 2520 Australia
Telephone +61 2 4222 2777 Fax: +61 2 4226 4884
Email sctnsw@sct.gs

Mackay Office
Telephone/Fax: +61 7 4952 5717
Email p.cartwright@sct.gs

Bendigo Office
Telephone: +61 3 5443 5941
Email s.macgregor@sct.gs

Brisbane Office
Telephone: +61 429 881 771
Email y.heritage@sct.gs

5 February 2016

David Clarkson
Group Environment and Approvals Manager
Wollongong Coal
PO Box 281
FAIRY MEADOW NSW 2519

Dear David

RESPONSE TO PAC QUESTIONS

On 18 January 2016, Hansen Bailey forwarded a document containing a number of points of clarification relating to the second Planning Assessment Commission (PAC) review of the Russell Vale Colliery Underground Expansion Project (UEP). Wollongong Coal commissioned SCT Operations Pty Ltd (SCT) to respond to queries that relate to those areas of the project that SCT has been working on. This letter report presents SCT's response to height of depressurisation, effect of Bald Hill Claystone to affect Cataract Creek tolerance to valley closure, and contingency to manage pillar layout issues at the western end of Longwall 7. The questions numbers used correspond to the numbering in the Hansen Bailey document.

1. HEIGHT OF DEPRESSURISATION

1.1 Question 13 "What is the upper limit and how is it determined?"

SCT understands this issue is also being addressed by the groundwater modelling team, but there is some overlap and this issue is also addressed here.

The maximum height of depressurisation was determined using the piezometer network installed by Wollongong Coal to measure the heights of depressurisation across the site.

The measured heights of depressurisation in a multi-seam environment are found to be consistently greater than the heights indicated by the Tammetta (2012) approach for 3.2 m thick single seam mining in the Wongawilli Seam. The Tammetta approach does not apply to multi-seam mining operations, but estimating the height of depressurisation based on mining in one seam only does provide a lower limit on the height of depressurisation that would be expected when other additional seams are mined in the same area.

The measured heights of depressurisation bear this out and indicate the height of depressurisation increases as additional seams are mined as would be expected.

The Tammetta approach was considered as to whether it could be applied using the cumulative thickness of coal from the three seams mined and the groundwater modelling initially explored this approach. However, the approach was found to significantly overestimate the actual measured height of depressurisation. The groundwater modelling is therefore based on the measured height of depressurisation that is more than the height indicated by the Tammetta approach based on the Wongawilli Seam geometry alone and less than the height indicated by the Tammetta approach using the combined height of all three seams.

It should be noted that the piezometer network installed above Russell Vale East to measure the height of depressurisation has expanded during the period that this Project Application has been running. The holes aimed specifically to target available areas of double and triple seam pillar extraction and longwall mining have been installed as resources and time lags for approval have allowed. Some of the early reports relating to estimating the heights of depressurisation predate the installations and subsequent monitoring and the learnings that came from this work.

1.2 Question 15 "Why was the height of the caved zone increased in area of multi-seam mining ..."

The subsidence experience at Russell Vale East indicates that the overburden strata is softened by each additional seam that is mined and the observed subsidence is primarily a consequence of this softening effect. The softened overburden strata is not able to span across each of the narrow longwall panels as effectively as intact strata.

The mining in each of the seams follow a different layout geometry so that there are areas of single seam, double seam, and triple seam mining as well as total extraction below large standing pillars, small pillars, large areas of extracted pillars, and narrow panels of extracted pillars. It has been possible from the variety of different geometries to develop an understanding of the effects of longwall mining in these various situations through surface subsidence monitoring, first in the Balgownie Seam and more recently in the Wongawilli Seam.

This understanding indicates that the height of the caved zone increases with each additional seam mined. This result is consistent with the results of piezometer monitoring

1.3 Question 16 "Please address matters raised in the following extract"

An extract from the OEH Preliminary Comments raises issues about the potential for multi-seam mining to affect the area around the finishing end of Longwall 7 and asserts there are conflicts in the height of depressurisation calculated. The SCT Report referred to makes the observation that the Tammetta height is appropriate for single seam mining. The height of depressurisation calculated using the Tammetta approach for a single seam mining thickness provides a lower limit for a multi-seam mining environment because the extra extraction thickness associated with multi-seam mining would be expected to increase the height of depressurisation. Adapting the Tammetta approach to use the full thickness of all three seams has been found from measurement of the piezometric profile to overestimate the height of depressurisation. Piezometer monitoring experience at Russell Vale Colliery has confirmed that the height of depressurisation in a double seam mining environment such as at the finishing end of Longwall 7 and a triple seam mining situation such as over Longwall 4 does indeed overestimate the height of depressurisation as expected.

2. Cracking of Cataract Creek

2.1 Questions 17 and 18 "How was ductility determined and what are the respective ductility values?"

The *Response to Planning Assessment Commission Review Report Part 2* (Hansen Bailey, 2015) used the term "more ductile" to refer to the section of the bed of Cataract Creek located within the outcrop of the Bald Hill Claystone. The term used is not technically correct and was intended to convey the concept of the Bald Hill Claystone being more tolerant to valley closure movements than Hawkesbury Sandstone.

The basis for this assertion is that Longwall 11 in the Balgownie Seam mined directly under Cataract Creek and caused valley closure of approximately 310mm (estimated from horizontal strain measurements). Inspection of the bed of Cataract Creek which outcrops in this area shows no evidence of mining related impact. If the bed of Cataract Creek were located in Hawkesbury Sandstone and subject to 310mm of valley closure, the impacts expected would be expected to be clearly apparent.

There are several reasons why the Bald Hill Claystone may show greater tolerance to valley closure effects. Valley closure is primarily driven by dilation (lateral expansion) of the subsiding rock strata above the level of the valley floor on either side of the valley that is undermined. The basal shear plane that develops to accommodate the valley closure may preferentially develop above the level of the Bald Hill Claystone at the interface with the Hawkesbury Sandstone and therefore isolate the rock in the bed of the creek from compression effects.

Another possible reason for the absence of perceptible effects is the nature of the creek bed. Whereas Hawkesbury Sandstone strata tends to form large intact sheets separated by isolated bedding planes some distance apart, the Bald Hill Claystone is much more closely fractured in its natural state. When compressed laterally, the Hawkesbury Sandstone tends to fracture through fresh rock with significant dislocation of adjacent units in order to accommodate the movement. The more closely fractured Bald Hill Claystone can accommodate the movement more easily through smaller movements on multiple natural joints.

Where the bed of the creek is located in Bald Hill Claystone, the creek bed tends to have a pebbly base rather than the rock base characteristic of creeks that outcrop in Hawkesbury Sandstone. Mining induced movements tend to be less apparent where there is an overlay of pebbles although significant impacts would still be expected to be apparent.

3. PILLAR STABILITY INBYE OF LONGWALL 7

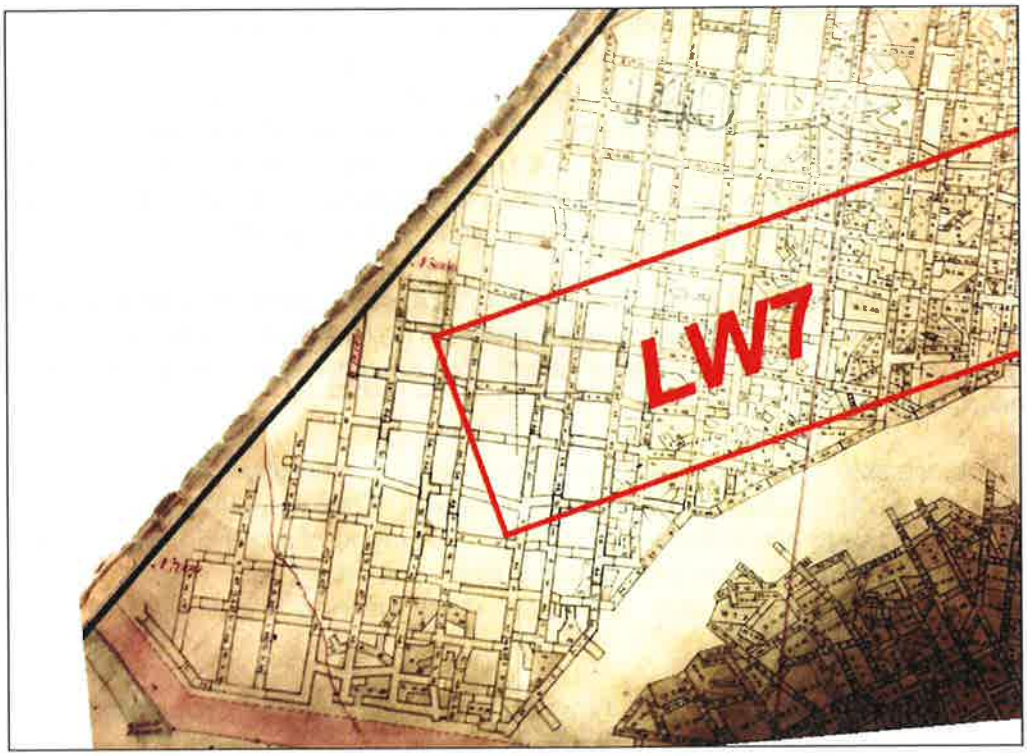
3.1 Question 19 "What contingency is proposed in the event that the reliability of the record tracing cannot be determine?"

The area in the Bulli Seam at the inbye end of Longwall 7 was mined in the period between about 1944 and 1949. Both the mine working plan and the record tracing for this area of the mine are available and have been reviewed. The mine working plan and record tracing reproduced in Figure 1 shows the dates of mining individual roadways and the individual pillar splits in areas of pillar extraction.

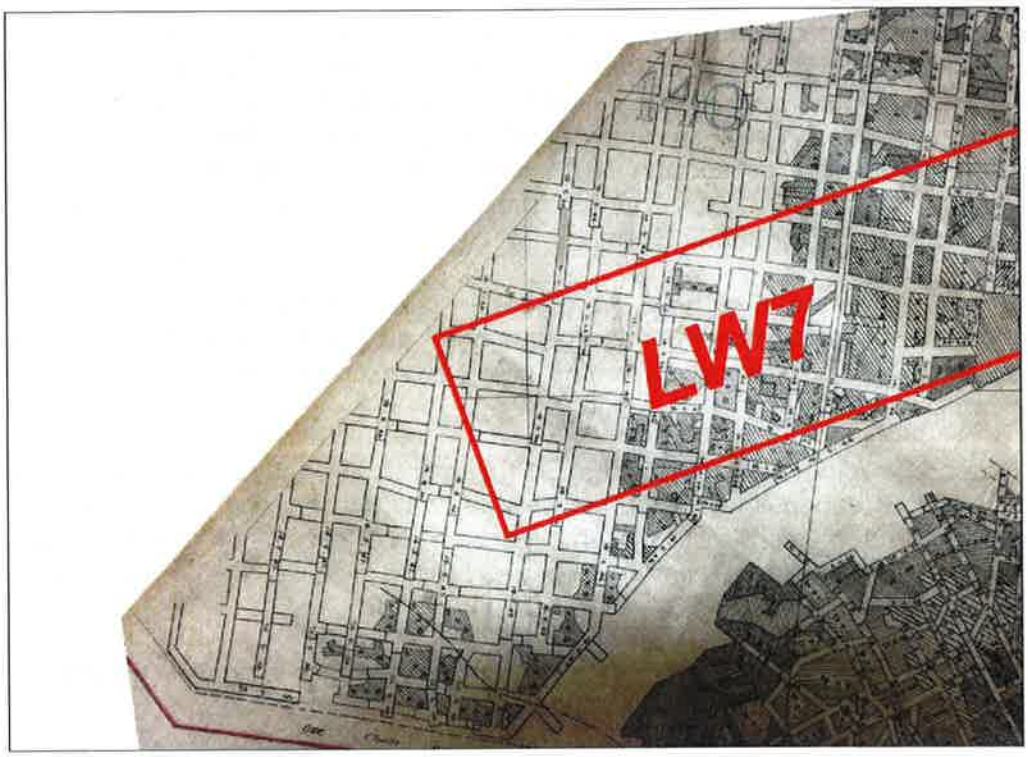
There is a mismatch at the boundary between two sheets of about 2m on the ISG version of the mine plan that is likely due to stretching of the medium on which the plans have been redrafted. However, this area of the mine is connected to the operating mine and the survey network is considered likely to be coherent with the known position of the main headings that are still accessible. On this basis, the actual position of the workings is expected to be accurate to within about 5 m. The relative accuracy of individual roadways and pillars is expected to be in the range of only a few metres.

The area itself is no longer accessible because of subsequent mining of longwall panels in the Balgownie Seam. However, experience of drilling upward from the Wongawilli Seam to intersect workings in the Bulli Seam and drain them of water has shown the plans to be accurate enough to allow intersections to be made consistently (±5 m). Similarly, mining below the goaf edges in the Bulli and Balgownie Seams has been clearly apparent in the roadway conditions experienced in the Wongawilli Seam and correlates closely with mine plans.

Subsidence monitoring experience in the Balgownie Seam and the Wongawilli Seam to date shows the subsidence behaviour for mining under multiple different types of pillar geometries in the Bulli Seam. The presence of large pillars in the Bulli Seam, and the presence of fully extracted areas in the Bulli



a) Eastern mine working plan with proposed LW7 outline.



b) Eastern record tracing with proposed LW7 outline.

Figure 1: Eastern mine working plan and record tracing with proposed LW7 outline.

Seam do not significantly modify the goaf edge subsidence profile. The only areas where there has been some additional subsidence in the Bulli Seam from longwall mining in the Balgownie or Wongawilli Seams has been in areas of narrow extraction in the Bulli Seam. The narrowness of the extraction has limited subsidence during mining in the Bulli Seam and this subsidence is recovered when the area is mined under in the Balgownie or Wongawilli Seams. Such a geometry does not exist at the inbye end of Longwall 7.

The only credible risk for the protection of Cataract Reservoir is that the mine plans are incomplete and the pillars have been extracted to the point where they are small enough to be marginally stable as a panel and large enough not to have failed during mining.

It is not credible that the roadways shown on the mine plan do not exist. The dates that each roadway was mined are shown. The irregular detail indicates that the roadways are individually mapped. The issue of possible uncertainty is whether these pillars have been subsequently mined without any reference to such mining making its way onto the mine working plans or the record tracings.

It is unlikely that mining might have occurred across the large area at the inbye end of Longwall 7 without being recorded on the mine working plan and the record tracings and without such mining presenting a significant mine safety hazard during the period of mining.

The pillars shown on the mine working plan and the record tracing are large enough to be stable when Longwall 7 is mined. Some adjacent areas shown on these mine plans are shown as having been extracted. If all the area had been extracted beyond what is shown, which appears unlikely, the effect on subsidence and the protection of Cataract Reservoir from mining Longwall 7 would be slight based on experience at multiple locations of mining below areas of full extraction in the Bulli Seam.

It is difficult to visualise how the pillars in the Bulli Seam might be actually mined so as to reduce them to a small enough size to be vulnerable to collapse when Longwall 7 is mined given the pillar geometries indicated on the mine working plan.

Although the mine workings in the Bulli Seam at the inbye end of Longwall 7 are no longer accessible, SCT understands that Wollongong Coal proposes to drill boreholes to confirm that the location and nature of the workings is consistent with the mine working plan and record tracings in the area adjacent to the inbye end of Longwall 7.

3.2 Question 20 "What are the implications of this situation on the likelihood of pillar failure?"

The nominal geometry of 22m x 33m is considered to be representative of the pillar sizes shown on the mine plan. While there are a few smaller pillars as small as 12m wide, these smaller pillars still have a width to height ratio of

greater than five and are therefore not susceptible to shedding significant load if they become overloaded. Furthermore, the stability of locally smaller pillars is not critical to the overall stability of the panel when the panel has a significant number of pillars with width to height ratios of ten or more.

These larger pillars continue to gain strength as they deform so irrespective of the abutment loading or proximity to existing goaf areas, the load bearing capacity of larger pillars continues to increase. In an operating mine, the increasing load on large pillars can cause deterioration of the adjacent roadways which are typically required to maintain ventilation and access so it is necessary to limit the load they are required to support. In abandoned workings there is no such requirement and any deterioration of the ribs and roof serves to provide additional confinement to the core of the pillar.

Subsidence in this circumstance is attributable to elastic compression of the overlying strata under the increased pillar load. This increased compression has the effect of reducing the hydraulic conductivity of the strata above and below the pillar. For the pillars at the inbye end of Longwall 7, a reduction in hydraulic conductivity would reduce the potential for flow from the reservoir to the mine through the barrier.

3.3 Question 21 "What are the implications if, as in the extreme case of Crandall Canyon pillar failure, failed coal has a much lower void content than the 50% assumed in the SCT analysis?"

Crandall Canyon was an example of extremely high loads causing large pillars to become suddenly overloaded and the roadways to become substantially filled with broken coal ejected from the ribs. The mine was extracting coal in an area at a depth of approximately 650 m below the surface between two already extracted longwall panels. The loads on the existing pillars were very high and much higher than could conceivably be generated at the inbye end of Longwall 7. At Crandall Canyon, the extraction of some of these pillars caused the loads to be elevated to a level where the edges of the remaining pillars failed suddenly and ejected coal into the adjacent roadways. Equilibrium was established by this failed material providing confinement to the pillar edges allowing them to carry the extremely high loads. Removal of this coal caused a second incident that was essentially similar to the first. Total subsidence at the surface from both events was about 250 mm.

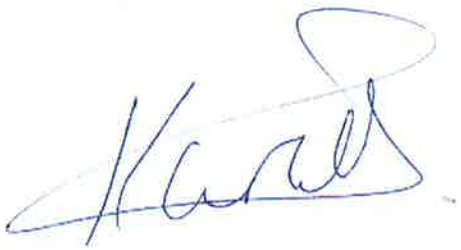
The circumstance at the inbye end of Longwall 7 is sufficiently different to Crandall Canyon for there to be no potential for the type of behaviour observed at Crandall Canyon to occur in Longwall 7.

The issue of void volume is not really critical to re-establishing equilibrium under the loading that would be expected at the inbye end of Longwall 7. The value of 50% was used as an example of what might occur under very extreme loading conditions. The actual void content is expected to be much less than 50% under the loading conditions expected. Even if it were greater than 50%, the subsidence at the surface would be low and the loading conditions would

be such that the hydraulic conductivity of the strata between the reservoir and the goaf of Longwall 7 would be reduced as a result of the additional load required to fail the pillars.

If you have any queries or would like further clarification of any of these issues, please don't hesitate to contact me.

Yours sincerely



Ken Mills
Principal Geotechnical Engineer

GeoTerra Pty Ltd
Suite 204 1 Erskineville Road
Newtown NSW 2042
PO Box 530 Newtown NSW 2042

Telephone: 61 2 9519 2190
Mobile: 0417 003 502
Email: geoterra@iinet.net.au

Email Transmission

To:	Wollongong Coal Ltd	**From:**	Andrew Dawkins
Attn:	Dave Clarkson	**Date:**	12/02/2016
Email:		**Our Ref:**	NRE12 E2
Cc:		**No. of Pages**:	

SUBJECT:	**Final Response to PAC Review**

Dave,

Enclosed is the final version of the response to selected questions raised by the PAC in January 2016.

Q10 - Are there any factors other than mining that would generate the observed hydraulic gradients?
A10 – No. Not at the quantum observed in the study area where the overburden has been significantly depressurised as a result of coal extraction in up to 3 seams along with the associated overburden subsidence fracturing and delamination over the Balgownie, Bulli and Wongawilli Seam workings at Russell Vale Colliery.

The phreatic surface within the overburden strata above the mining area is significantly below the level of the Cataract River and Cataract Creek. The only credible gradient is downward toward the mining horizons.

The depressurisation also extends over a significant regional extent associated with extraction in adjoining mines within the Bulli Seam to the east, south and north of Russell Vale Colliery.

Q11 - How does the pressure profile indicate enhancement and what is the enhanced vertical flow?
A11 – RV20 is a borehole located over Longwall 4 in an area where triple seam mining has caused significant strata fracturing, delamination and associated groundwater depressurisation. The head vs depth pressure profile of the piezometric array shown below indicates that all the strata from 35 – 65m below surface in the Hawkesbury Sandstone and then from 65- 85 m in the Bald Hill Claystone is highly depressurised.

The data indicates a head pressure rise at 105 mbgl in the top of the Bulgo Sandstone. However, the piezometer at 134 mbgl in the Bulgo Sandstone is depressurised.

The enhanced vertical flow rate, in terms of hydraulic conductivity, has not been directly measured, however the quantum of inflow into the underground workings is separated

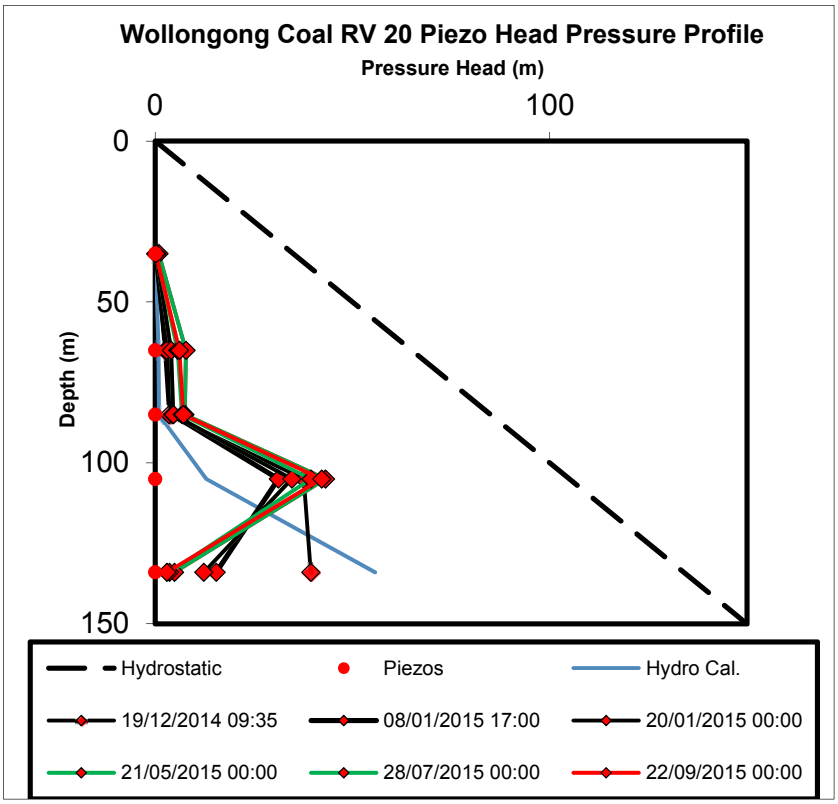
into inflows into Longwall 4 and 5 and these inflows are consistent with downward flow through the overburden strata via a tortuous fracture network.

The non-hydrostatic nature of the piezometric profile indicates the tortuous / discontinuous nature of the fracture network.

Based on an analytical assessment of the measured heads and modelled vertical hydraulic conductivity using Darcyian flow over the triple seam mined area monitored by RV20, the interpreted enhanced vertical flow rates are estimated as shown in **Table 1.**

Table 1 Vertical Overburden Darcy Flow Rates at RV20

Interval	Kv (m/day)	Vertical Gradient	Area (m2)	Q =KiA (m3/day)
0 - 35	0.00001	0	1	0.000000
35 - 65	0.000069	0.80	1	0.000055
65 - 85	0.0000099	0.95	1	0.000009
85 - 105	0.0001	-0.75	1	-0.000075
105 - 134	0.00002	2.35	1	0.000047



However, it should be noted that all but one VWP transducer (105 mbgl) in RV20 has any significant head with essentially depressurisation occurring at other levels. The head gradient indicated between the VWP instruments at 105 and134 mbgl was applied at both intervals and compared to an area mass balance for the cell in which RV20 resides within the groundwater flow model with a cell size of 50 x 50m.

Table 3 shows the flux rates anticipated using this groundwater head difference. **Table 4** shows the model flux for the same area using the mass balance tool in Groundwater Vistas.

Table 1 Modelled Vertical Flow Rates at RV20 for Model Cell Area

Interval	Kv m/day	Vert Gradient	Area (m^2)	Q =KiA (m3/day)
85 - 105	0.0001	2.35	2500	0.589
105 - 134	0.00002	2.35	2500	0.118

Table 2 Model Flux at RV20

Layer	Surface	Base of Layer	Depth	Flux through Top (m3/day)	Flux through Bottom (m3/day)
5	354	260	94	0.8	0.9
6	354	238	116	0.9	1.8

Q13 – What is the upper limit (of the height of depressurisation) and how is this determined?
A13 – The upper limit of the height of depressurisation was derived based on vibrating wire piezometer (VWP) data over the various workings at Russell Vale East and Russell Vale West within Russell Vale Colliery.

The upper limit of the height of depressurisation varies depending on whether there has been 1, 2 or 3 phases of seam extraction, and on the interaction of the various adjoining mine, overlying fracture networks and strata delamination that has occurred as a result of mine subsidence.

The greatest height of strata depressurisation (or upper limit) measured within the Russell Vale Colliery VWP network is within RV20, which is within a triple seam mined area overlying Longwall 4 in the Wongawilli Seam. At this location, the height of depressurisation extends to between 105mbgl and 134mbgl (approximately 220-240 m above the mining horizon), with a perched horizon that maintains up to about 40 m of head as represented by the 105mbgl VWP intake. The low piezometric heads measured above the 105mbgl VWP at the 35, 65 and 85mbgl VWPs indicate this zone is highly fractured and hydraulically connected and does not support a positive piezometric profile.

The height of depressurisation calculated using Tammetta (2012) for a 3.2 m mining height and 150 m wide panel at 350 m depth is 148 m for just the Wongawilli Seam and 290-340 m if the equivalent seam thickness of 5.4-5.8 m for all three seams is used.

The measured height of 220-240 m used in the model is significantly greater than for mining the Wongawilli Seam alone and less than the combined height of mining all three seams. The Tammetta formula is intended for single seam mining only, but the measured values are consistent with the range that would be expected.

Q14 – What is the level of confidence, or risk, associated with the reliability of this alternative approach?
A14 – The conceptual model of caving, fracturing and associated strata depressurisation used in the groundwater model was principally based on the observed VWP head versus pressure data within the Russel Vale Colliery overburden.

The relevant site data was initially incorporated into the Tammetta (2012) strata fracturing / strata depressurisation theory that was developed for single seam mining over an extracted longwall panel, however, the derived theoretical values did not correlate with the observed in-situ VWP depressurisation profile/s.

Where multiple seam extraction was conducted, the Tammetta (2012) theory was then modified by adding the cumulative thickness of all workings. This approach overestimated the height of depressurisation measured by the piezometers. Subsequently, the Ditton and Merrick (2014) theory of strata fracturing / strata depressurisation (which was also developed for single seam mining over a longwall panel) was compared to the observed VWP data, and this theory also did not reliably predict the observed height of depressurisation using a RAMP function with a linear decline of enhanced vertical conductivity (weighted layer thickness) that did not match the observed groundwater pressures in the site VWP's, primarily in the Bulgo Sandstone.

As a result, the model utilised a modified version of a vertical conductivity ramp function enhancement whereby a greater degree of enhancement was made within the Lower and Mid Bulgo Sandstone as shown in **Figure 1**.

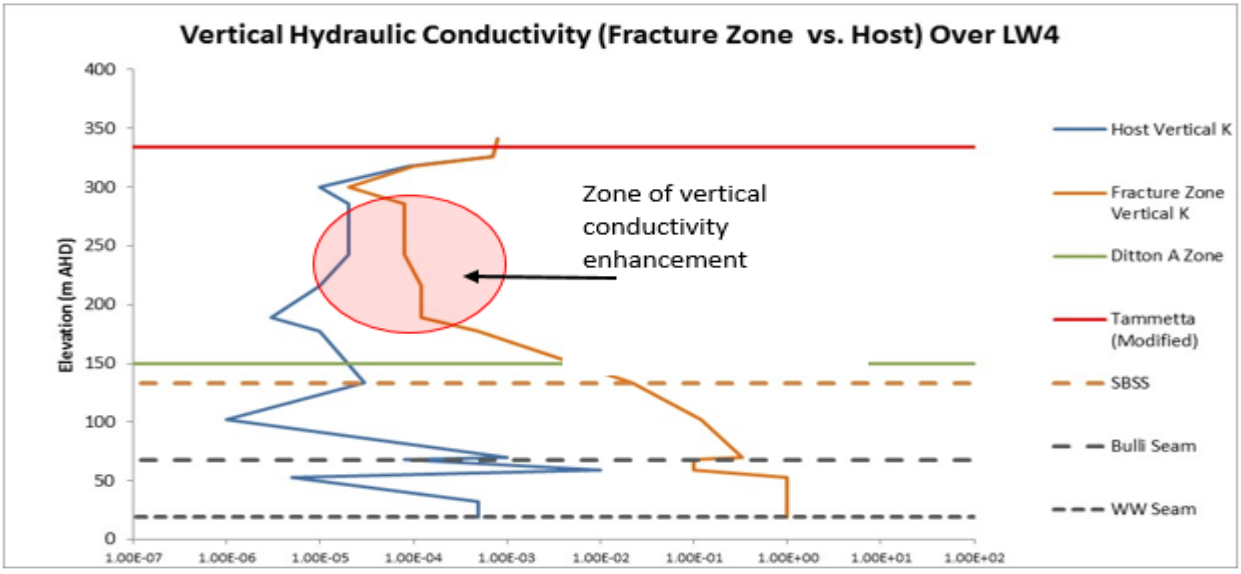


Figure 1 **Vertical Hydraulic Conductivity (Fracture Zone vs Host) Over LW4**

Q15 – Why was the height of the caved zone increased in areas of multi-seam mining when subsidence behaviour suggest that minimal additional voids result from extraction of second and subsequent seams that are in close proximity (that is, incremental subsidence approximates the extracted height of second and subsequent seams)
A15 – see response for A14
In essence, the measured depressurisation from the suite of VWPs was used in the groundwater model set up and calibration, however they did not correlate well to the modified Tammetta (2012) (using cumulative seam thickness) theory, whilst the Ditton Merrick (2014) approach was somewhat less conservative and also wasn't used.

Q16
Paragraph 1 – (OEH comment – Tammetta equation provides a lower limit to prediction of the height of depressurisation)
Answer - see Q15 answer

Paragraph 2 – (OEH comment – height of depressurisation was predicted to extend to the surface over many areas)
Answer - surface to seam depressurisation was initially predicted over parts of LW3 – LW8 (actually LW7 as LW8 doesn't exist) within the June 2014 Preferred Project groundwater modelling assessment (GeoTerra/ GES, 2014).

Following installation of the latest VWPs in July to December 2014 (RV16, 17, 22, 23, and particularly RV20) and subsequent detailed interpretation of the VWP steady state data, which was not available during the previous assessment, adherence to the previously modified (i.e., cumulative) Tammetta (2012) theory was assessed to be inappropriate.

The revised (GeoTerra / GES, 2015) groundwater report for the Preferred Project Report subsequently assessed that surface to seam depressurisation was not predicted to potentially occur at the end of the proposed mining of the Wongawilli Seam at Russell Vale East.

Depressurisation from surface to seam was predicted, however, by the model 100 years after mining Longwalls 1-3 in the southern tributary of Cataract Creek, whilst the larger, northern tributary is not predicted by the groundwater model to be affected.

The 2015 Independent Risk Assessment concluded that due to the 700mm of closure predicted in the southern tributary of Cataract Creek over LW1-3 (SCT 2014) that the tributary would be potentially cracked, with potentially no connective overland flow over Longwalls 1-3. Therefore the underlying surface to seam strata depressurisation predicted by the groundwater model 100 years after completion of LWs 1 -3 will have no additional detrimental effect on overland stream flow in the subsided and fractured tributary reach.

Although surface to seam depressurisation is predicted 100 years after cessation of mining over LWs 1-3, the actual annual flow loss from the stream in the latest version due to strata depressurisation, which incorporates the comments and model revisions provided in the January 2016 PAC suite of questions, is very low and is essentially indistinguishable from the previous (GeoTerra / GES, 2015) June 2015 assessment.

The surface water assessment (WRM Water & Environment, 2015) calculated that if, in the unlikely case that total loss from Tributary 1 of Cataract Creek over LWs 1- 3 occurred, it would equate to a maximum of 0.58ML/day median baseflow or 1.01ML/day median total flow.

Connection to surface is not predicted at the end of mining, however it is also predicted after 100 years of mining to the east of Cataract Creek, adjacent to, but not over, LW5. This is because in this reach of the creek, the Hawkesbury Sandstone has been eroded through to the Bulgo Sandstone.

The predicted maximum groundwater model stream baseflow losses associated with the potential surface to seam depressurisation adjacent to LW5 from Cataract Creek are 0.07ML/year and therefore not a significant proportion of total stream flow into Cataract Reservoir.

Paragraph 3 – (OEH comment) there is a serious risk to Cataract Creek from surface to seam hydraulic connection where Balgownie LW11, a Bulli Pillar extraction block and Wongawilli LW7 and LW8 coincide)
Answer – the assessment of potential areas of surface to seam depressurisation was based on a previous version of the groundwater modelling / reporting (GeoTerra / GES 2014) which utilised an analytical calculation of the revised (cumulative seam thickness) version of Tammetta (2012).

Subsequent to receipt, interpretation and incorporation in the study of additional VWP data after late 2014, and utilising a ramping depressurisation function in the (GeoTerra / GES, 2015) model, which was based on in-situ VWP pressure head distributions, the "risk" of the LW7, and, LW8 (which actually doesn't exist) region in or near Cataract Creek depressurising to surface was no longer predicted. The potential risk of surface to seam depressurisation was present in GeoTerra / GES (2015), however, in a small area to the west of Cataract Creek and east of LW5, and over LWs1 -3 as explained in the above (paragraph 2) answer

Paragraph 4 – (OEH comment) Tammetta's assessment of depressurisation underestimates the potential depressurisation due to multi seam mining, therefore the UEP risk assessment is out of step with statements predictions by SCT / Coffey / IESC.
Answer – As outlined above, the latest version (GeoTerra / GES 2015) moved away from using the modified (multi-seam cumulative extraction thickness) Tammetta (2012) approach as the current suite of VWP data does not support the Tammetta (2012) theory in the Russell Vale multi-seam extraction environment.
The latest assessment (GeoTerra / GES, 2015), which has been collaboratively derived between GeoTerra, GES and SCT Operations, is in joint agreement.

References

Ditton, S Merrick, N., 2014 A New Subsurface Fracture Height Prediction Model for Longwall Mines in the NSW Coalfields. Geological Society of Australia, 2014 Australian Earth Sciences Convention (AESC), Sustainable Australia. Abstract No 03EGE-03 (p.136) of the 22nd Australian Geological Convention, Newcastle, NSW

GeoTerra / GES, 2014 Russell Vale Colliery Underground Expansion Project Preferred Project Report Wonga East Groundwater Assessment, June 2014

GeoTerra / GES, 2015 Russell Vale Colliery Underground Expansion Project Russell Vale East Revised Groundwater Assessment, September 2015

Hansen Bailey, 2015 Russell Vale Colliery Underground Expansion Project Independent Risk Assessment Panel – Risk Assessment Supporting Technical Information, September 2015

SCT 2014 Update of Subsidence Assessment for Wollongong Coal Preferred Project Report Russell Vale No 1 Colliery, June 2014

SCT 2015 Assessment of Corrimal Fault and Dyke D8 at Russell Vale East as Risks to the Stored Waters of Cataract Reservoir, August 2015

Tammetta. P, 2012 Estimation of the Height of Complete Groundwater Drainage Above Mined Longwall Panels. Groundwater - Vol. 51, No. 5. (pp/723–734)

WRM Water & Environment, 2014 Russell Vale Colliery Wonga East Underground Expansion Project Surface Water Modelling, May 2014

WRM Water & Environment, 2015 Russell Vale Colliery Underground Expansion Project Surface Water Modelling: Response to Planning Assessment Commission, August 2015

Yours faithfully,

Andrew Dawkins Principal Hydrogeologist (CP Env)

Groundwater Exploration Services Pty Ltd

1/156 Arden Street,
Coogee
NSW 2034
Tel +61 2 96649782
andyfulton@gmail.com
ABN 22 150 946 615

12 February 2016

Dave Clarkson
Wollongong Coal Pty Ltd
Russell Vale Colliery
Bellambi Lane
Russell Vale NSW 2517

Attention: Dave Clarkson

Re: Russell Vale Colliery Underground Expansion Project – Groundwater Modelling PAC Review

1. INTRODUCTION

The groundwater modelling (GeoTerra / GES, 2015) for the proposed Underground Expansion Project at Russell Vale Colliery by Wollongong Coal Ltd (WCL) has been reviewed by the Planning Assessment Commission (PAC) in January 2016.

Following a subsequent meeting in late January 2016, the PAC recommended that further changes be made to facets of the model and the modelling code utilised to derive the predictions associated with the groundwater impacts and effects of the proposal.

This letter documents changes undertaken to the groundwater flow model for the Russell Vale Colliery Underground Expansion Project.

The groundwater model has been revised to address the issues raised by the PAC. Whilst the revised model is not substantially different from the previous iteration, it does contain updates which supersede the previous version. The details of which will be included in a technical addendum to be provide separately.

To describe how the implemented changes impact on the previous predictions, a precis of the issues raised by the PAC (and its independent experts) is restated below, followed by a description of changes that have been made to the model and a discussion of how this affects the revised modelling outcome.

Issues raised include

- Q1 – Model layers 1 – 15 have been treated as variably unconfined while model layers 16 – 19 have been treated as strictly confined.
- Q2 – Why has the upper section of the Wongawilli Seam been represented as the working section? What are the implications for model calibration?
- Q3 – How was the scaling for horizontal conductivity determined?

- Q4 – Can the proponent provide an explanation as to why scaling was applied over a stress period and to what extent the modified *[drainable]* porosity has affected the estimated mine water flux. What is the implication for calibration in the volumetric balance?
- Q5 – How were the heads and conductance terms determined for individual cells for General Head boundaries along active mine perimeter.
- Q6 – Model Layers 1 -10 have similar values for drainable porosity.
- Q7 – It has not been possible to replicate inflows. How were mine water influx estimates derived?
- Q8 – Were influx estimates only captured at the end of stress periods? If so what is the implication for calibration.
- Q9 – What is the cause of the regionally extensive complete loss of pore pressure and what field observations are there to support this?
- Q12 – Evaporation rate used in the modelling and implications for model calibration and outcomes.
- Layering continuation over the escarpment causing model layers to roll over at the escarpment.
- Groundwater Levels / Pressures
    - What factors other than mining could generate the observed hydraulic gradients.
    - Does the pressure profile indicate enhancement and what is the enhanced vertical flow
- What is the height of depressurisation (upper limit) and how was it determined
- What is the level of confidence, or risk, associated with the reliability of this alternative approach.
- Why is the height of the caved zone increased in areas of multi-seam mining relative to subsidence behaviour?
- Additional issues raised at the onsite meeting have also been addressed. These include:
    - Layering continuation over the escarpment causing model layers to roll over at the escarpment.
    - Vibrating Wire Piezometer NRE GW1 water levels and correlation with targets used in the model.

2. Discussion of Issues Raised and Actions Undertaken

2.1 Aquifer type

Q1 – Why are the Wongawilli seam and the overlying layer treated as strictly confined layers where drainable porosity is not taken into account when it is expected that the mined seam and the overlying strata will be completely dewatered during mining? What are the implications for model calibration?

The model domain can be separated into two almost distinct groundwater flow systems; one below the Bulli Seam and one above. These are currently essentially separated by the regional scale depressurisation and dewatering which has occurred in and above the Bulli Seam that is associated with historical mining activities.

Above the Bulli Seam, the groundwater model and resulting groundwater levels / pressures and stream base flow characteristics have been essentially unaffected by the recent changes to the aquifer type definition in the lower layers of the model which were used to report the updated mine groundwater inflows.

We believe there are no deleterious implications for calibration of groundwater levels derived in the model as all available monitoring data from vibrating wire piezometers at Russell Vale is located within the Scarborough Sandstone or higher strata (i.e. all above the Bulli Seam).

However, the model has been updated to address issues raised by the PAC.

As mine inflow estimates are an important calibration tool and there was no pressure data available for the Wongawilli Seam, it is acknowledged that there are calibration implications for matching mine inflows, as the previously used 'confined aquifer' setting did not account for the Sy component of dewatering. The result of this approach was that disproportionately high hydraulic conductivity in the lower coal measures were required to achieve an inflow estimate which correlated to the measured mine inflow data.

Accordingly, there was a requirement to re-calibrate hydraulic conductivities to recorded inflows in the lower coal measures only. The strata from Bulli Seam and above remain relatively untouched and there is negligible impact on previously recorded groundwater / surface water interaction.

These settings have been reset through an updated definition of hydraulic parameters within the coal measures strata in the lower layers of the model, and are in line with expected values gained from experience elsewhere within the Southern Coalfield.

2.2 Wongawilli Seam Working Section Drain Cells

Q2 – Why has the upper section of the Wongawilli seam been represented as the working section? What are the implications for model calibration?

Drain cell invert levels were originally placed mid-level within the Wongawilli Seam. There are 29,424 drain cells within the model of which approximately 1,300 represent workings in the Wongawilli Seam within the Russell Vale lease area. The vast majority of these drain cells (i.e. All Bulli Seam and Balgownie Seam Drain Cells) had head boundaries set 0.1m above the base, but it is acknowledged, as noted by the PAC's independent expert, that within the Wongawilli Seam these drain cells were set at 5m above the layer base. It was not initially considered that this created a serious mine inflow reporting issue as there is a significant dip to the west in the Wongawilli Seam in all but the most eastern panel in the original model version (Strata layer issue), and hence groundwater reported down dip to the next active longwall panel. Nevertheless, the drain cells have been reconfigured and set with an invert level at 0.1m above the base of the Wongawilli Seam in the revised model after discussion with the PAC.

2.3 Horizontal Scaling

Q3: How was the scaling factor for Kh determined? Given the significant influence of the enhanced material properties on the groundwater systems, what are the likely implications for model calibration and model outcomes if an equivalent porous media approach was adopted?

Enhancement of horizontal conductivity by a factor of 2 was used within the fracture zone using the TMP package of MODFLOW-SURFACT. This enhancement was used primarily based on experience in other groundwater modelling studies for underground mines in the Southern Coalfield.

We acknowledge that the horizontal permeability factor is likely to be low. However model calibration to mine inflow was not sensitive to variability of hydraulic conductivity in the horizontal direction within the fracture zone, as opposed to the hypersensitivity in the vertical direction within the fracture zone.

Additional sensitivity modelling has subsequently been undertaken to demonstrate this by increasing horizontal conductivity by a factor of 100 wherever changes to vertical conductivity are made (with the exception of the working level where increases to horizontal conductivity are made by greater than 2 orders of magnitude). The results of which are included in the technical addendum.

Q4 – Can the proponent provide an explanation as to why scaling was applied over a stress period and to what extent the modified *[drainable]* porosity has affected the estimated mine water flux. What is the implication for calibration in the volumetric balance?

The TMP package changes physical properties at the start of each stress period which changes hydraulic conductivity and storage properties in a linear fashion between the TMP start time and the next period. The issue was if a change in Sy was implemented in TMP (increased by some factor), then SURFACT conserved head in the cell but the mass balance can be off.

The implications are that a large volume of groundwater is dumped from affected model cells in the first time step, and if the model is not set up to report on these events, this volume of groundwater is not accounted for in the inflow rates.

It is also acknowledged that care must be taken in how this is applied to any outflow, as in reality, this does not occur, and is actually spread out over a stress period.

2.4 Boundary Head Conductance

Q5 – How were the heads and conductance terms determined for individual cells?

Generally, conductance of a boundary condition was set to match a formation hydraulic conductivity. In the model, conductance values were set higher than formation hydraulic conductivities.

There are four perimeter boundary condition areas, some of which are active or present in multiple layers.

1. These include the boundary conditions to the east, representing the coastline which is at least 2.5km at its closest point to the Wongawilli workings. The connection between the active Russell Vale mining area and the coastal boundary is also affected by the vertical separation between the underground mine through the escarpment to the coast on the eastern margin of the model. Following re-working of the structural contours of the model layering on the eastern margin, only two lowest layers have this boundary applied.

2. To the southeast, a boundary operates within the Wongawilli Seam at the northern edge of Dendrobium Mine. This boundary is approximately 10km from the proposed Wongawilli Seam workings.
3. To the west, Tahmoor Colliery is represented with a boundary at a distance of 18km. A significant area of extracted Bulli Seam workings lie between the proposed Wongawilli Seam workings and this boundary.
4. To the northwest, Appin Colliery is at a distance of 12km and also has intervening extracted Bulli Seam workings.

The distance to each of these boundaries and the presence of extracted workings between the Russell Vale workings and the boundaries means that the General Head Boundaries (GHBs) do not play a significant role in governing mine inflows at Russell Vale.

2.5 Drainable Porosity in Layers 1 -10

Q6 – Can the proponent provide an explanation for the adoption of similar values for widely differing lithologies?

These results are based on both model calibration and on porosity (not Sy) values obtained from core testing at Southern Coalfield mines (although not from Russell Vale).

2.6 Derivation of Mine Water Influx Estimate

Q7 – How were the mine water influx estimates derived?

The updating of the groundwater model has generated updated mine inflow curves. Details a contained within the technical addendum**.**

Inflow estimates from the updated adaptive time stepping are recovered from the cell by cell (CBB) utilising the Mass Balance Zone Budget Reporting out of the Groundwater Vistas (GWV).

Inflows are extracted from the zone budget file outside GWV using a macro driven spreadsheet application. Inflows for each drain reach are exported separately and each reach has identical time print signatures. These are then collated with correlating print times and the reaches are added. Within each stress period, flows are then weighted on the print time interval.

2.7 Stress Period Print Times

Q8 – Were influx estimates only captured at the end of stress periods? If so what is the implication for calibration?

Print times within the model prior to the current version were set at 100 days, that is, output times were set at 100 day intervals after the beginning of each stress period and also at the end of each stress period. . The implications are that due to the manner in which groundwater is removed from cells under the stresses applied by the TMP package in MODFLOW-SURFACT, the initial outflow can be very large. If the model is not set up to record these early stress period intervals, a considerable quantity of the actual outflow to the drain cell is not reported. Therefore, there is the potential to under-report total inflows.

The model has been revised to include adaptive time stepping. Each stress period now has 4 reporting print times. These include a 3rd order polynomial starting at day 1 (i.e. 1, 3, 9, 27, days) and at the end of each stress period where the Russell Vale Wongawilli Seam workings are active. The number of reporting print times varies depending on the length of the stress period.

The mine inflows have been re-calculated using a time-weighted average from each stress period as noted in Section 2.7.

2.8 Regionally Extensive Complete Loss of Pore Pressure

Q9 – What is the cause of the regionally extensive complete loss of pore pressure and what field observations are there to support this?

A regionally extensive area with complete loss of pore pressure was previously indicated in the prior model version to the north and south of the Project.

The changes made to the revised model includes changes in aquifer type (LAYCON) from confined variable confined nature of Layers 15 to 18 as noted in Section 2.1. This has also changed the nature of simulated groundwater pressures in these areas. The revised version has removed the completely dewatered areas of the Wongawilli Seam to the north and south of Russell Vale.

Although the completely dewatered areas are removed and the Wongawilli Seam remains saturated, these areas still have low pressures, below 10m to the north of Russell Vale Colliery, and therefore the water levels are close to the roof of the Wongawilli Seam.

These remnant low pressures within the Wongawilli Seam are due to the Russell Vale area being situated within the northern limb of a westerly plunging syncline which dips to the west in a localised basin structure.

To the north and south of Russell Vale, the Wongawilli Seam is at higher elevations than the adjacent excavated Bulli Seam workings in the Russell Vale lease area due to the dip of the syncline limbs.

Details of revised groundwater pressures prior to the start of mining in the Wongawilli Seam are provided within the technical supplement.

2.9 What Pan Evaporation Value Was Used

Q12 - Why has the rate of 1825 mm/annum been adopted rather than the much lower rates? What are the implications in respect of model calibration and model outcomes?

Full evaporation values have been routinely used, although it is acknowledged that it may also be warranted to use lower than that reported such as pan values. A lower evapotranspiration rate may lead to greater rates of groundwater discharge to surface water and thus affect simulated baseflow dynamics.

However, within Layer 1 (which is fully extensive and active across the model domain) groundwater levels are generally 5-10m below surface level, with only minor areas where the regional phreatic surface is <7m below ground level.

The extinction depth within the Evapo-transpiration package is set at 7m based on experience from other coal mining projects.

Sensitivity to variable evaporation was undertaken and is further discussed within the technical addendum.

2.1 Model Layer Structural Contours

The review process highlighted concerns with the model layering in the vicinity of the escarpment on the eastern margins of the groundwater model, and the use of continuous model layers in areas where geological units subcrop in the escarpment.

Part of the re-working of the model involved updating the layering and the use of no-flow cells where the layers subcrop / outcrop. This process re-shaped stratigraphic contours within approximately 1.0 – 1.5km from the escarpment with no changes required further west and down dip in the model.

The results of the updated parameters and subsequent re-modelling have been compared to previously reported key findings, which confirms there are no significant effects on the groundwater level calibration compared to that previously reported.

2.2 Vibrating Wire Piezometer NRE GW1 water levels and target / layer application

Some doubt was cast as to the application of groundwater level data in vibrating wire piezometer (VWP) NRE GW1. This has significant implications to calibration as it is the only key VWP which captures groundwater pressure reduction as a result of mining stresses resulting from extraction of three seams, including Longwall 4 and Longwall 5 in the Wongawilli Seam. Of the eight VWP transducers installed, transient data from seven were used as calibration targets.

GW1 is located near Cataract Creek in an area where Hawkesbury Sandstone and Bald Hill Claystone have been significantly eroded. The Bulgo Sandstone is close to surface in the groundwater model in the vicinity of Cataract Creek, with layering elsewhere where the Hawkesbury Sandstone and Bald Hill Claystone is present having a greater thickness and is more continuous. To account for this, shallow layers are thinned except for Layer 1 which has a uniform thickness of 20m and has been linked to the properties of the underlying Bulgo Sandstone.

Therefore layering of the horizons, and the corresponding application of target levels may appear to be erroneous, however a check of the target depths in the model confirm that the correct depths and layers were chosen for all but the instrument located within the Stanwell Park Claystone, as this could have been mode to Layer 9.

However, the reaction of pressures measured by this VWP transducer was near identical to that in the lower Bulgo Sandstone and there was some doubt as to the veracity of the data. **Table 2** shows the layer definition at NRE GW1 and the depth of the corresponding VWP data / target levels.

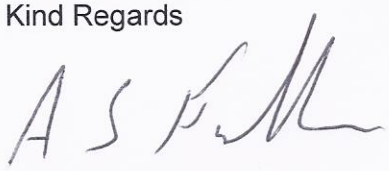
The key assessment from the GW1 VWP data is the large disparity in pressure between the Base of the Bulgo Sandstone and the Scarborough Sandstone, and also the reaction to

stresses within the Bulgo Sandstone, as this is the stratum in which the bulk of the pressure transition occurs.

Table 2 NRE GW1 Layer Definition and VWP Relative Levels

Layer	Base	Top	VWP RL (m AHD)
1	294.1	314.1	_
2	291	294.1	_
3	289	291	_
4	280	289	288
5	269.5	280	273
6	250.3	269.5	255
7	227.3	250.3	_
8	202.5	227.3	193 / 225
9	190.3	202.5	178
10	145.2	190.3	153

Kind Regards



Andrew Fulton

Groundwater Exploration Services Pty Ltd

1/156 Arden Street,
Coogee
NSW 2034
Tel +61 2 96649782
andyfulton@gmail.com
ABN 22 150 946 615

15 February 2016

Dave Clarkson
Wollongong Coal Pty Ltd
Russell Vale Colliery
Bellambi Lane
Russell Vale NSW 2517

Attention: Dave Clarkson

Re: Russell Vale Colliery Underground Expansion Project – Groundwater Modelling PAC Review – Technical Addendum

1. INTRODUCTION

The groundwater modelling (GeoTerra / GES, 2015) for the proposed Underground Expansion Project at Russell Vale Colliery by Wollongong Coal Ltd (WCL) has been reviewed by the Planning Assessment Commission (PAC) in January 2016.

Following a subsequent meeting on 28 January 2016, the PAC recommended that further changes be made to facets of the model and the modelling code utilised to derive the predictions associated with the groundwater impacts and effects of the proposal.

The groundwater model has been revised to address the issues raised by the PAC. Whilst the revised model is not substantially different from the previous iteration, it does contain updates which supersede the previous version.

This document is the technical addendum supporting the response to questions dated 12 February 2016 titled “Re: Russell Vale Colliery Underground Expansion Project – Groundwater Modelling PAC Review” (GES) which responds to individual questions raised by the PAC in its letter dated 15 January 2016.

This document outlines changes to the groundwater model for the Russell Vale Colliery Underground Expansion Project and provides the technical details and resulting outcomes from the updated model. These changes address the recommendations made by Dr Colin Mackie acting as an independent expert for the PAC.

Key updates to the revised groundwater model include:

1) All layers are treated as variably unconfined;
2) The base of the Wongawilli Seam is represented as the working section;
3) Minor changes were made to drainable porosity in clay rich stratum;
4) Application of adaptive time stepping;
5) The structural geometry of the layers was corrected at the escarpment; and

6) Additional sensitivity modelling undertaken to address and fracture zone horizontal conductivity scaling and evaporation concerns (Page 41).

1.1 Model Implementation of the Mine Schedule

The underground mining and dewatering activity is defined in the model using drain cells within mined coal seams, with modelled drain elevations set to 0.1m above the base of the Bulli Seam (Layer 13), Balgownie Seam (Layer 15) and Wongawilli Seam (Layer 17).

These drain cells were applied wherever workings occur and were maintained as constant within the Bulli and Wongawilli Seams and implemented in line with mine progression in the Wongawilli Seam. A variation in this version of the model is the reduction of drain cells within the Balgownie workings to replicate removal from actual pumping areas.

Mining prior to the transient modelling period was simulated as steady state within the Bulli Seam (Layer 13) and Balgownie Seam (Layer 15).

The model set-up involved changing the parameters with time in the goaf and overlying fractured zones directly after mining of each panel, whilst simultaneously activating drain cells along all development headings.

The development headings were activated in advance of the active mining and subsequent overburden subsidence.

Although the coal seam void is essentially dominated by the drain mechanism, the horizontal and vertical permeabilities as well as specific yields were increased to simulate the highly disturbed nature within the caved zone and overlying variable fracture zone of the overburden and interburden.

1.2 Existing Mine Workings

Adjacent to the proposed workings are large areas of abandoned Bulli seam workings to the north and south of the Russell Vale lease boundary, as well as the combined Corrimal / Cordeaux complex to the south.

The model maintains active sinks using drain cells which represent Bulli Seam workings at the following decommissioned operations:

- Old Bulli;
- Excelsior 1, 2 and B;
- North Bulli;
- South Clifton Tunnel;
- Darkes Forest;
- Coal Cliff;
- Corrimal;
- Cordeaux, and;
- Mt Kembla.

Drain cell invert levels were set at 0.1m above the seam floor and were maintained throughout transient modelling with the exception of small areas at Russell Vale West, where drain cell invert levels were raised slightly to mimic reported ponding areas.

A variation within this updated model includes the lowering of drain cell inverts within the Wongawilli Seam to represent the lower section of the seam as the working level.

The degree of hydraulic connectivity between the Corrimal / Cordeaux complex and the older mine workings adjacent to the Wollongong Coal lease area is not known and has been

assumed in the model to be constrained by hydraulic conductivities of the host strata.

Active mining within the Bulli Seam is occurring in the northern periphery of the model in the South32 Illawarra Coal Appin workings. Additionally, active mining is occurring within the Wongawilli seam at Dendrobium at the southern boundary of the model area.

1.3 Model Calibration

Model calibration involves comparing predicted and observed data and making modifications to model input parameters, where required, within reasonable limits defined by available data and specialist judgment to achieve the best possible match.

Model calibration performance can be demonstrated in both quantitative (head value matches) and qualitative (pattern-matching) terms, by:

- contour plans of modelled head, with posted spot heights of measured head;
- hydrographs of modelled versus observed bore water levels;
- water balance comparisons; and
- scatter plots of modelled versus measured head, and the associated statistical measure of scaled root mean square (SRMS) value.

Due to the complex interactive depressurisation effects of the existing subsidence and adjacent workings on groundwater levels and the predominantly “dry” nature of the Russell Vale workings, model calibration focussed on matching observed and modelled groundwater levels and mine inflows, particularly during periods where mining impacts have been observed.

Scaled RMS value is the RMS error term divided by the range of heads across the site and forms a quantitative performance indicator. Given uncertainties in the overall water balance volumes (e.g. it is difficult to directly measure evaporation and baseflow into the creeks), it is considered that a 10% scaled RMS value is an appropriate target for this study, with an ideal target for long term model refinement suggested at 5% or lower. This approach is consistent with the best practice Australian Groundwater Modelling Guidelines (SKM, 2012).

Steady state calibration was used to compare assumed long term average groundwater levels with groundwater levels prior to the transient calibration period (1993 – 2013).

Recent revision of aspects of the model have resulted in slightly poorer calibration statistics as compared to the previous model version, with a systematic over prediction of water levels within parts of the Bulgo Sandstone and below. However the statistics remain within accepted limits provided in the Australian Groundwater Modelling Guidelines.

1.3.1 Transient Calibration

Transient calibration against groundwater levels was carried out for the period 1993 to 2013 inclusive, utilising 24 target locations using water head or level data from single screen standpipes and multi-level vibrating wire piezometers.

Although this period covers an extended time where limited to no significant secondary extraction occurred in the lease area from 1998 to 2010, it covers two periods where groundwater hydrographs show a response to mining influences.

Mining was re-started at Russell Vale East with development of first workings in the Wongawilli Seam in 2011, followed by non-continuous extraction of Longwalls 4, 5 and the western portion of Longwall 6 (340m) after April 2012.

The RMS value for the calibration period is 9.0m, whilst SRMS error is 3.8%, which is within

the target range of 5%.

The SRMS value is the RMS value divided by the range of heads across the site, and forms the main quantitative performance indicator. This result is consistent with the relevant groundwater modelling guideline (SKM, 2012).

A diagram of measured versus modelled potentiometric head targets is shown in Figure 1, and it can be seen that the model is reasonably well balanced against the targets (i.e. although in the changes undertaken in the model revision has resulted in some over prediction of pressures in deeper strata).

There are some significant departures from the matching curve, and these can be attributed to a number of reasons. These include what appears to be a delayed equilibration of vibrating wire transducers and the fact that the multi-level VWP network has doubled in number within the past 12 months. As a result, a short extent of data was used within the calibration data set which can be updated when longer monitoring records are available. This is, however, the key area where the model has not fully simulated observed groundwater pressures and there is, accordingly, a groundwater pressure separation between the Lower Bulgo Sandstone and the Scarborough Sandstone data.

The model has been unable to fully simulate these physical changes, resulting in variability of observed pressures and lack of variability within the computed heads, resulting in 'flat lining' of heads within the observed vs. computed calibration values shown.

Quantitatively, curve matching in GW1 detracts from the calibration statistics to some degree, yet, qualitatively, the results reasonably reflect the groundwater response, with the exception of the pressures occurring in the Stanwell Park Claystone.

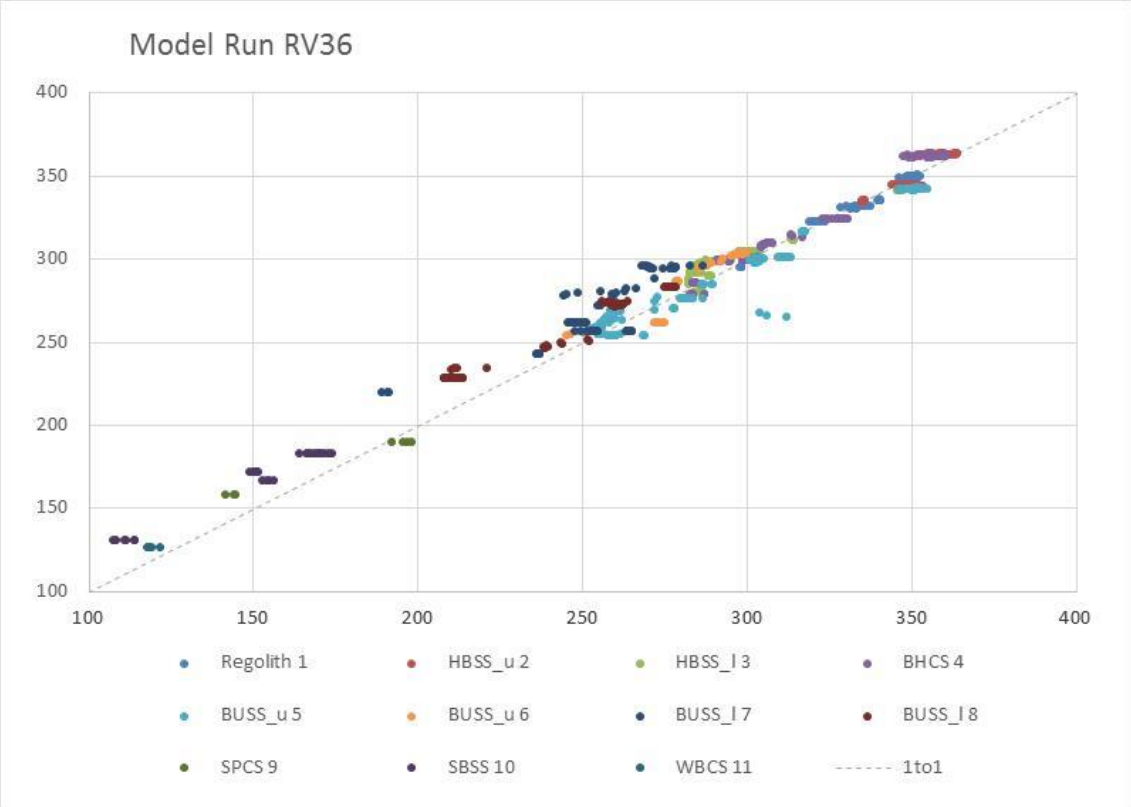


Figure 1 Observed vs. Modelled Heads

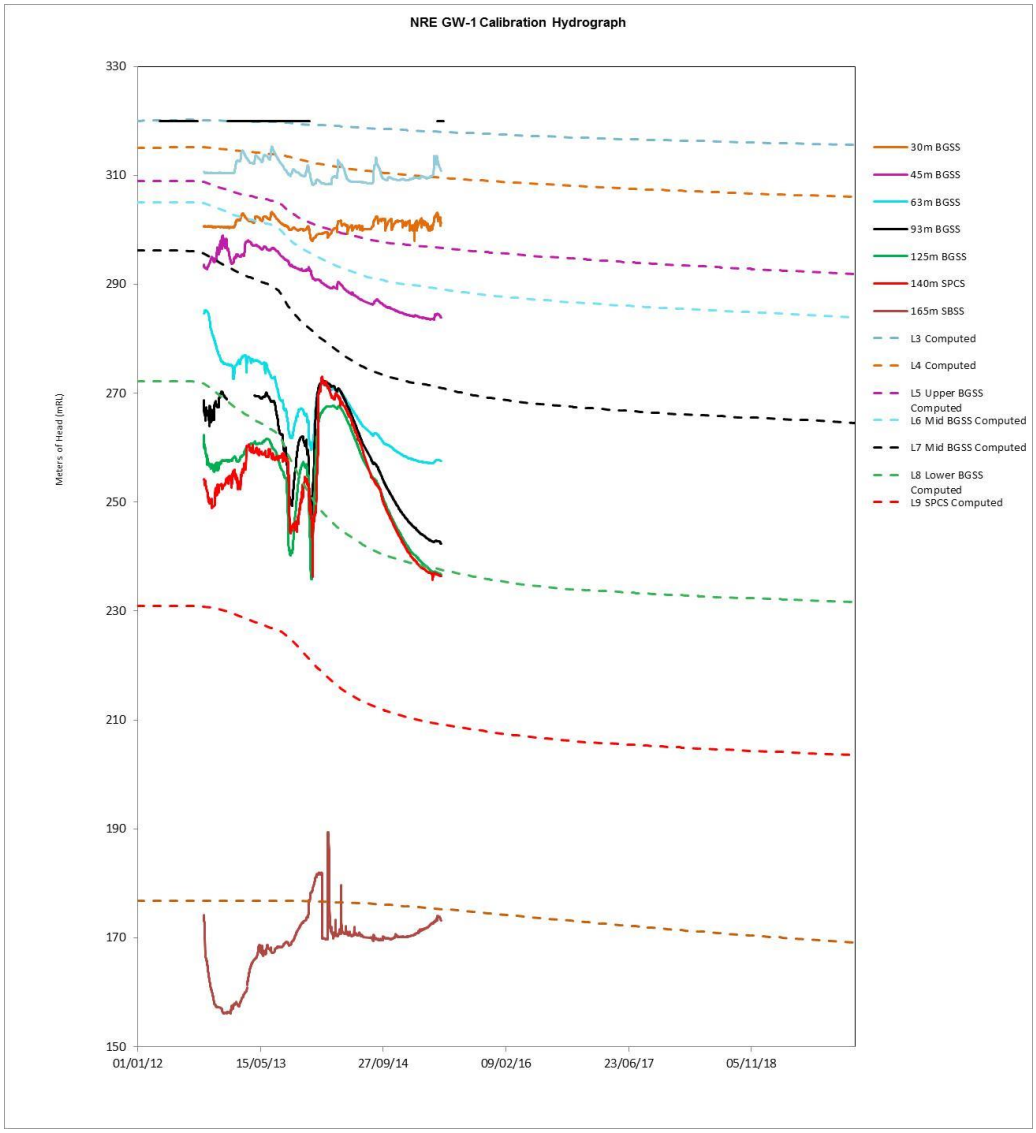


Figure 2 Observed vs. Computed Groundwater Levels for NRE GW1**Table** 1 summarises the calibrated hydraulic properties of the revised model layers

Table 1 Hydraulic Properties

Layer		Zone	Kx [m/day]	Kz [m/day]	Ss [m^{-1}]	Sy
1	Alluvium	1	10	3.00E-02	1.03E-04	1.14E-01
1	Regolith / Weathered Hawkesbury Sandstone	2	5.00E-01	2.00E-02	1.03E-04	3.00E-02
2	Hawkesbury Sandstone - mid	2	5.00E-05	1.00E-05	6.00E-06	1.10E-02
3	Hawkesbury Sandstone - lower	3	5.40E-04	6.90E-05	6.00E-06	1.10E-02
4	Bald Hill Claystone	4	2.00E-05	9.90E-06	6.00E-06	1.10E-03
5	Bulgo Sandstone - upper	5	6.00E-04	1.00E-04	6.00E-06	1.10E-02
6	Bulgo Sandstone - upper mid	17	5.00E-04	2.00E-05	6.00E-06	1.10E-02
7	Bulgo Sandstone - lower -mid	6	9.00E-09	3.00E-05	6.00E-06	1.00E-02

8	Bulgo Sandstone - lower	30	5.00E-05	1.00E-05	6.00E-06	1.10E-02
9	Stanwell Park Claystone	7	1.00E-04	3.00E-06	7.00E-06	2.50E-03
10	Scarborough Sandstone	8	8.00E-04	1.00E-05	4.50E-06	7.50E-03
11	Wombarra Claystone	9	1.70E-05	1.50E-06	6.00E-06	2.50E-03
12	Coal Cliff Sandstone	10	4.00E-04	4.00E-06	2.50E-06	6.00E-03
13	Bulli Coal Seam	11	9.50E-03	2.00E-03	5.00E-06	2.00E-02
14	Bulli-Balgownie Interburden	12	1.50E-04	1.50E-05	4.00E-06	6.00E-03
15	Balgownie Seam	13	5.00E-04	1.00E-04	7.00E-06	8.00E-03
16	Balgownie - Wongawilli Interburden	14	5.00E-04	3.00E-07	4.00E-06	5.00E-03
17	Wongawilli Seam	15	4.00E-04	9.00E-05	4.00E-06	5.00E-03
18	Shoalhaven Group	38	3.00E-04	9.00E-05	2.50E-06	5.00E-03
19	Shoalhaven Group	16	1.00E-04	7.00E-05	2.50E-06	5.00E-03

1.4 Mine Inflows

Based on available mine water balance records, the average daily groundwater inflow derived from strata leakage extracted from Russell Vale Colliery was 0.5 ML/day prior to extraction of LW4 and 1.5 – 2 ML/day during extraction of extraction of LW4 and LW5 as shown in **Figure 3**.

There is some uncertainty to inflow records prior to prior to the extraction of LW4, however more accurate mine water pumping records have been obtained since the start of LW4.

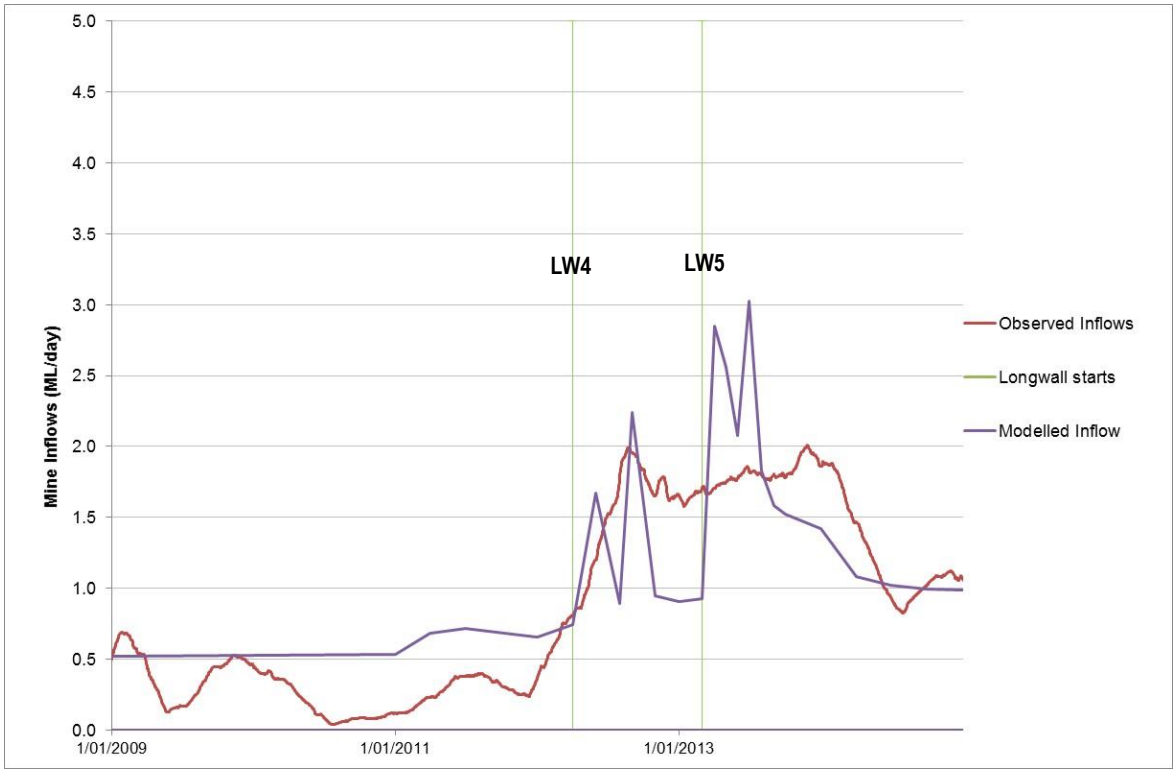


Figure 3 Mine Inflows During the Calibration Period

1.5 Water Balance

There are numerous opportunities for groundwater to discharge from, and recharge to, the groundwater system and into / out of the groundwater model domain. Those implemented in the model include:

- baseflow to major streams (represented by the river cells in MODFLOW);
- outflow / inflow to the eastern margin boundary representing the coastline, the northern margins representing the Appin mining area within the Bulli Seam and southern margin representing the Dendrobium mining area in the Wongawilli Seam (as general heads in MODFLOW), and;
- water inflows to active mining areas and the sinks caused by historical mining areas.

The average water balance across the transient model run up until the end of the mining period across the entire model area is summarised in **Table 2**. Key components of the water balance include a total inflow (recharge) to the aquifer system into the model domain is approximately 82ML/day comprising rainfall recharge (approximately 71%), inflow from the head dependent boundaries on the margins (approximately 0.5%) and leakage from streams into the aquifer (approximately 22%).

The remaining 6% is accounted for with changes in storage within the overburden strata.

Table 2 Simulated Water Balance at End of Mining

	Inflow (ML/d)	Outflow (ML/d)
Storage	3.69	8.28
Constant Head	0.001	0.03
Drains (Outflow = Groundwater Entering Mine Workings)	0	1.91
Recharge (Direct Rainfall)	58.86	9.00
Ponded Storage	1.33	0.63
Et (Evapotranspiration)	0	48.83
River (Leakage/Baseflow)	18.76	14.27
Head Dependent Boundary (GHB)	0.001	0.27
Total	87.27	0.099
% Discrepancy	-0.046%	

2. POTENTIAL SUBSIDENCE EFFECTS, IMPACTS AND CONSEQUENCES

2.1 Stream Bed Alluvium and Plateau Colluvium

There are no anticipated significant subsidence effects on stream bed alluvium or plateau colluvium as there is no significant accumulation of Quaternary sediments within the Russell Vale lease area.

The presence of alluvial sediments is limited to the upland swamps, which have been measured up to 1.8m deep, whilst the stream beds are either based on outcropping sandstone, or contain boulder fields or limited reaches of thin (<1m thick) sandy sediments.

2.2 Upland Swamps

Due to limitations of MODFLOW SURFACT and the regional scale model set up, the effect of subsidence on the thin (<2m) perched groundwater in upland swamps, with their limited and variable spatial extent, was not assessed in the model simulation.

Further discussion of the potential effects on swamps is contained in Biosis (2014).

2.3 Basement Groundwater Levels

Figure 4 to **Figure 9** show north - south and east – west cross sections of the overall modelled hydraulic head (m) and groundwater levels for modelled initial conditions at the end of the calibration period (i.e. the end of LW5 extraction) and at the end of proposed Wongawilli Seam extraction at Russell Vale East.

Figure 4 shows initial pre-mining pressure and head cross sections for a North-South section (Easting 303000) and **Figure 5** shows initial pre-mining pressure and head cross sections for an East-West section (Northing 6196700) conditions and de-saturated areas in elevated areas of the escarpment in the south eastern area of the model.

Zero pressures also extend into the Bulli Seam and overburden due to pre-existing mining voids from the lengthy period of mining in the region prior to the model simulation period.

Figure 6 and **Figure 7** show these same cross sections following completion of mining in the Wongawilli Seam where the over / interburden fracture zone has fully developed and caused further vertical propagation of the zero pressure contour.

The fracture zone and associated zero pressure contour has not formed a continuous, connected flow path from surface to the mined Wongawilli Seam.

Figure 8 and **Figure 9** show the same cross sections 50 years after mining has ceased. **Figure 8** shows the peak effect of mining on groundwater pressures where the height of effective depressurisation has broken through to surface at the northern end of LW3.

Within the process of groundwater system recovery, the adits along the Illawarra Escarpment within the study region will spill well before full recovery of the groundwater system. The lowest observed adit RL is at 54mAHD (SCT Operations, 2015B).

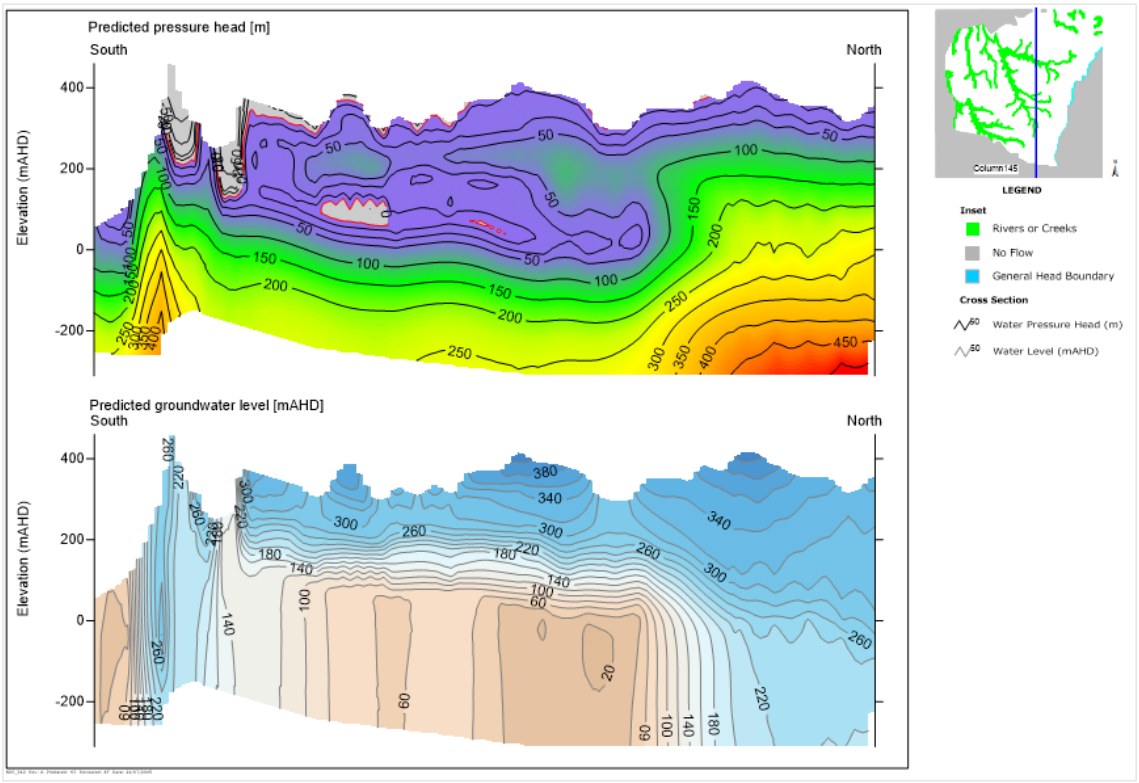


Figure 4 Predicted Pressure Head Initial Conditions (North – South Cross Section on Easting 303000)

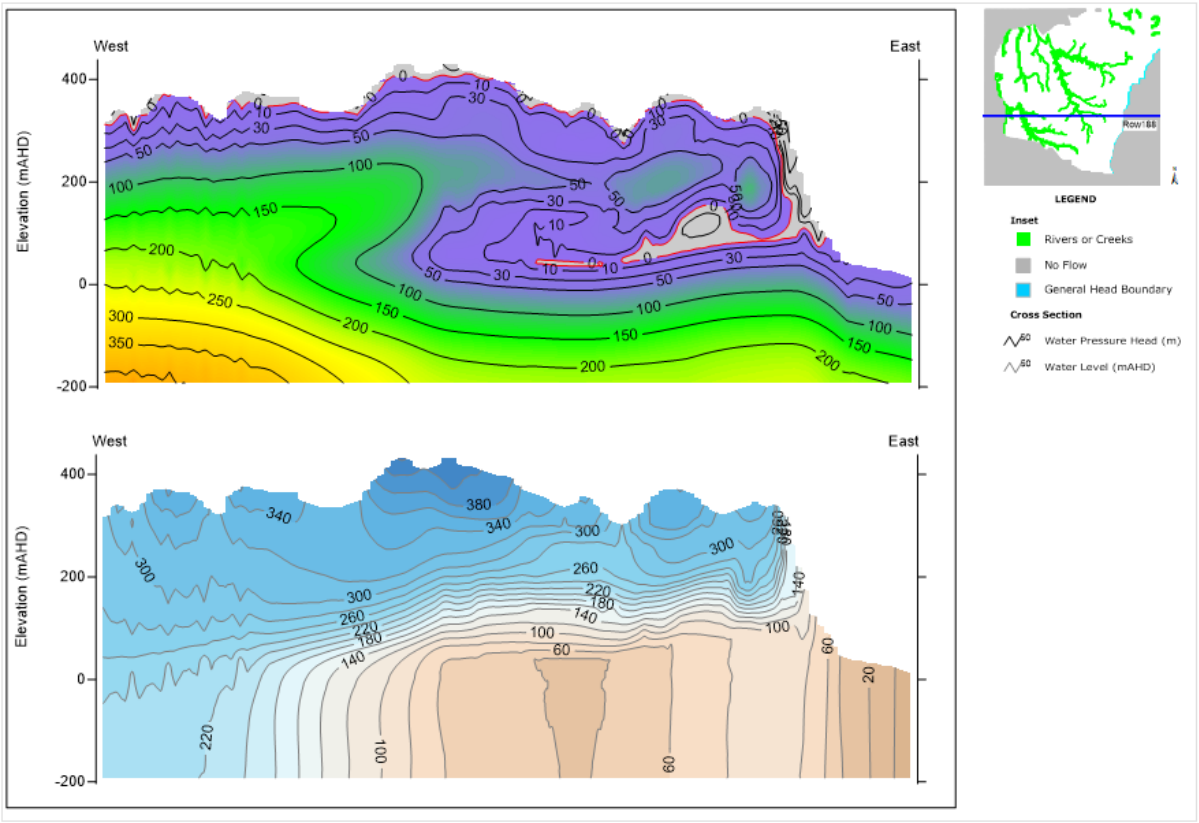


Figure 5 Predicted Pressure Head Initial Conditions at (East – West Cross Section on Northing 6196895)

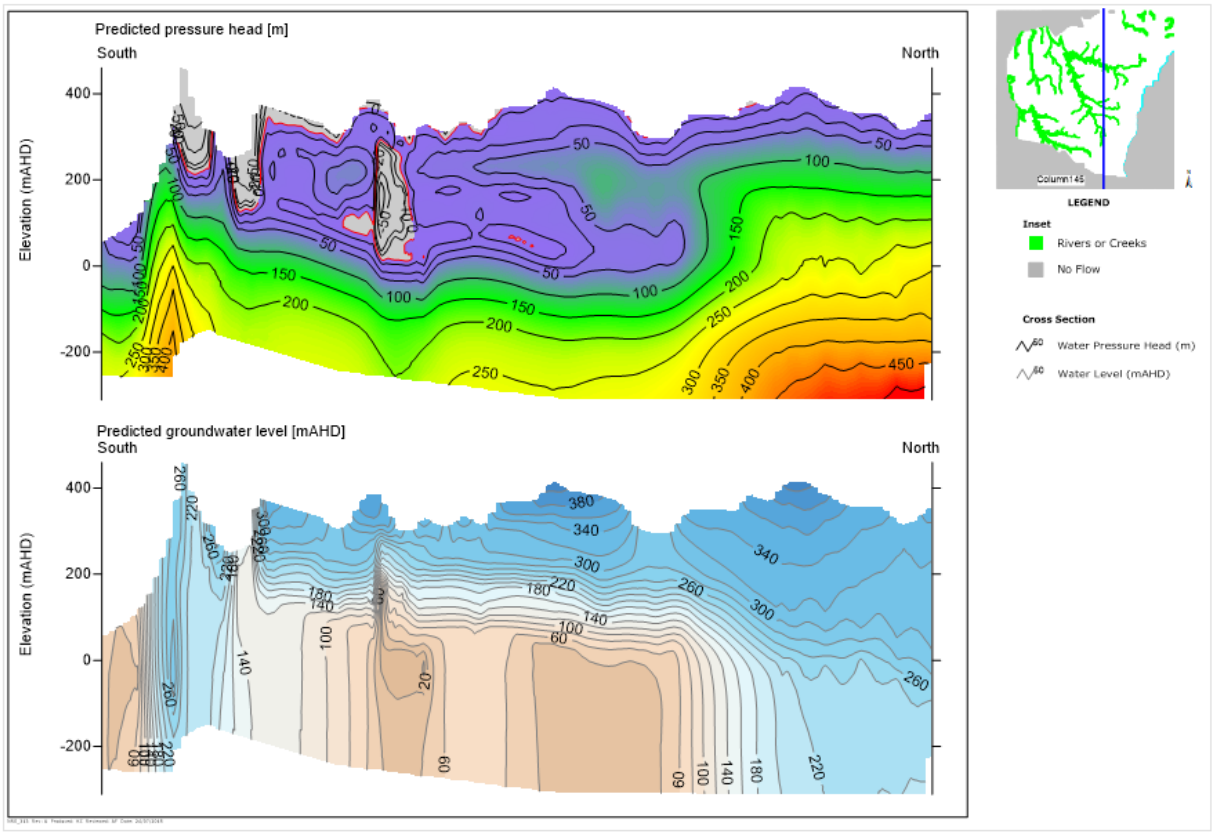


Figure 6 **Predicted Depressurisation at the End of Mining (North – South Cross Section on Easting 303000)**

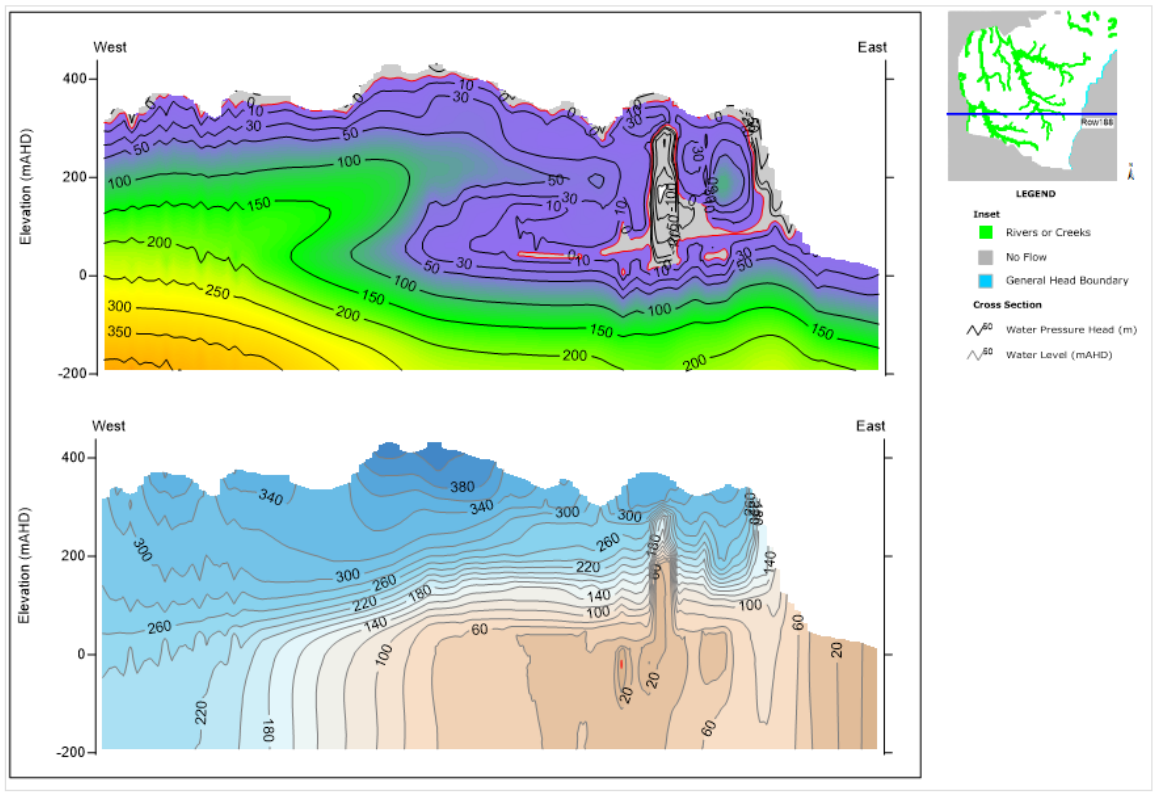


Figure 7 **Predicted Depressurisation at the End of Mining (East – West Cross Section on Northing 6196895)**

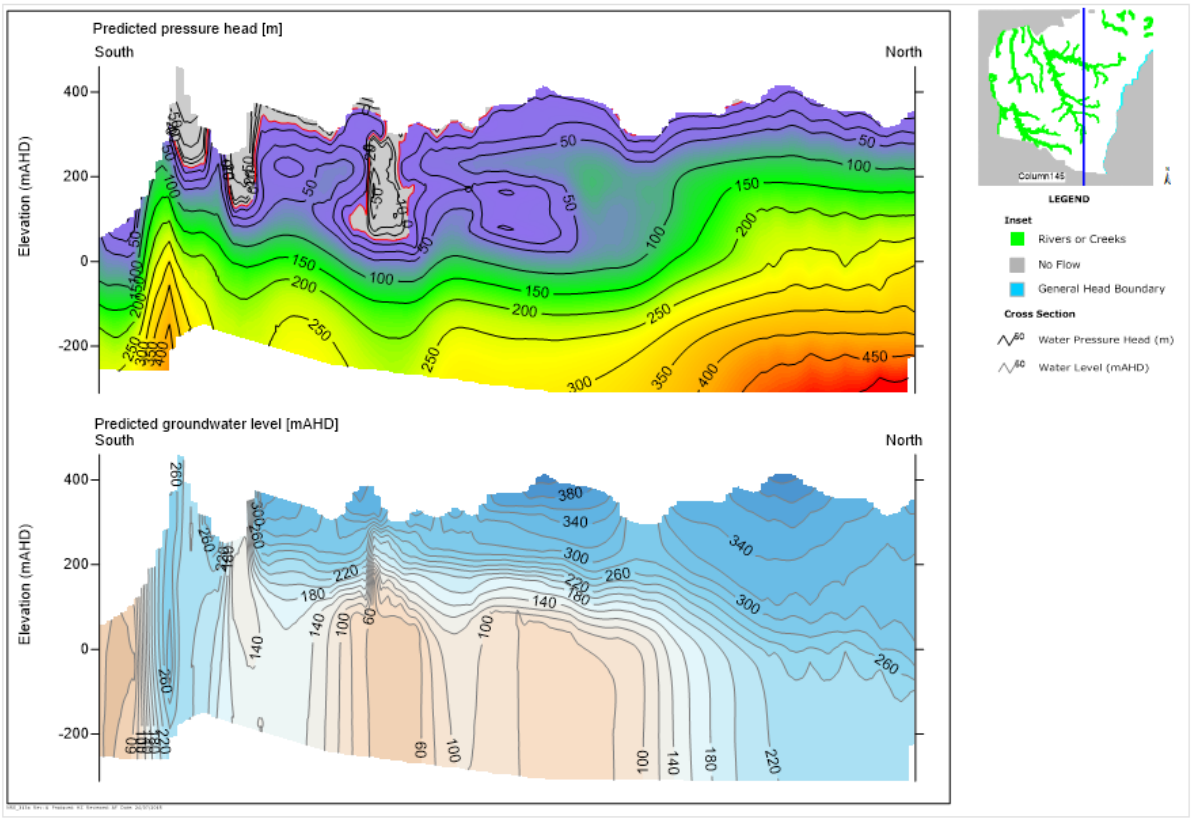


Figure 8 **Predicted Pressure Head at 50 Years after End of Mining (North – South Cross Section on Easting 303000)**

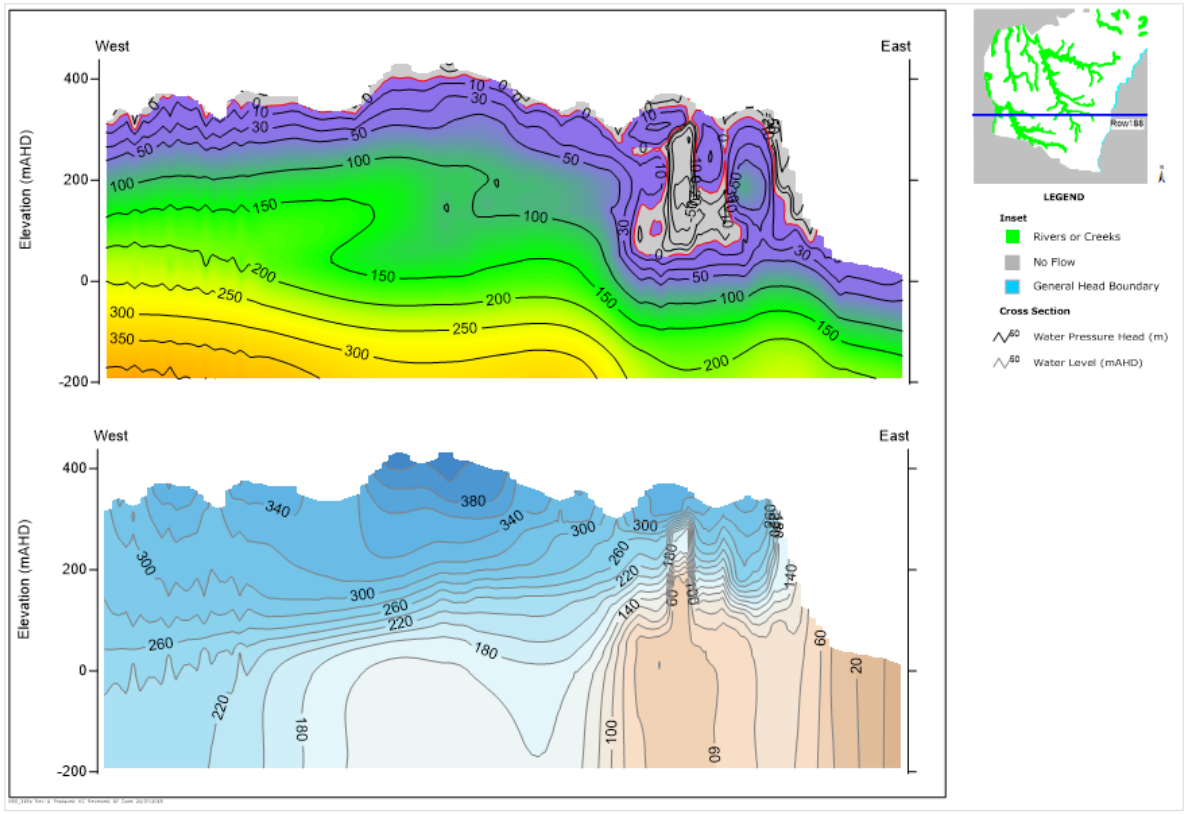


Figure 9 **Predicted Depressurisation at 50 Years after End of Mining (East – West Cross Section on Northing 6196895)**

2.3.1 Shallow, Perched, Ephemeral, Hawkesbury Sandstone

Perched, ephemeral, shallow groundwater within the upper Hawkesbury Sandstone (within Layer 1) have a potential to undergo a water level reduction over the proposed workings after subsidence.

However, as the ephemeral shallow Hawkesbury Sandstone aquifers desiccate after extended dry periods, the effect on the mostly disconnected, shallow, perched aquifers with limited areal extent was not modelled. However, it is logical to conclude that fracturing of the upper, shallow strata would enhance the leakage rate from the perched aquifers into underlying strata over subsided areas, as well as enhancing rainfall recharge and subsequent seepage rates from these perched aquifers into local streams or the underlying aquifers.

2.3.2 Upper Hawkesbury Sandstone / Regolith

The upper Hawkesbury Sandstone aquifer extends across the Study Area, with piezometer data indicating phreatic water levels ranging from 1 – 20m below surface within Russell Vale East. It should be noted that the monitored water level is affected by semi-confined head pressures, whereas the first drilling water intercept, which indicates the upper bound of the aquifer varied from 17 – 48m below surface at Russell Vale East.

After a piezometer is installed, the subsequent water level measurements indicate a combination of head pressure in the aquifer, variability of recharge and other associated factors.

Based on past experience in the Southern Coalfields, the upper regional Hawkesbury Sandstone water levels can rise by up to 2m ahead of a piezometer being undermined, then reduce by up to 15m after development of cracking and additional secondary void space (porosity) in the aquifer. Apart from GW1, all of the piezometers installed by Wollongong Coal have monitored the post mining period in the Bulli and / or Balgownie mining phases.

GW1 was installed after Longwall 4 in the Wongawilli Seam was extracted and observed a water level reduction of up to 25m, with subsequent recovery by up to 31m due to the intermittent stop /start method by which Longwall 5 was mined.

The reduced water level generally recovers over a few months, depending on rainfall recharge in the catchment and the post subsidence outflow seepage rate, if it occurs, to local streams.

Modelling of Layer 1 (including the Hawkesbury Sandstone, Newport / Garie Formation, Bald Hill Claystone and upper Bulgo Sandstone in eroded creek bed locations) after the end of mining in Russell Vale East indicates up to 10m of drawdown as shown in **Figure 10** in comparison to pre Wongawilli Seam development. **Figure 11** shows drawdown after mining is completed in comparison to post LW5 groundwater levels.

Groundwater pressures relative to the end of mining are shown in **Figure 12** to **Figure 15**, which represent 10, 50, 100 and 150 years respectively. Negative groundwater levels indicate that pressures continued to fall post-mining. However, the continued depressurisation appears to stabilise by 50 years after mining and shows partial recovery at 100 years over all mined Russell Vale East longwall panels. At 150 years post mining, Layer 1 shows significant recovery over LWs 9 to 11. However LW's 1-2 remain dewatered at 150 years after mining.

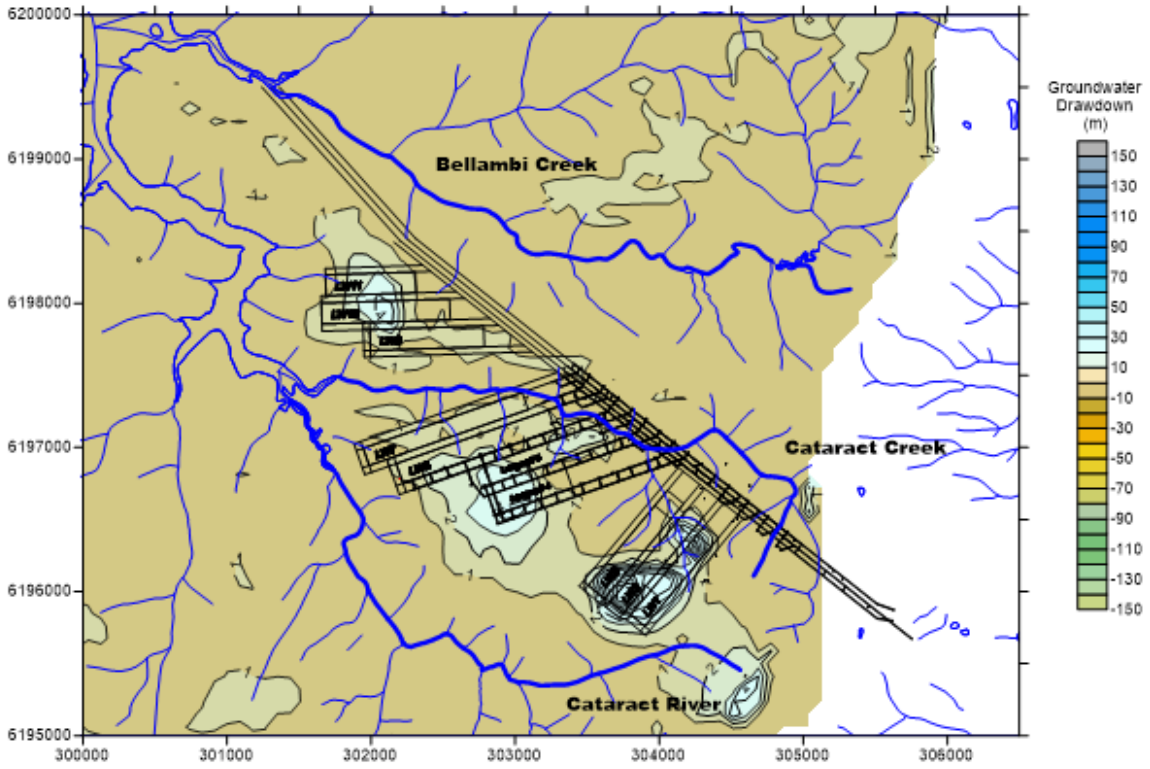


Figure 10 **Layer 1 Drawdown After Mining in Comparison to Pre Wongawilli Seam Development**

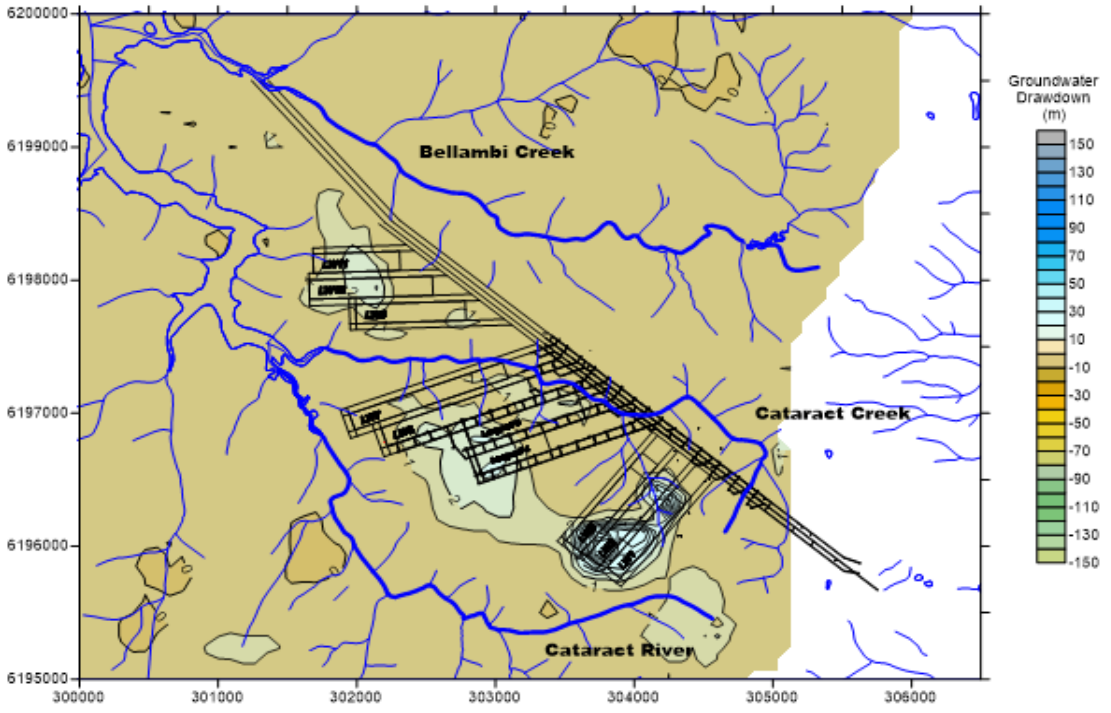


Figure 11 **Layer 1 Drawdown After Mining in Comparison to Post LW5 Development**

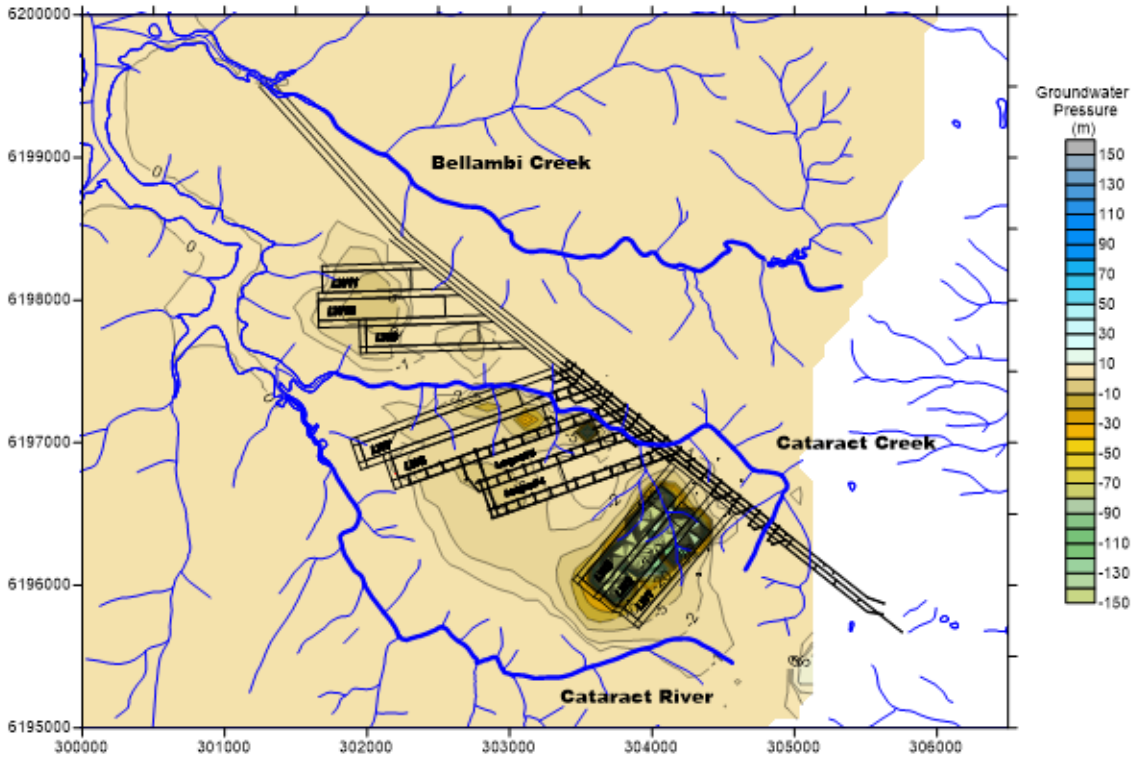


Figure 12 Layer 1 Pressure Difference 10 Years After End of Mining

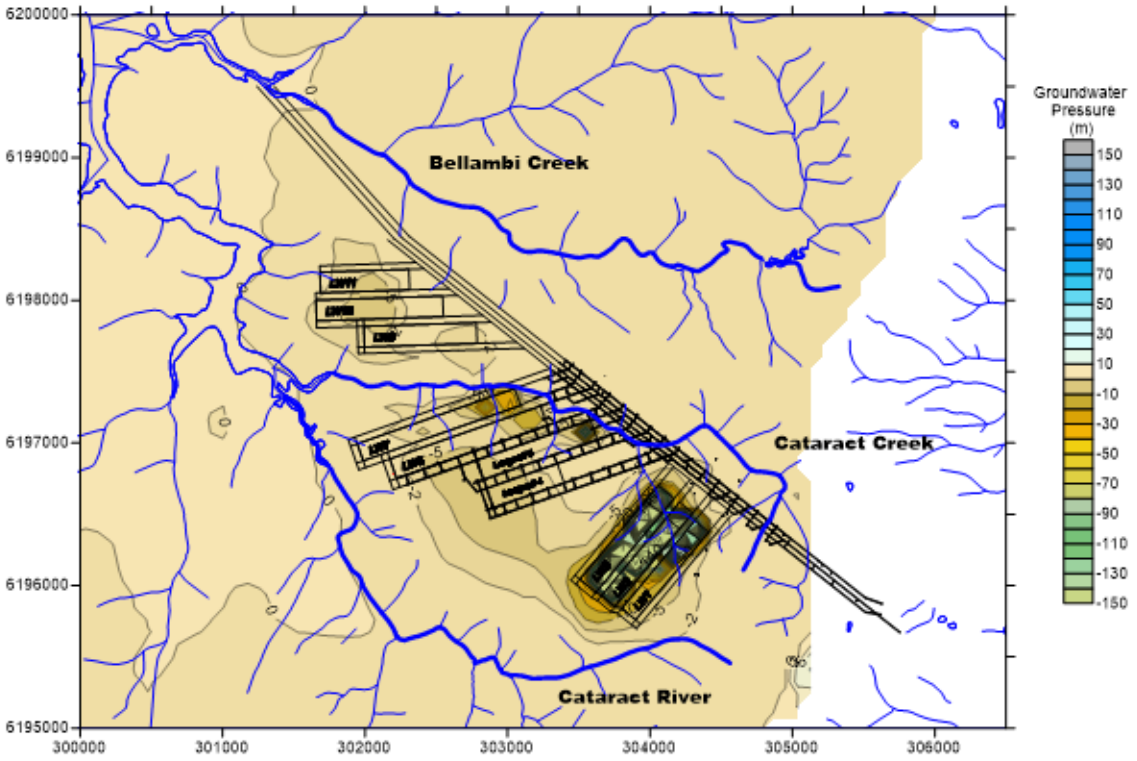


Figure 13 Layer 1 Pressure Difference 50 Years After End of Mining

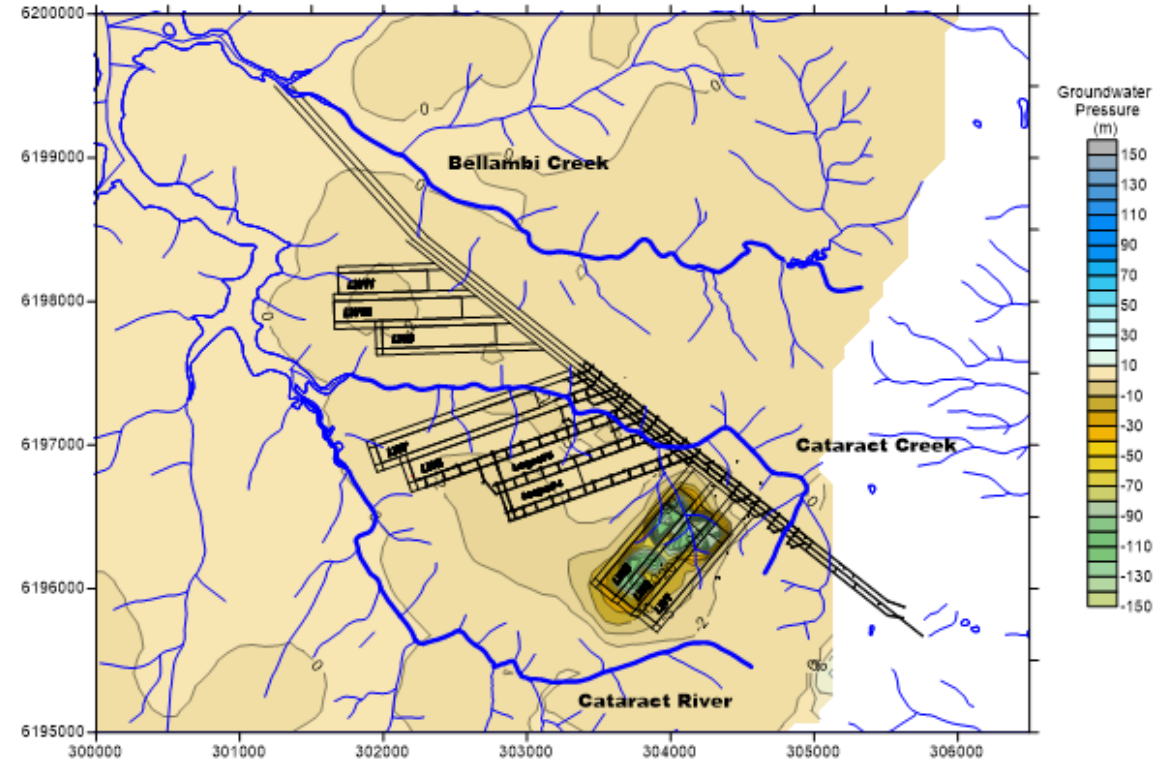


Figure 14 Layer 1 Pressure Difference 100 Years After End of Mining

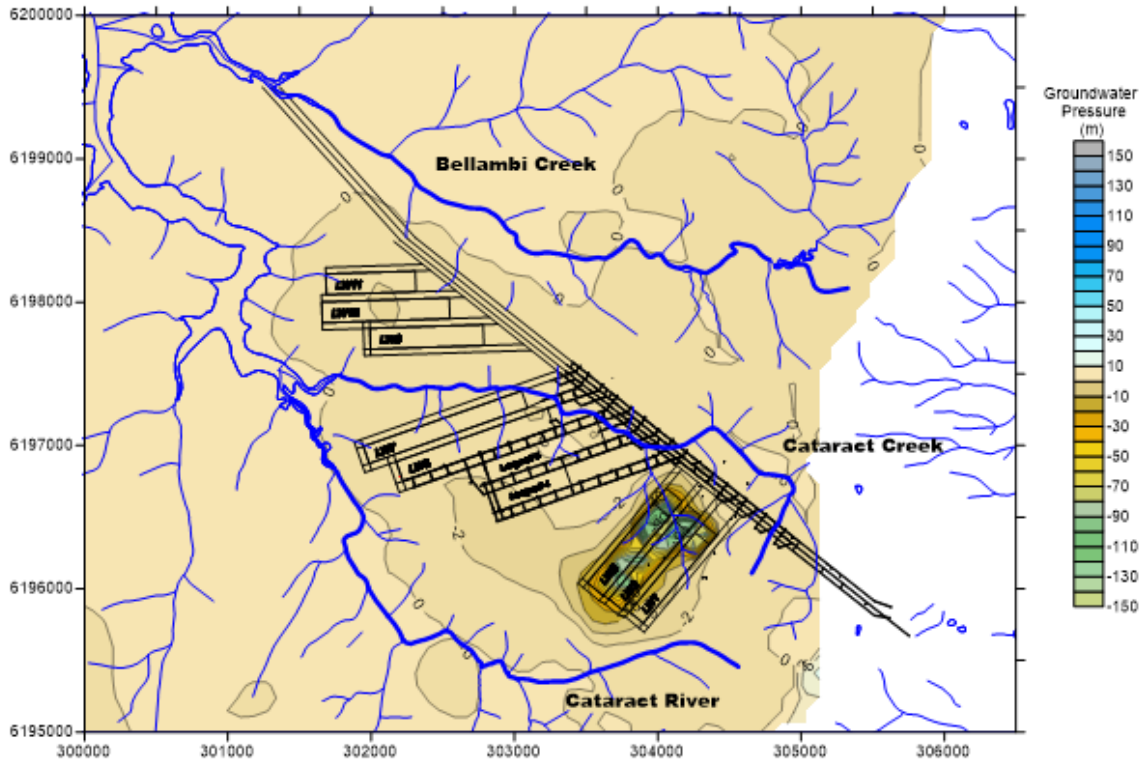


Figure 15 Layer 1 Pressure Difference 150 Years After End of Mining

Modelling of Layer 3 (Lower Hawkesbury Sandstone, Newport / Garie Formation, Bald Hill Claystone and upper Bulgo Sandstone) in eroded creek bed locations after the end of mining at Russell Vale East indicates up to 50m of drawdown occurs over LW1, LW2 and LW3, and a small area in LW6 as shown in **Figure 16** in comparison to pre Wongawilli Seam development. This suggests that the Hawkesbury Sandstone in this layer over LWs 1-3 will become unsaturated. **Figure 17** shows drawdown after mining is completed in comparison to post LW5 groundwater levels.

Figure 18 to **Figure 21** represent 10, 50, 100 and 150 years respectively after mining. As in the upper Hawkesbury Sandstone and regolith in Layer 1, negative groundwater levels indicate that pressures continued to fall post-mining. This is most prevalent in LW7 and part of LW 6 and also in LWs 1-3 where dewatering has occurred. These figures show that further reduction in groundwater pressures are expected to occur to 10 years after mining. By 50 years after mining, loss of pressure peaks and begins to show recovery. By 100 years after mining, the layer has re-saturated in all areas, except over LW1-3.

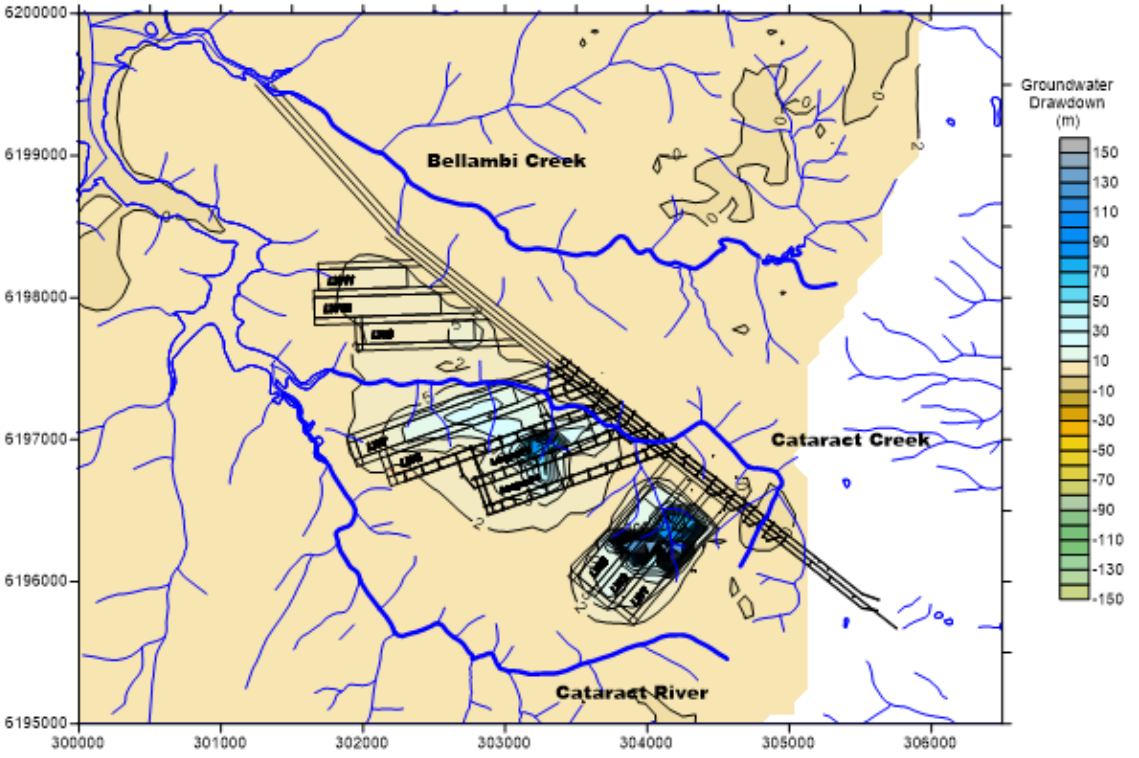


Figure 16 **Layer 3 Drawdown After Mining in Comparison to Pre Wongawilli Seam Development**

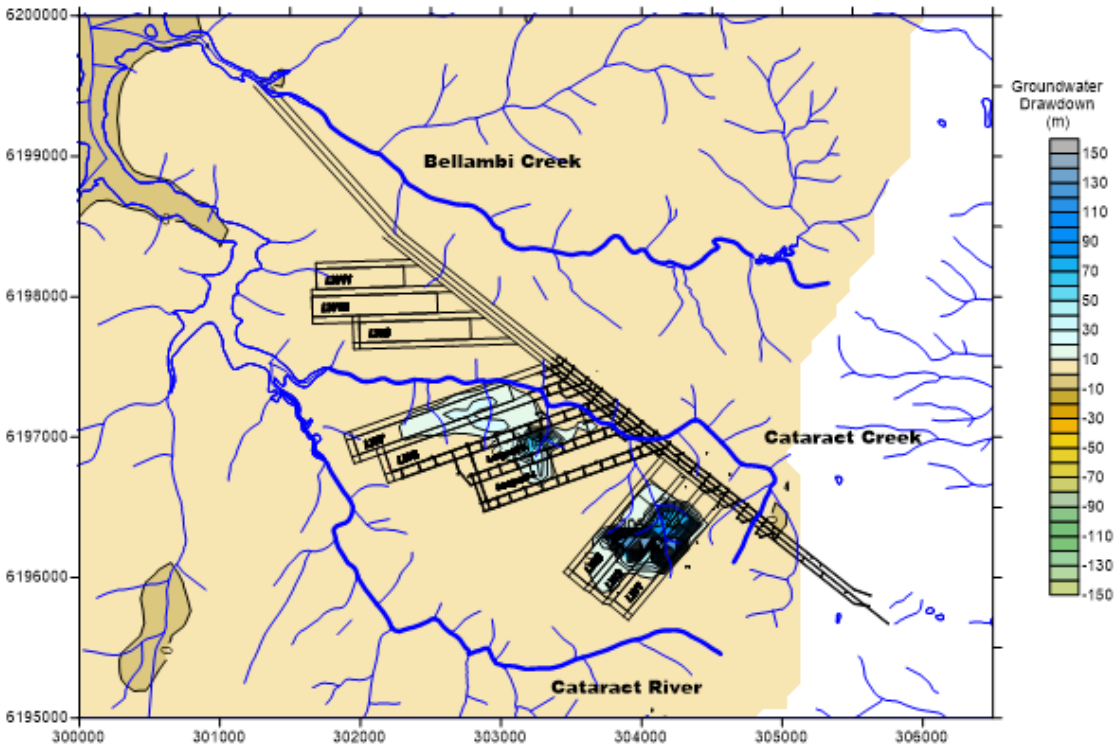


Figure 17 **Layer 3 Drawdown After Mining in Comparison to Post LW5 Development**

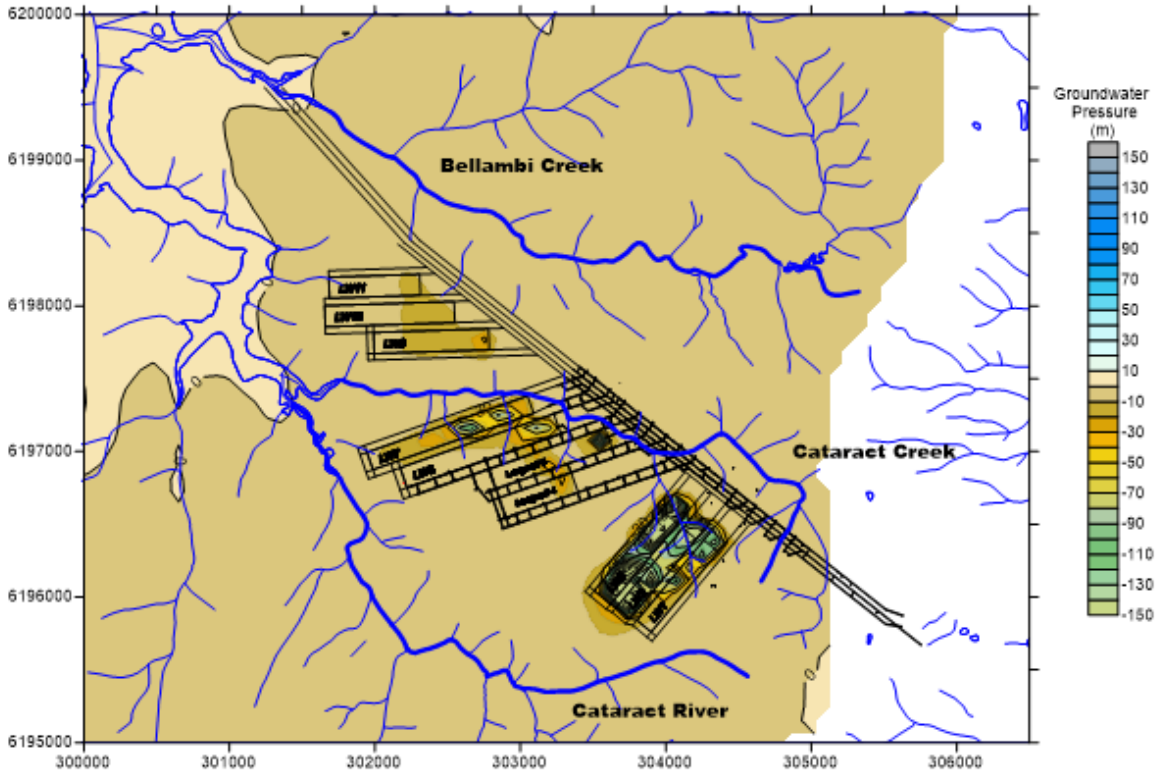


Figure 18 Layer 3 Pressure Difference 10 Years After Mining at Russell Vale East

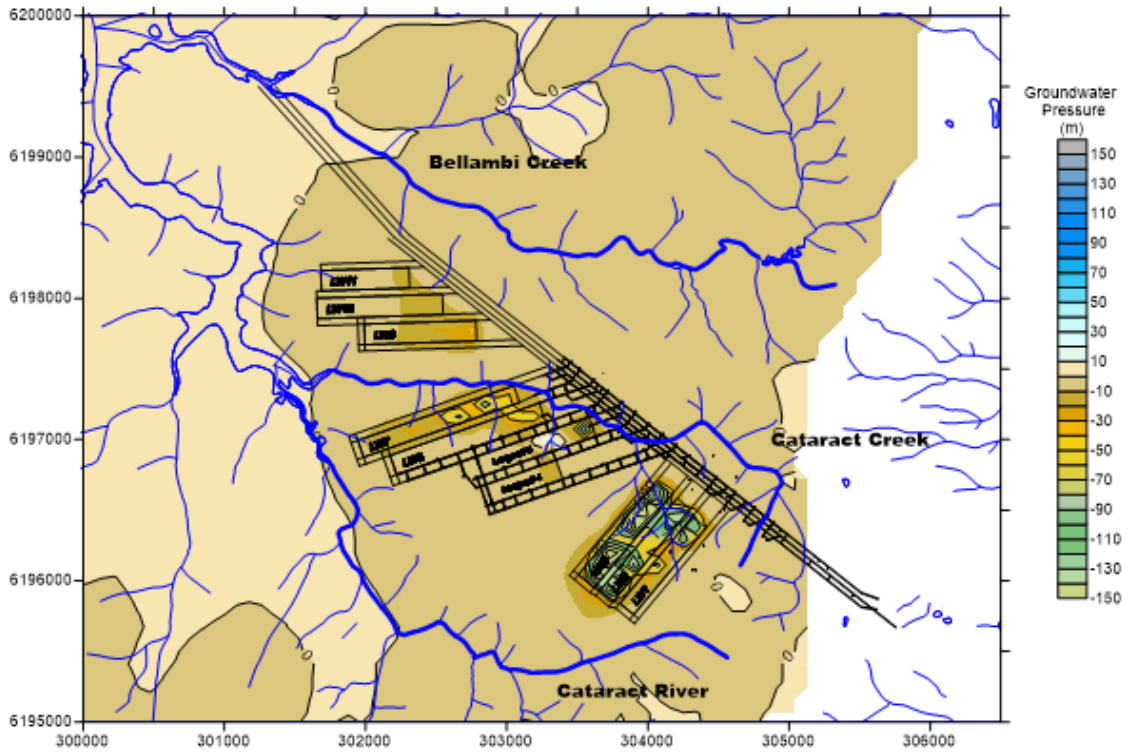


Figure 19 Layer 3 Pressure Difference 50 Years After Mining at Russell Vale East

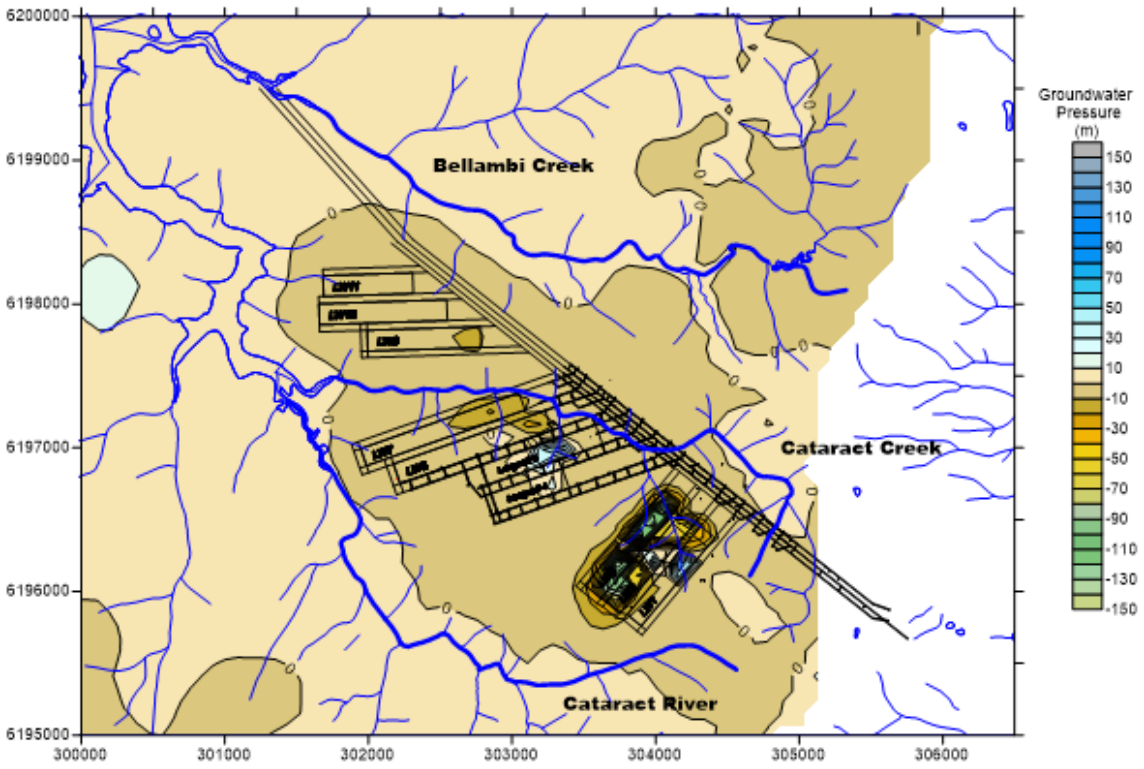


Figure 20 Layer 3 Pressure Difference 100 Years After Mining at Russell Vale East

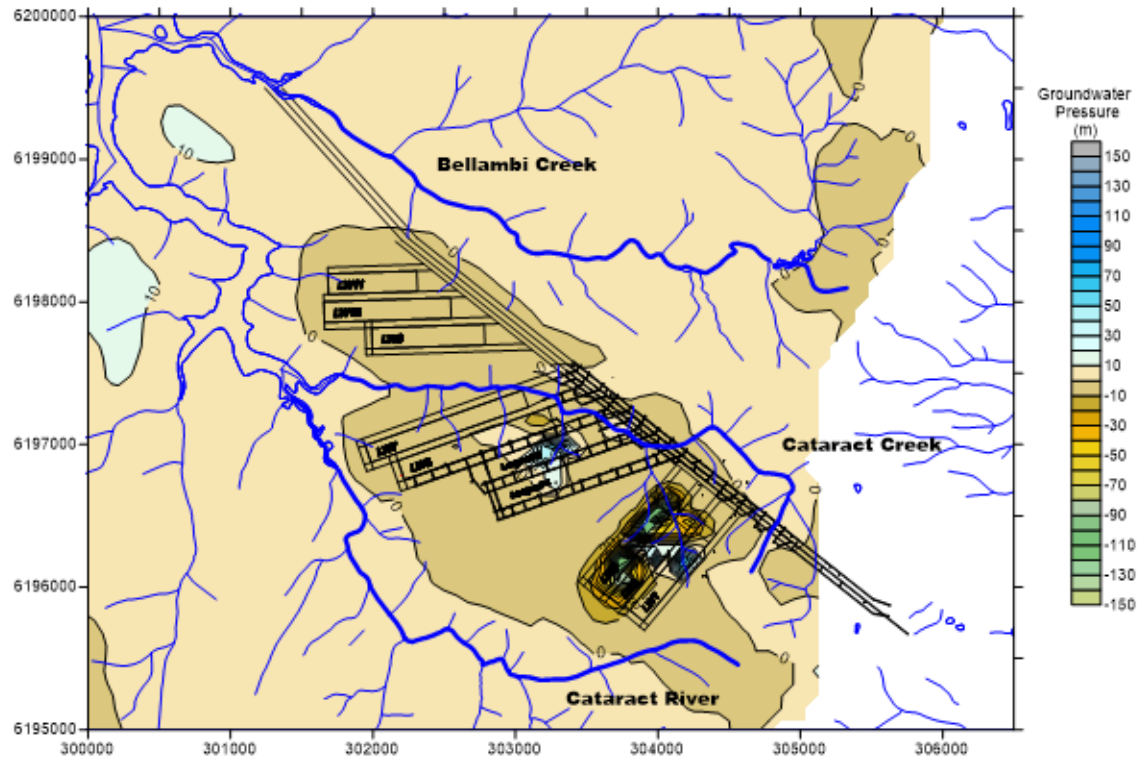


Figure 21 Layer 3 Pressure Difference 150 Years after Mining at Russell Vale East

2.3.3 Upper Bulgo Sandstone

Figure 22 shows modelling results for Layer 5 (Upper Bulgo Sandstone) after the end of mining, which indicates up to 45m of drawdown over Russell Vale East, which occurs within the footprint of LWs 1-7 and part of LW9, in comparison to pre Wongawilli Seam development. **Figure 23** shows drawdown after mining is completed in comparison to post LW5 groundwater levels. As was the case for the overlying layers, the main difference between these two drawdown periods is the drawdown over LW4 and LW5.

Elsewhere over LW1 to LW3, drawdown of up to 25m occurs after the completion of mining.

Modelling indicates that drawdown of up to 2m extends a maximum of 1km to the west of LW7 following completion of mining.

Figure 24 to **Figure 27** represent 10, 50, 100 and 150 years after mining respectively. Negative groundwater levels indicate that pressures continue to fall post-mining. The drawdown cone remains relatively steep and pressure loss appears to peak at approximately 50 years after mining, although a significant proportion of the mining footprint remains unsaturated throughout the recovery period.

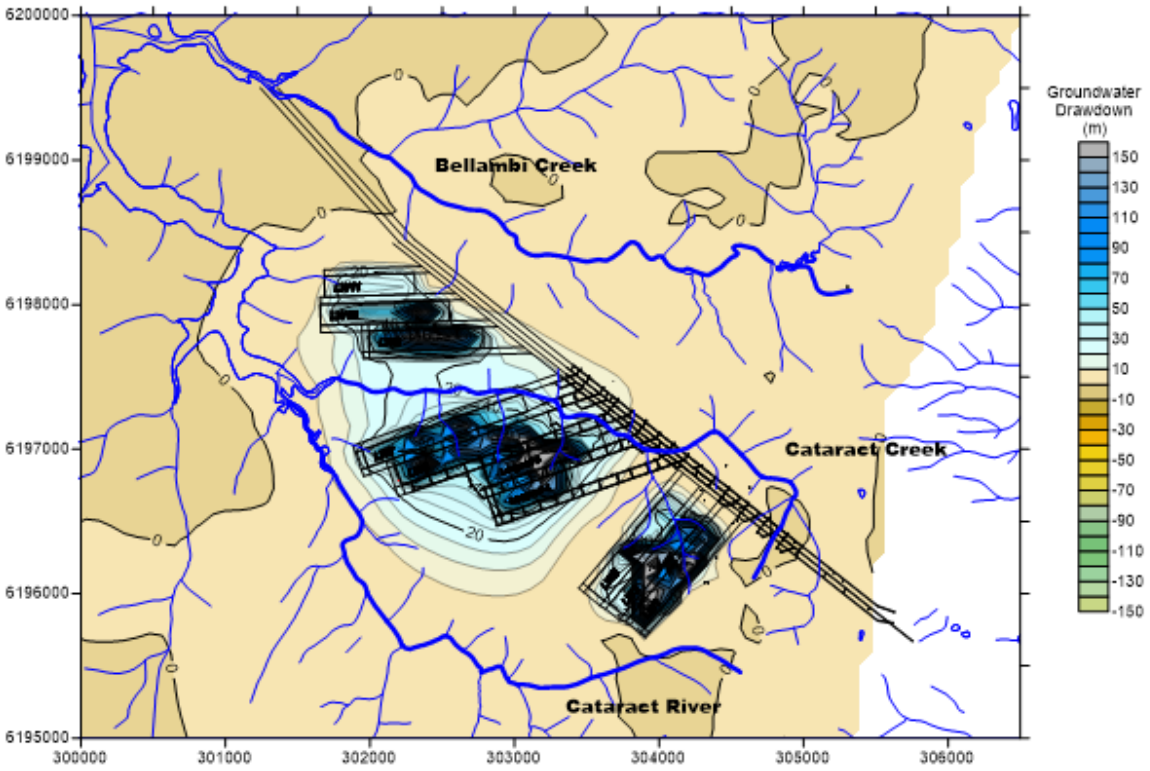


Figure 22 **Upper Bulgo Sandstone Drawdown After Mining in Comparison to Pre Wongawilli Seam Development**

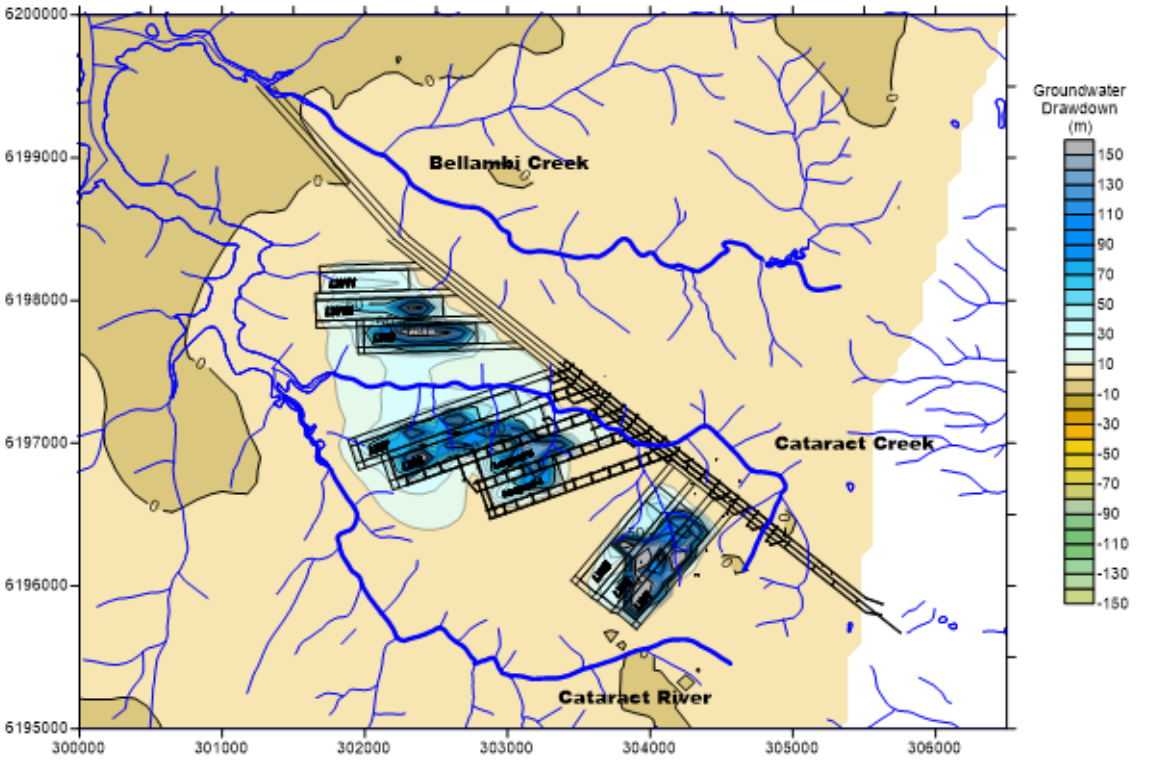


Figure 23 **Upper Bulgo Sandstone Drawdown After Mining in Comparison to Post LW5 Development**

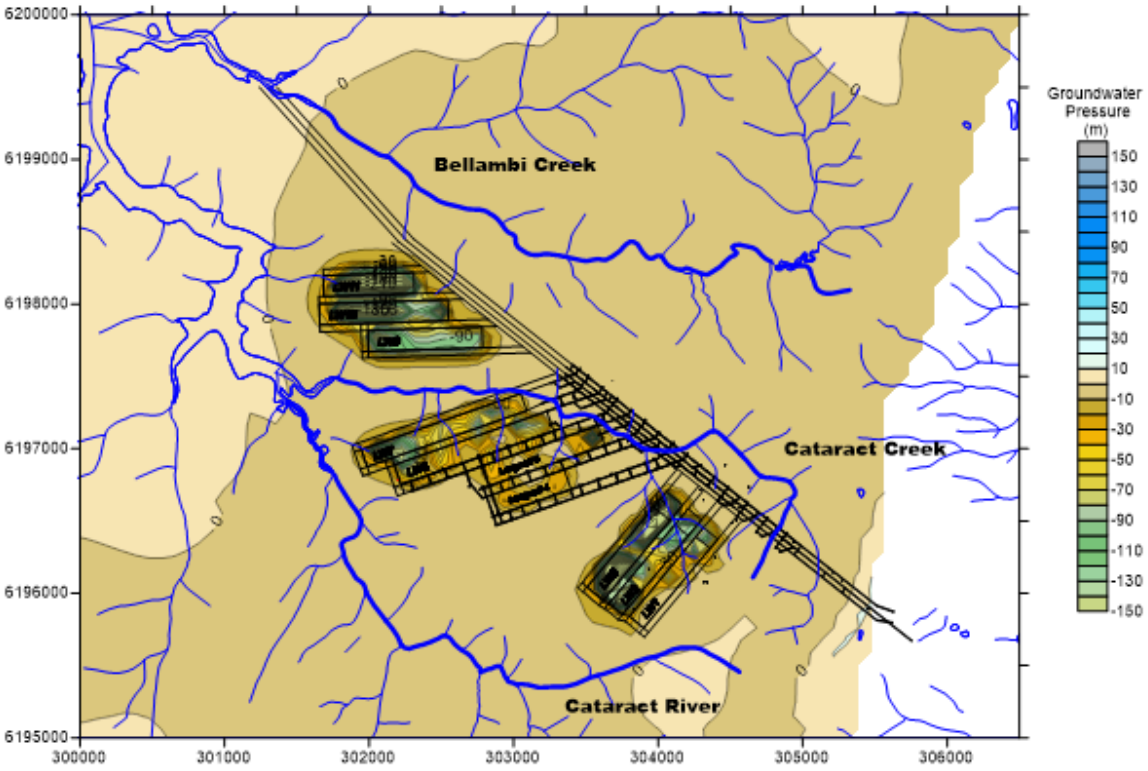


Figure 24 Upper Bulgo Sandstone Recovery at 10 Years After Mining

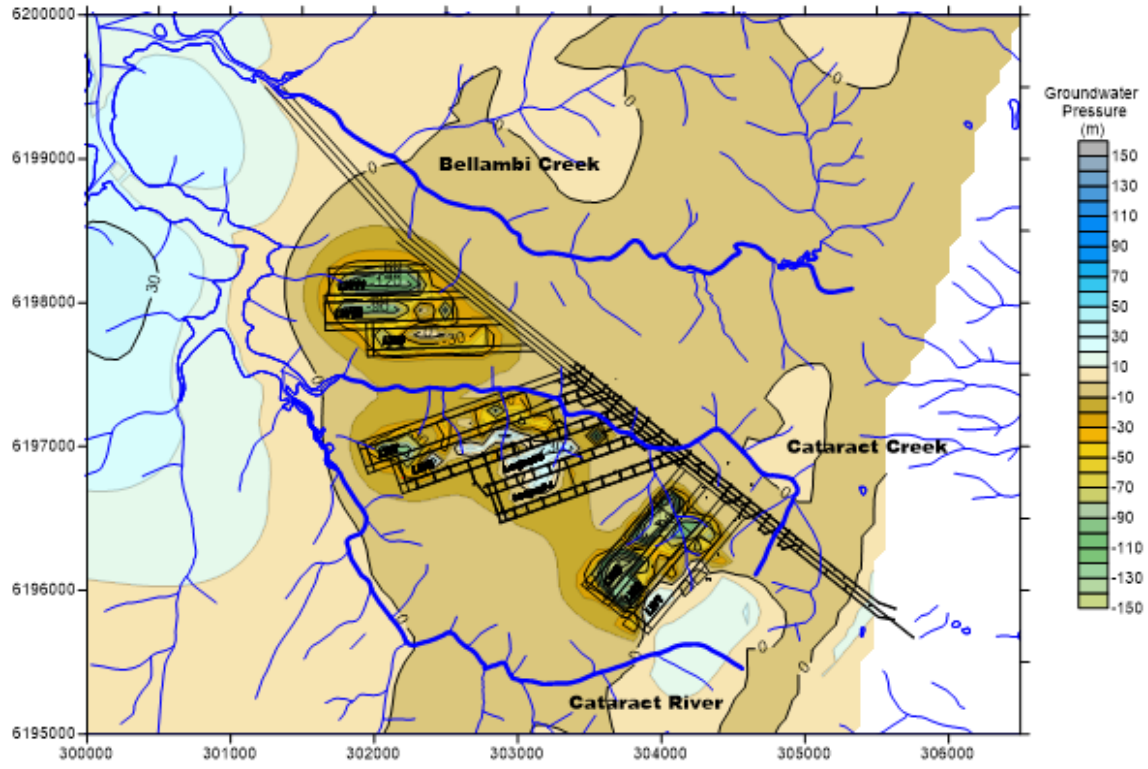


Figure 25 Upper Bulgo Sandstone Recovery 50 Years After Mining East

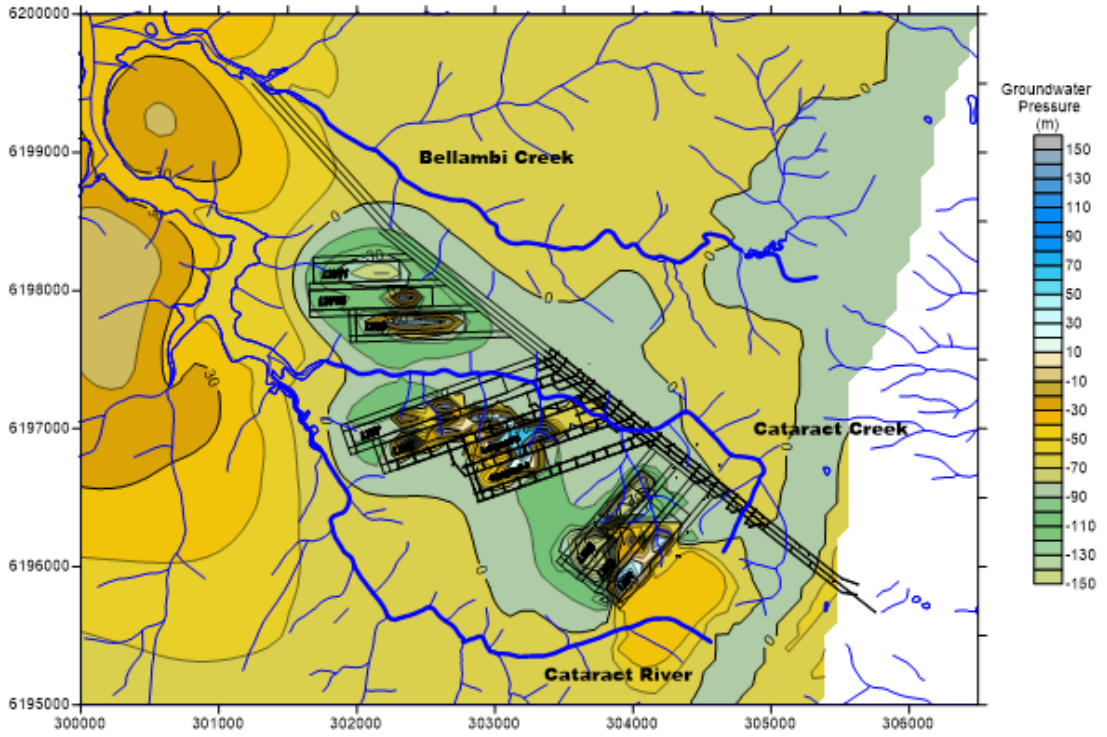


Figure 26 Upper Bulgo Sandstone Recovery 100 Years After Mining

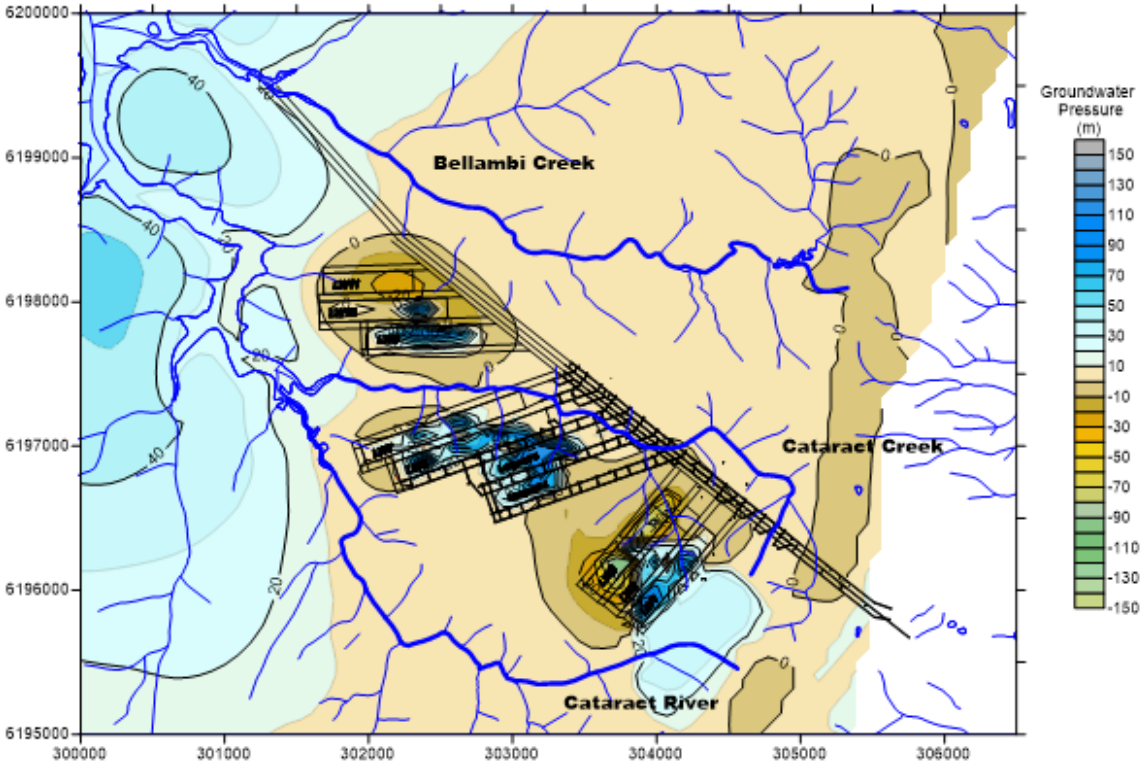


Figure 27 Upper Bulgo Sandstone Recovery 150 Years After Mining

2.3.4 Scarborough Sandstone

Modelling of Scarborough Sandstone (Layer 10) after the end of mining at Russell Vale East indicates drawdown below the base of the layer within the footprint of the proposed Wongawilli Longwalls as shown in Figure 28. The extent of depressurisation is limited by already impacted water levels from previous regional mining activities. The predicted areal extent of drawdown at the end of mining shows 0m extending a maximum of 2km to the south of LW4. Depressurisation at the end of mining relative to the end of LW5 is shown in **Figure 29**.

Figure 30 shows pressures 10 years after mining has been completed, relative to the end of mining and **Figure 31** shows groundwater levels (mAHD) for the same period. These show that a level of recovery has begun. A wave of pressure is pushing in from the west as all drain cells are turned off following the end of mining the Wongawilli Seam at Russel Vale.

Similarly, **Figure 32** and **Figure 33** show the same situation at 50 years after mining is completed which shows a greater degree of recovery within the longwall footprint but still some residual drawdown is present.

Figure 34 and **Figure 35** show the situation at 100 years after mining is completed. **Figure 36** and **Figure 37** show the situation simulated at 150 years after mining is completed. These show progressive recovery beyond initial conditions.

2.3.5 Bulli Seam

No Bulli Seam drawdown figures are presented in this section as the seam is generally dry at Russell Vale East.

2.3.6 Wongawilli Seam

Drawdown in the Wongawilli Seam at the end of mining in comparison to pre Wongawilli Seam development in Russell Vale East is modelled to reach up to 42m over LW1 and to 67m over LW10. The areal extent of the 2m drawdown contour at the end of mining at Russell Vale East extends a maximum of 2km to the north and south of the main workings as shown in **Figure 38**.

Figure 39 shows drawdown after mining is completed in comparison to post LW5 groundwater levels. As in overlying layers, the main difference between these two drawdown periods is the drawdown over LW4 and LW5. There is a significant difference in the areal extent of the drawdown cones observed between the two scenarios due to the drawdown associated with the currently approved mining of LW5 and development headings for LW6.

At 10 years after completion of mining, the Wongawilli Seam is predicted to recover by up to 20m in the western areas (LW10) in comparison to end of mining conditions as shown in **Figure 40**. Groundwater pressure (mAHD) at the same period are shown in **Figure 41**.

At 50 years after completion of mining, the Wongawilli Seam is predicted to recover by up to 120m over LW10 which is above initial conditions and again brought about by the removal of all regional drains. **Figure 42** shows groundwater pressures in comparison to end of mining conditions over Russell Vale Colliery. At this time there, is 80m recovery in the vicinity of LW10 and 30m in the vicinity of LW2. Groundwater pressure (mAHD) at the same period are shown **Figure 43.**

This trend continues following 100 years after mining as indicated in **Figure 44** and **Figure 45** respectively.

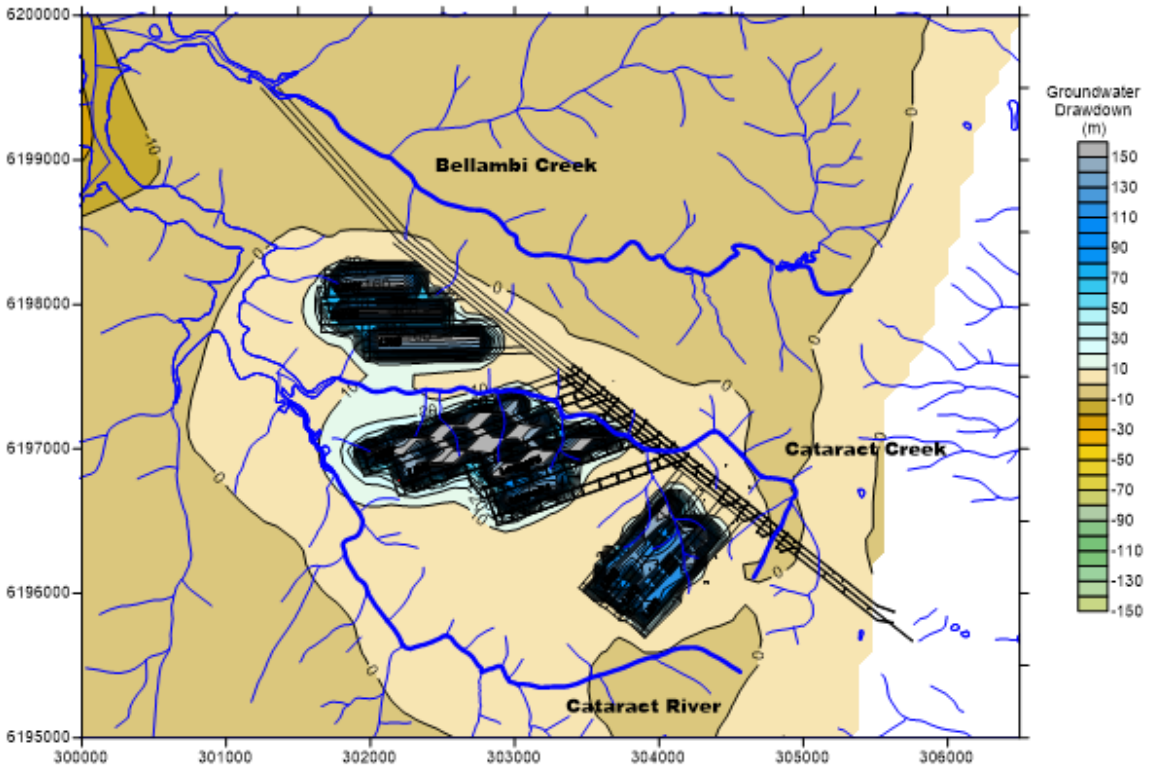


Figure 28 Scarborough Sandstone Drawdown After Mining in Comparison to Pre Wongawilli Seam Development

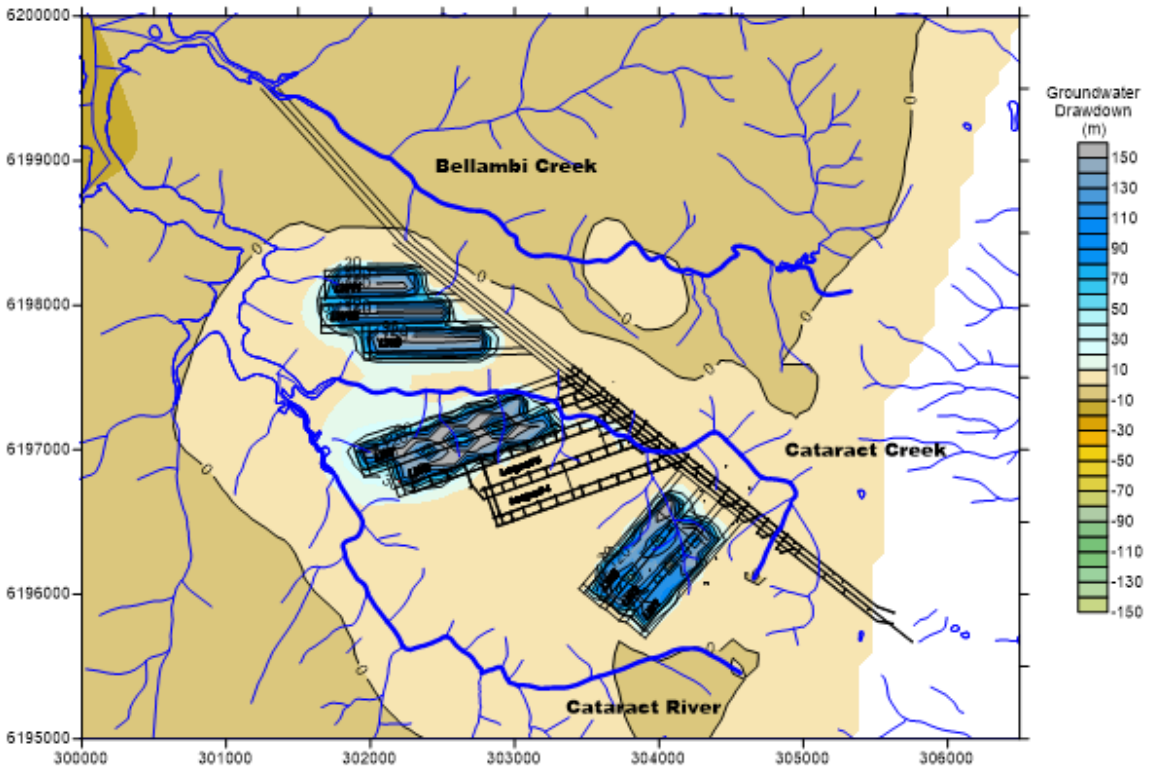


Figure 29 Scarborough Sandstone Drawdown After Mining in Comparison to Post LW5 Development

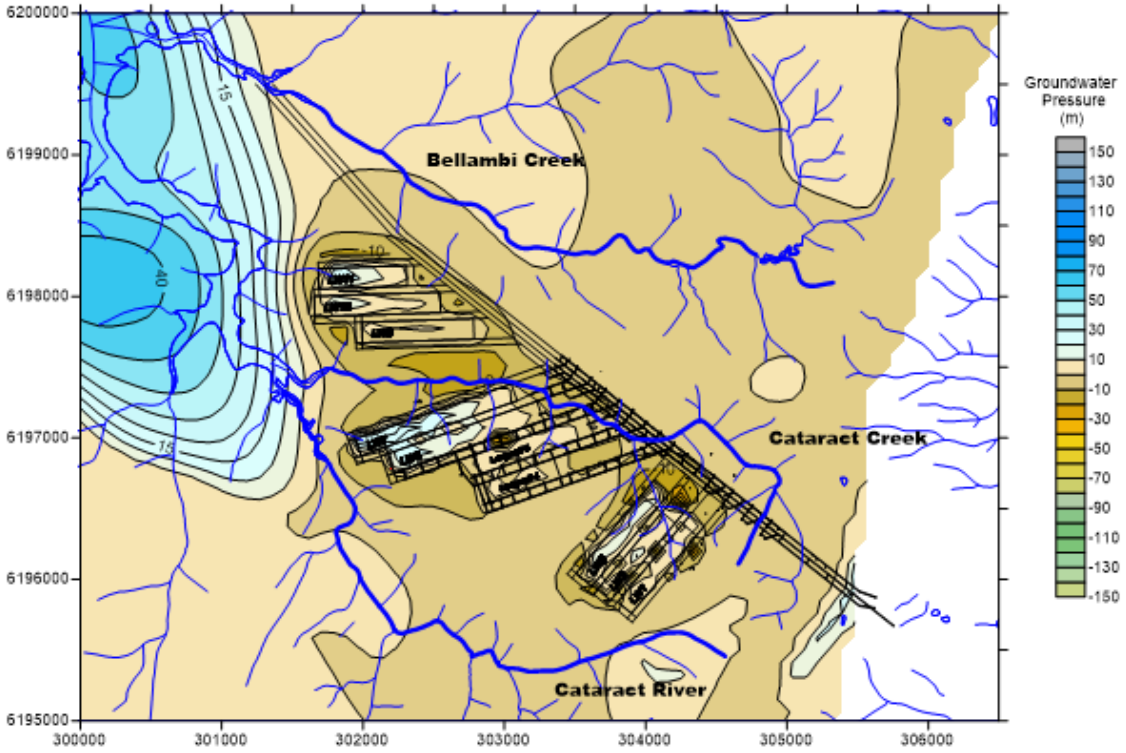


Figure 30 Scarborough Sandstone Pressure Recovery at 10 Years After End of Mining

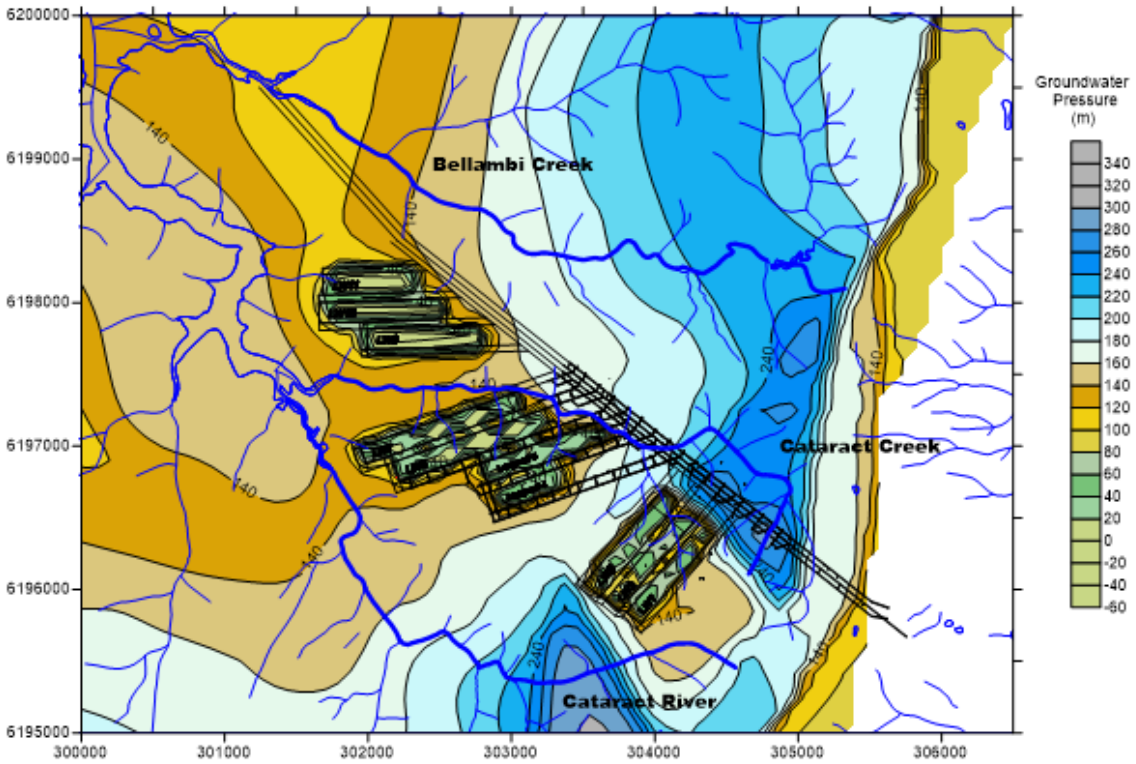


Figure 31 Scarborough Sandstone Groundwater Pressures 10 Years After Mining (mAHD)

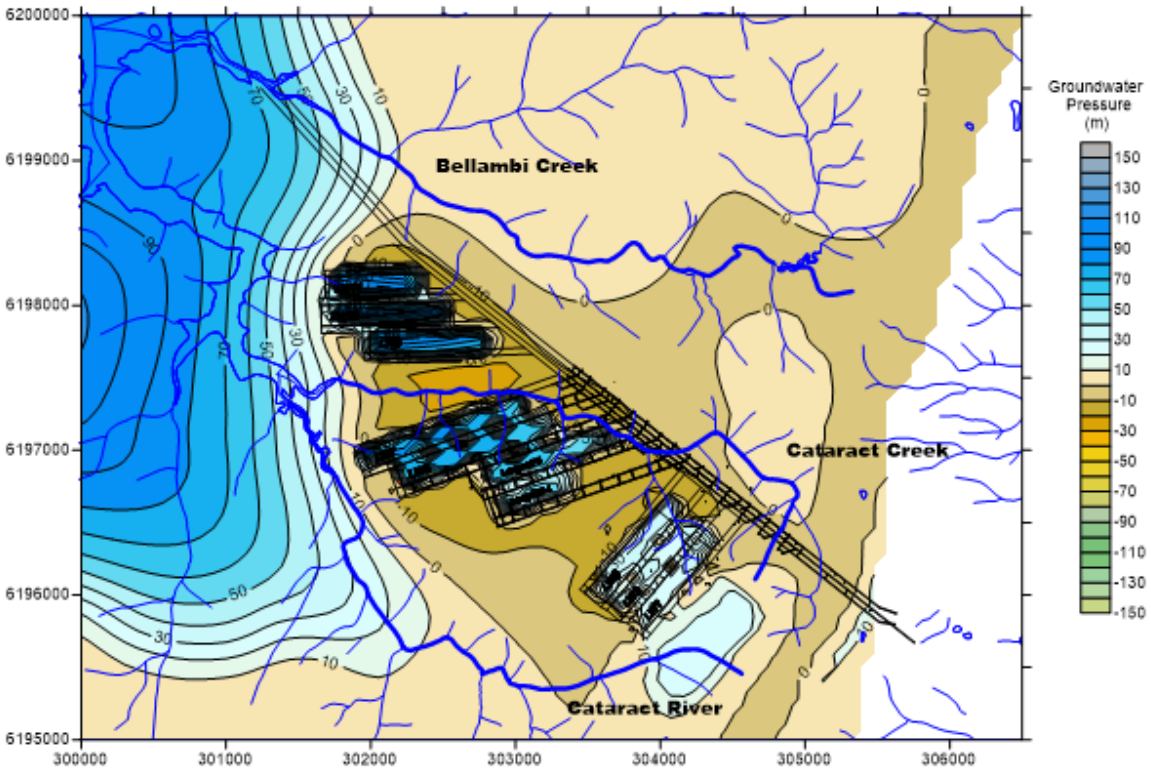


Figure 32 Scarborough Sandstone Pressure Recovery at 50 Years After Mining

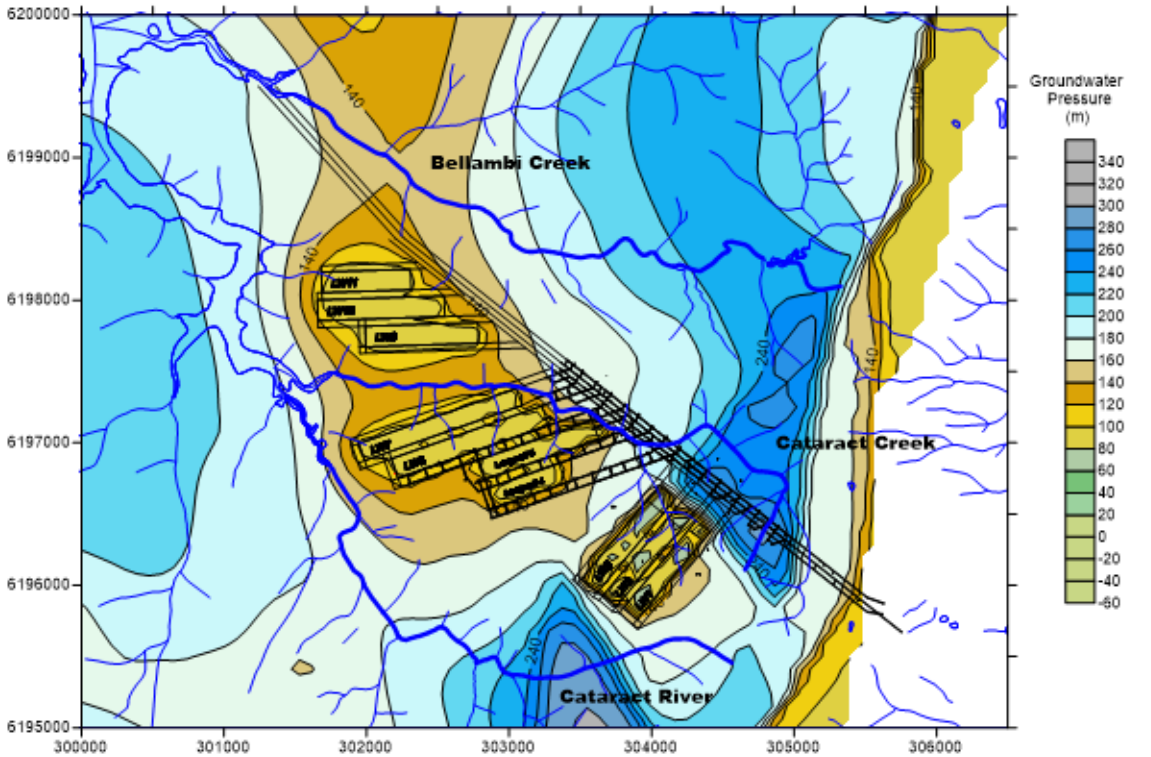


Figure 33 Scarborough Sandstone Groundwater Pressures at 50 Years After Mining (mAHD)

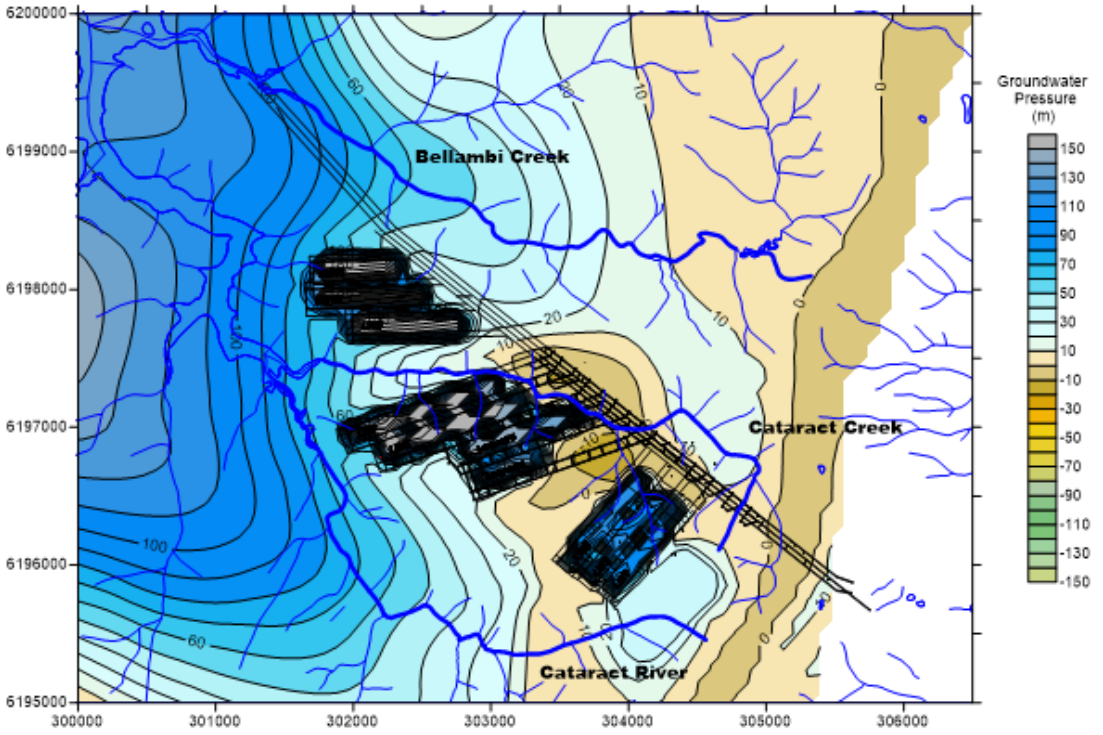


Figure 34 Scarborough Sandstone Pressure Recovery at 100 Years After Mining

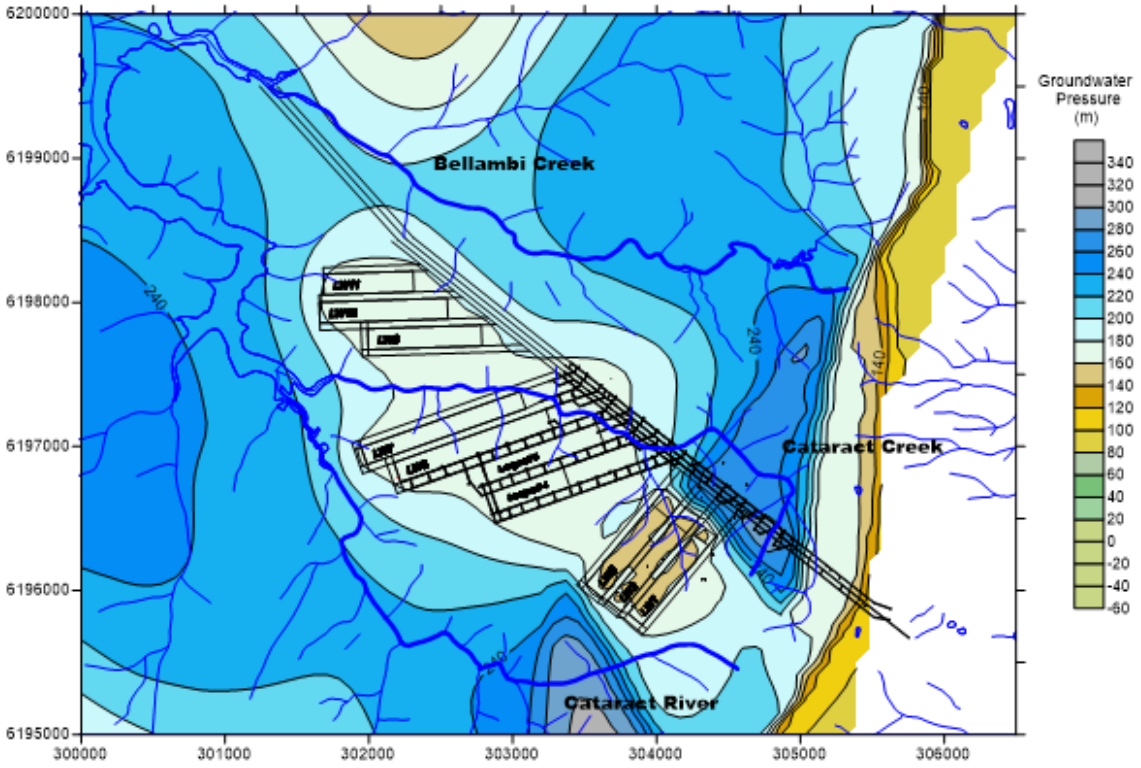


Figure 35 Scarborough Sandstone Groundwater Pressures at 100 Years After Mining (mAHD)

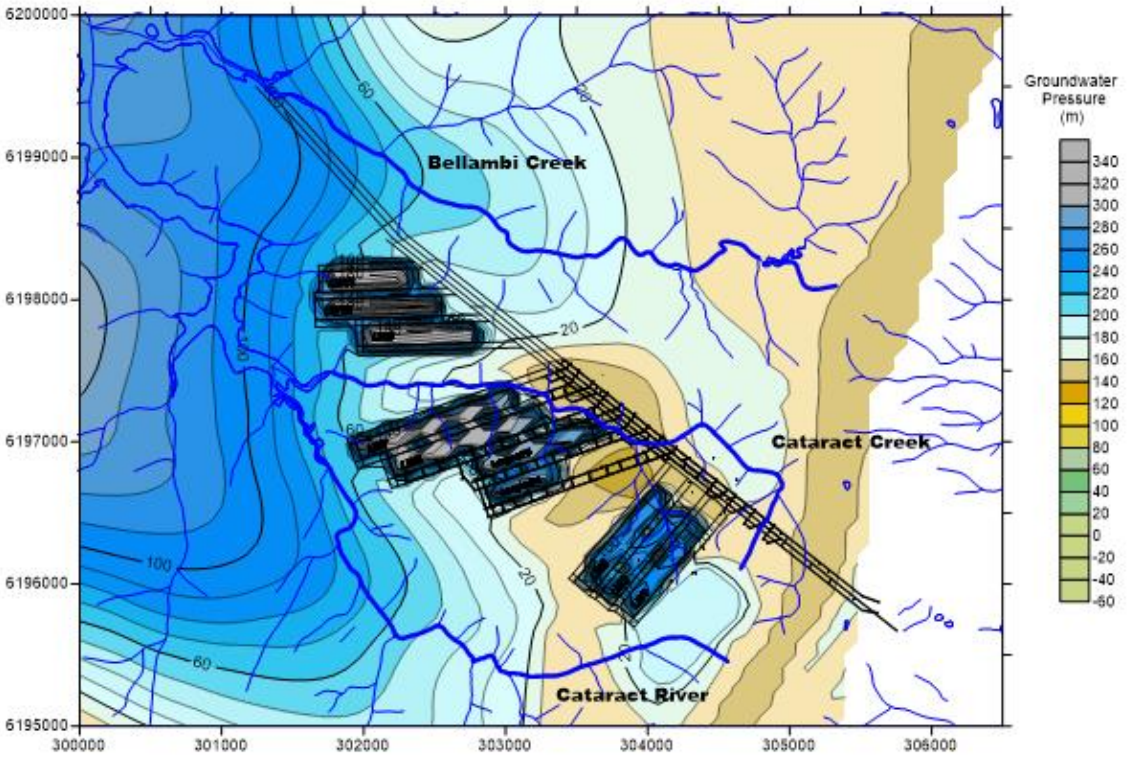


Figure 36 Scarborough Sandstone Pressures Recovery at 150 Years After Mining

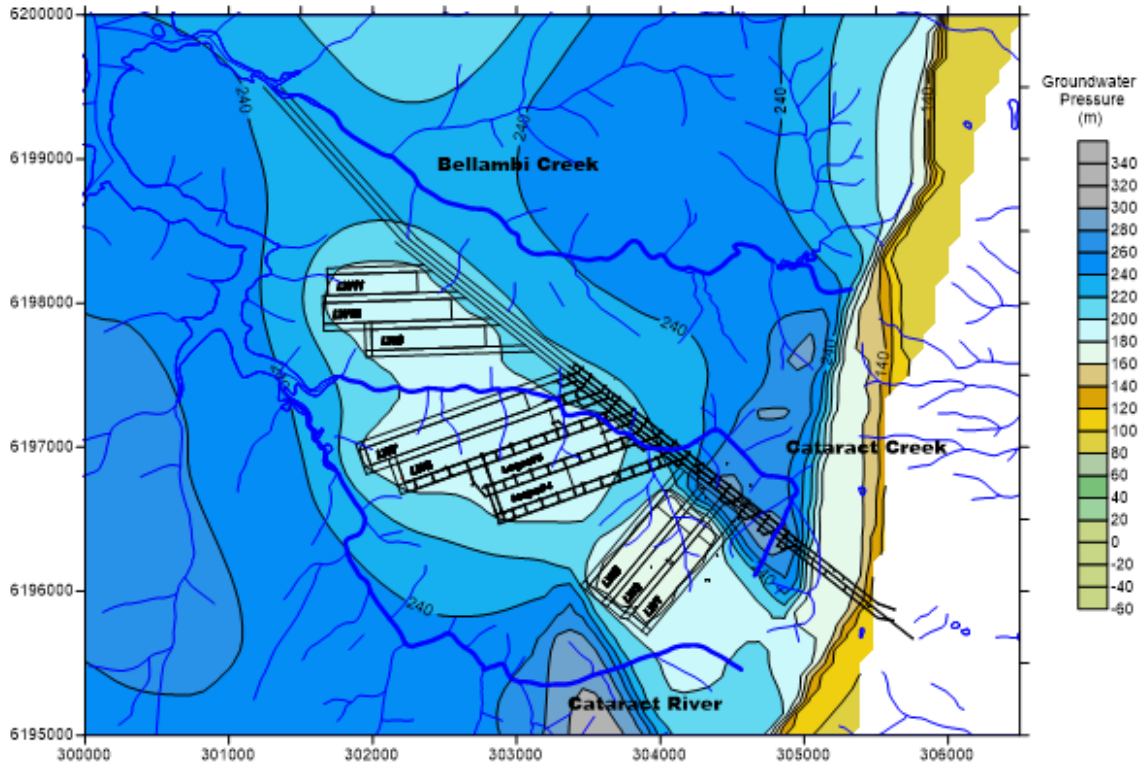


Figure 37 Scarborough Sandstone Groundwater Recovery at 100 Years After Mining (mAHD)

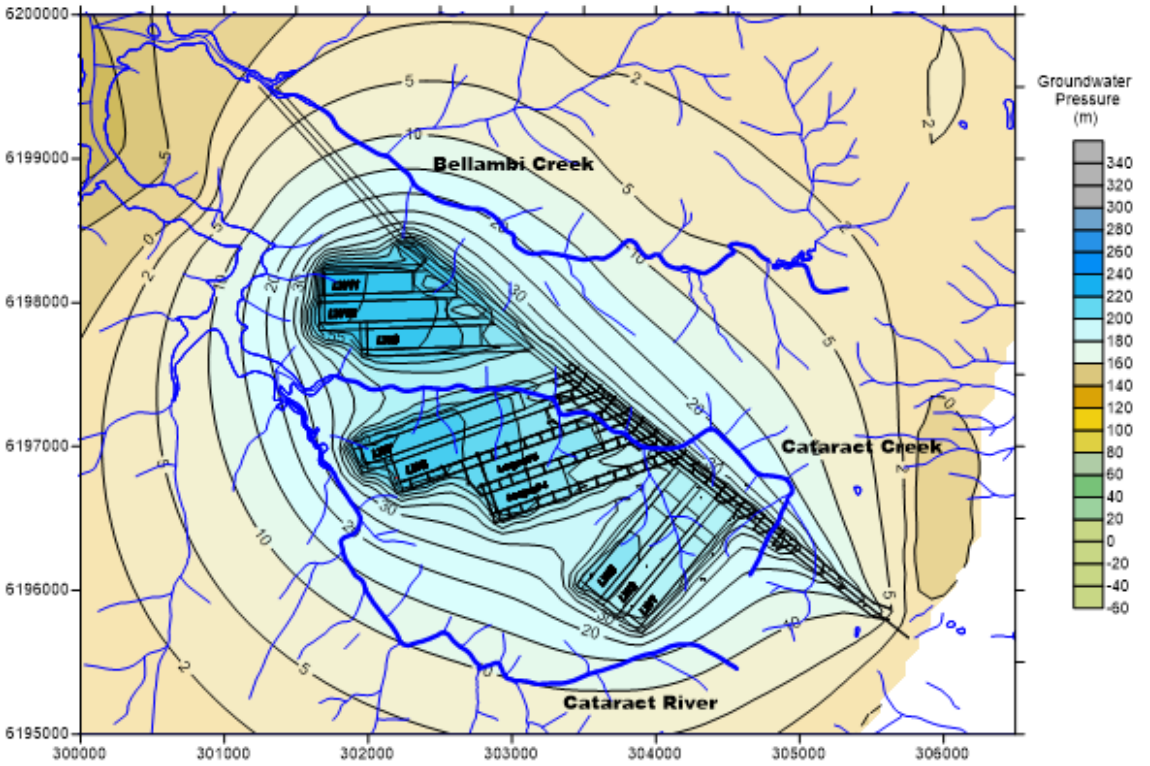


Figure 38 Wongawilli Seam Drawdown After Mining Russell Vale East in Comparison to Pre Wongawilli Seam Development

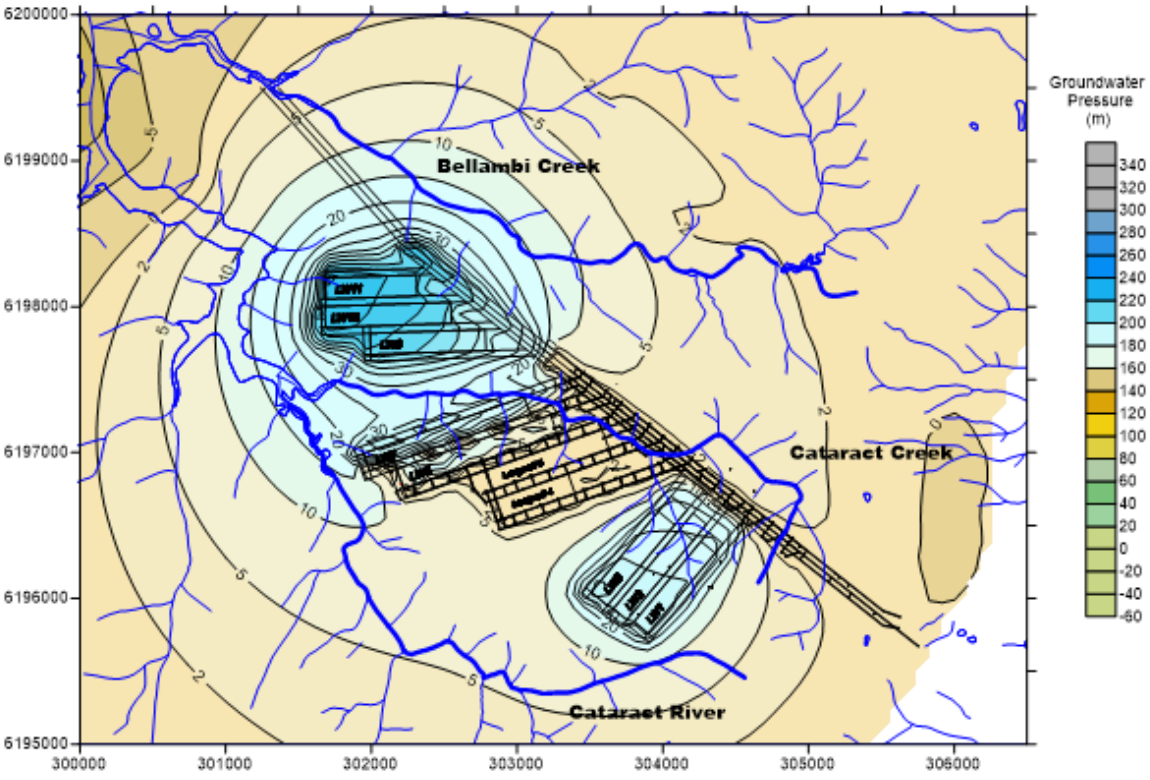


Figure 39 Wongawilli Seam Drawdown After Mining at Russell Vale East in Comparison to Post LW5 Development

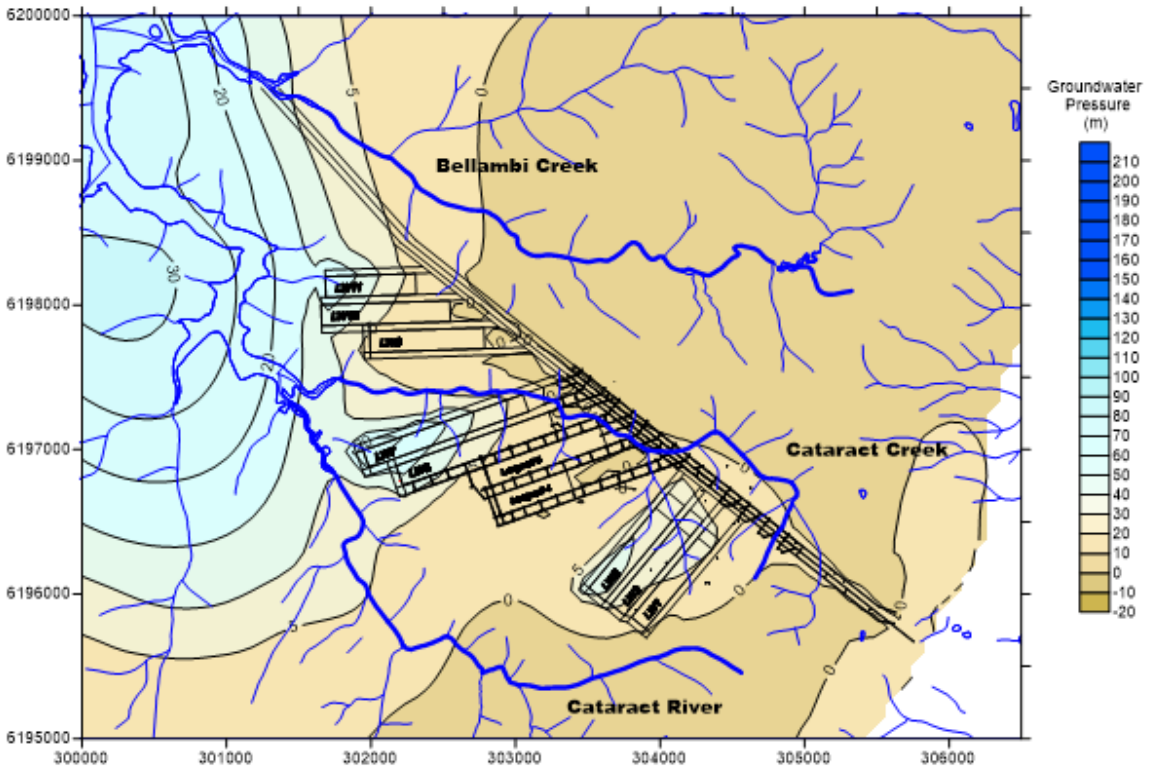


Figure 40 Wongawilli Seam Pressures Recovery at 10 Years After Mining

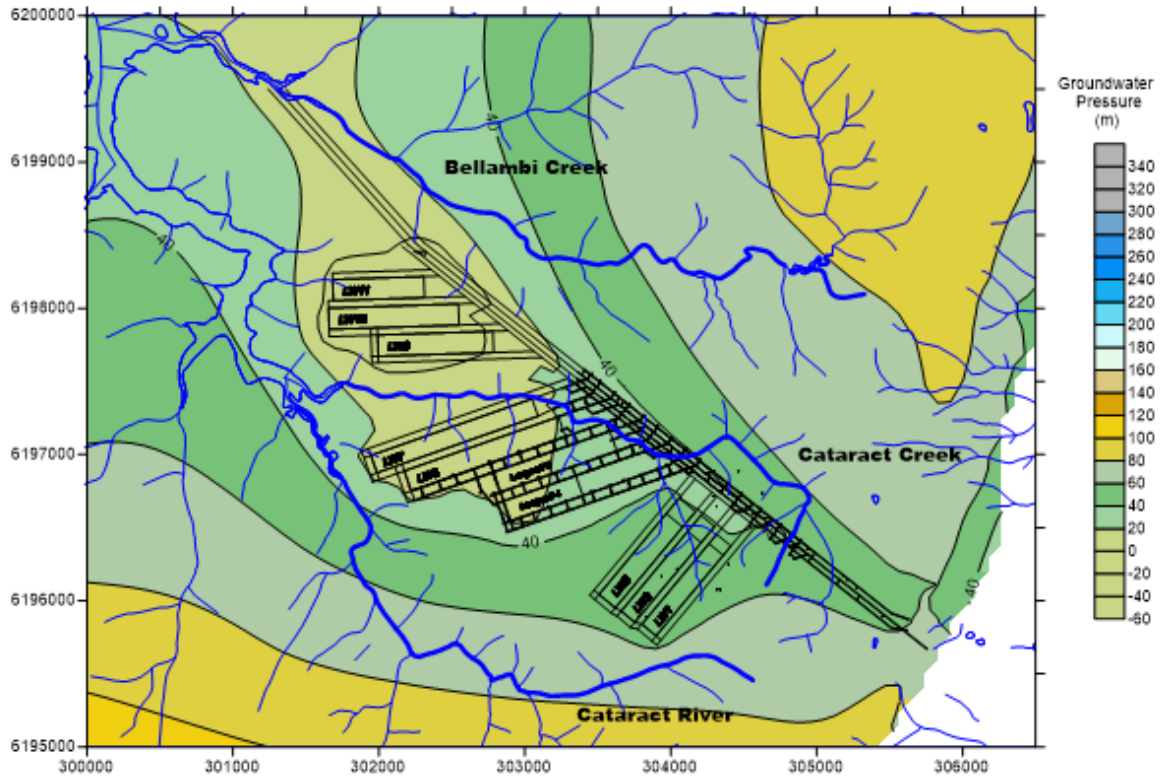


Figure 41 Wongawilli Seam Groundwater Pressures at 10 Years after Mining (mAHD)

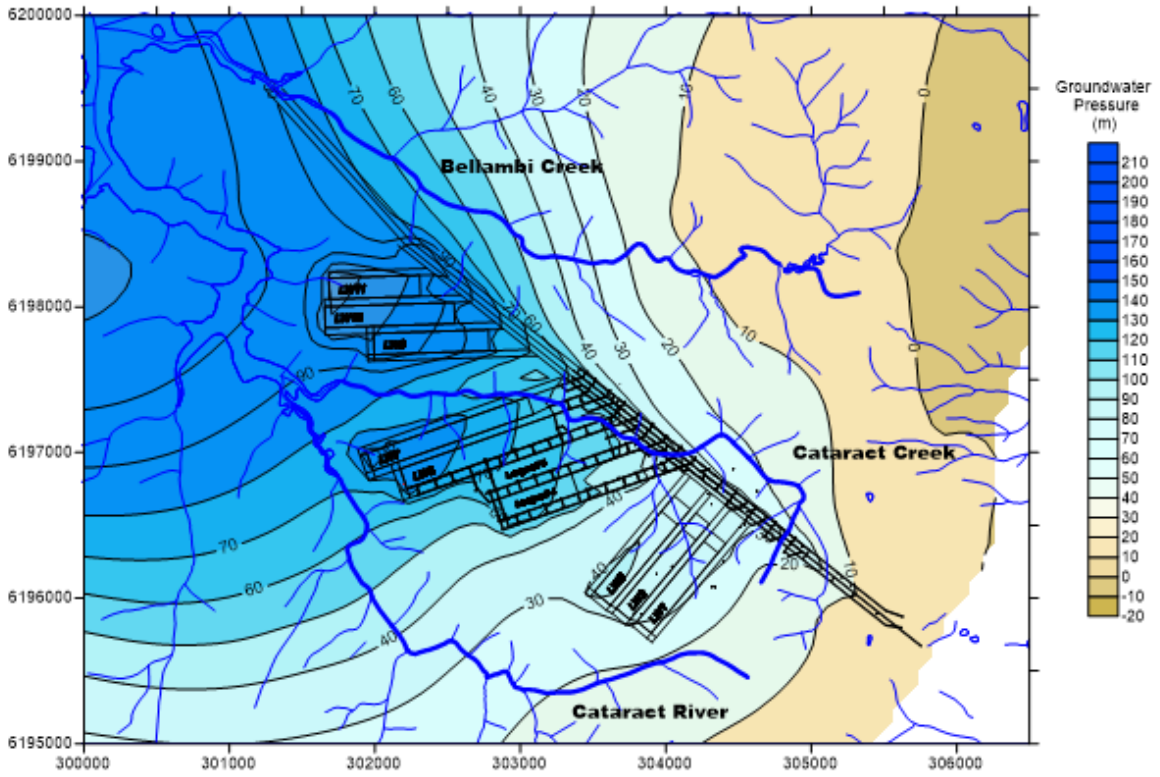


Figure 42 Wongawilli Seam Pressure Recovery at 50 Years After Mining

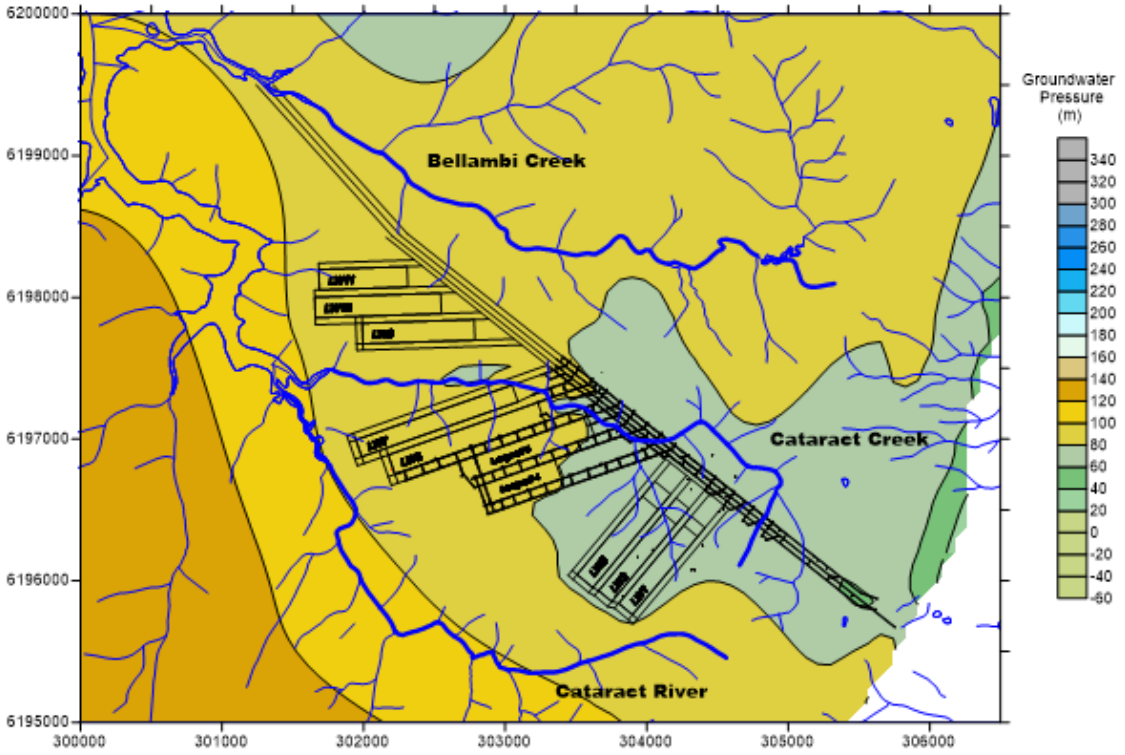


Figure 43 Wongawilli Seam Groundwater Pressures at 50 Years after Mining (mAHD)

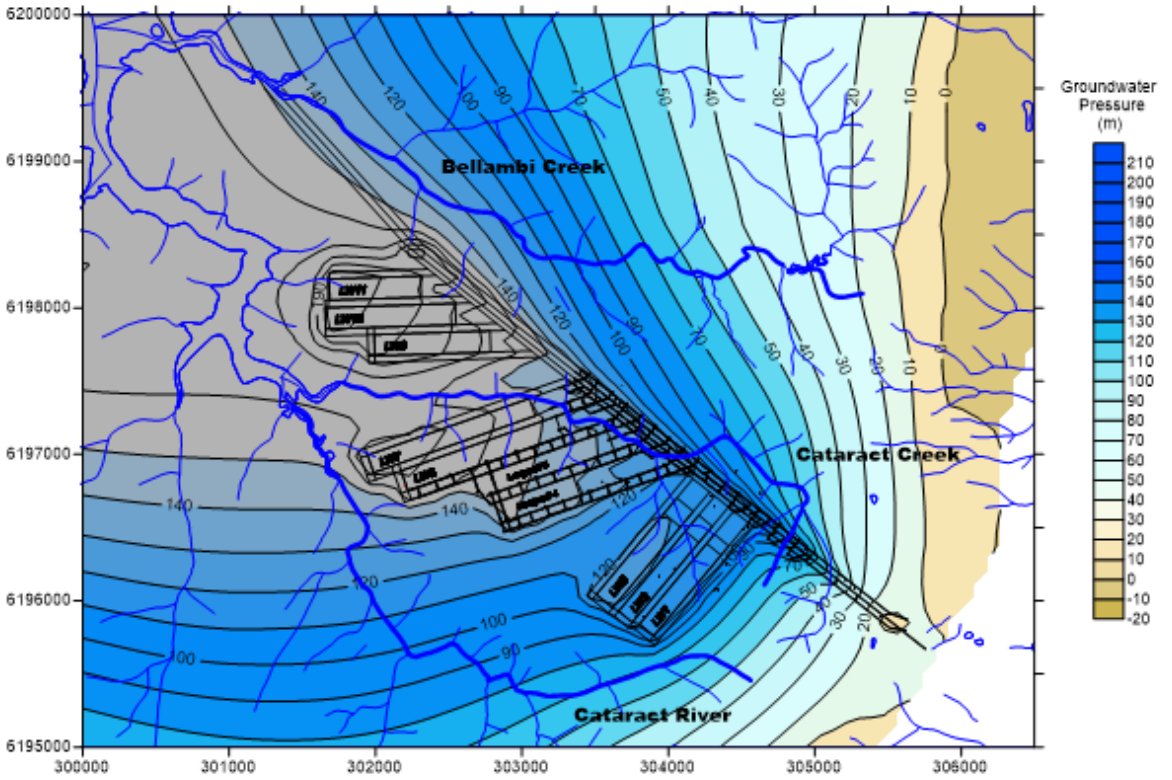


Figure 44 Wongawilli Seam Pressure Recovery at 100 Years After Mining

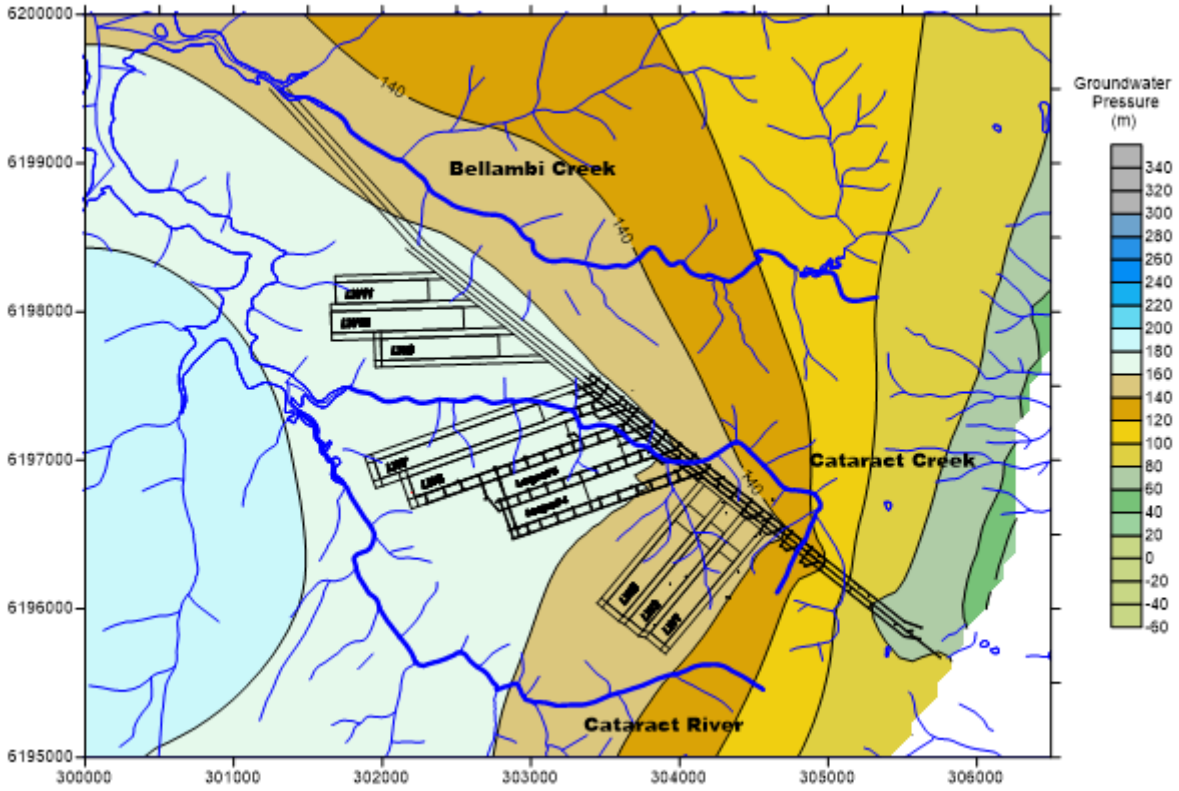


Figure 45 Wongawilli Seam Groundwater Pressures at 100 Years after Mining (mAHD)

2.4 Stream and Groundwater System Connectivity

A number of mechanisms can potentially occur within shallow groundwater systems which cause interaction with streams or other surface water features. These include::

- direct flow of surface water into mining induced fracture systems with vertical drainage into the shallow basement groundwater system;
- inter-connection of the depressurised strata and horizontal to sub-horizontal or “stepped” shear plane/s located beneath a stream bed and associated subsided hill slopes;
- flow of surface water from “losing” streams into the shallow groundwater system migrates along the local hydraulic gradient and re-emerges further downstream, with no hydraulic connection to the workings if there is no continuous, vertically connected fracturing, or;
- reversal of water transfer from the shallow groundwater system to the “gaining” streams during periods of high recharge;

2.4.1 Cataract Creek

The modelled, localised reduction in shallow groundwater pressures is anticipated to reduce the regional phreatic surface gradient from the plateau to Cataract Creek, as well as toward Cataract Reservoir, thereby potentially reducing baseline seepage flow volumes to the creek and dam.

2.4.2 Cataract River (Upstream of Cataract Reservoir) and Bellambi Creek

Although groundwater level reductions are predicted over the Russell Vale East workings, the majority of the changes are contained within the Cataract Creek catchment.

As such, there is anticipated to be no observable change in stream flow or groundwater seepage in the Cataract River (upstream of Cataract Reservoir) and Bellambi Creek catchments due to the very low proportion of the two catchments that may be partially depressurised as shown in **Table 3** and **Figure 46.**

The modelling predicts a peak reduction in baseflow of 0.0035 ML/day (1.64 ML/yr) in the Cataract River (upstream of Cataract Reservoir) and a reduction of 0.005ML/day (1.83 ML/yr) in Bellambi Creek.

Table 3 Modelled Cataract Creek, Cataract River and Bellambi Creek Stream Flow Changes

	Baseflow Loss (ML/day) / (ML/year)	Change Due to Proposed Mining Compared to Current Flows (ML/day) / (ML/year)
Cataract Creek (Upstream of Cataract Reservoir)		
End of LW5	0.001 / 0.37	-
End of Mining	0.0075 / 2.73	0.0065 / 2.37
Peak During Recovery **(Years after completion of mining)**	0.07 / 25.5 (50)	0.069 / 25.19
Cataract River (Upstream of Cataract Reservoir)		
End of LW5	9×10^{-6} / 0.03	-
End of Mining	0.003 / 0.11	0.003 / 0.11
Peak During Recovery **(Years after completion of mining)**	0.0045 / 1.64 (50)	0.0045 / 1.64
Bellambi Creek		
End of LW5	6×10^{-6} / 0.002	-
End of Mining	4.9×10^{-5} / 0.018	4.3×10^{-5} / 0.016
Peak During Recovery **(Years after completion of mining)**	0.005 / 1.83 (100)	0.0049 / 1.81
Cataract Reservoir		
End of LW5	1.4×10^{-7} / 5×10^{-5}	-
End of Mining	0.0005 / 0.18	0.0005 / 0.18
Peak During Recovery **(Years after completion of mining)**	0.007 / 2.56 (50)	0.007 / 2.56
Peak change		**0.085 / 31.7**

2.5 Cataract Reservoir

Cataract Reservoir has a full operating storage of 97,190ML. The lowest level of the storage as advised by Water NSW is 27,620ML or 29.3% capacity on 20 July 2006.

2.5.1 Stream Inflow

Due to the setback of the proposed workings from the Cataract Reservoir, no adverse impacts on stored water quantity or quality are predicted to occur on, or in, Cataract Reservoir, based on the factors discussed in previous sections.

It is anticipated, however, that the water will flow via subsurface fractures and discharge down gradient into the lower section of the streams, and / or into Cataract Reservoir. As

such, the change is anticipated to be essentially a sub-surface diversion within the stream reaches over the subsidence areas, as opposed to an overall loss to the surface water balance, outside of the strata depressurisation related stream flow losses.

The modelled sub-surface total transfer of 0.0784 ML/day (28.64ML/year) from the Cataract Creek, Cataract River and Bellambi Creek catchments at the peak of losses occurring post proposed mining at Russell Vale East is 0.1% of the low level storage, or 0.029% of its full storage capacity.

2.5.2 Strata Depressurisation

The modelled transfer of stored water within Cataract Reservoir to the underlying groundwater system due to depressurisation of the regional groundwater system in the vicinity of the reservoir is 0.0005ML/day (0.18ML/year) at the end of mining. This increases to a peak approximately 50 years after completion of mining to 0.007ML/day (2.56ML/year) as shown in **Figure 46.** The modelled sub-surface transfer of 0.18ML /year from the stored waters at the end of the proposed mining is less than 0.0006% of the low level, or 0.0002% of its full storage capacity.

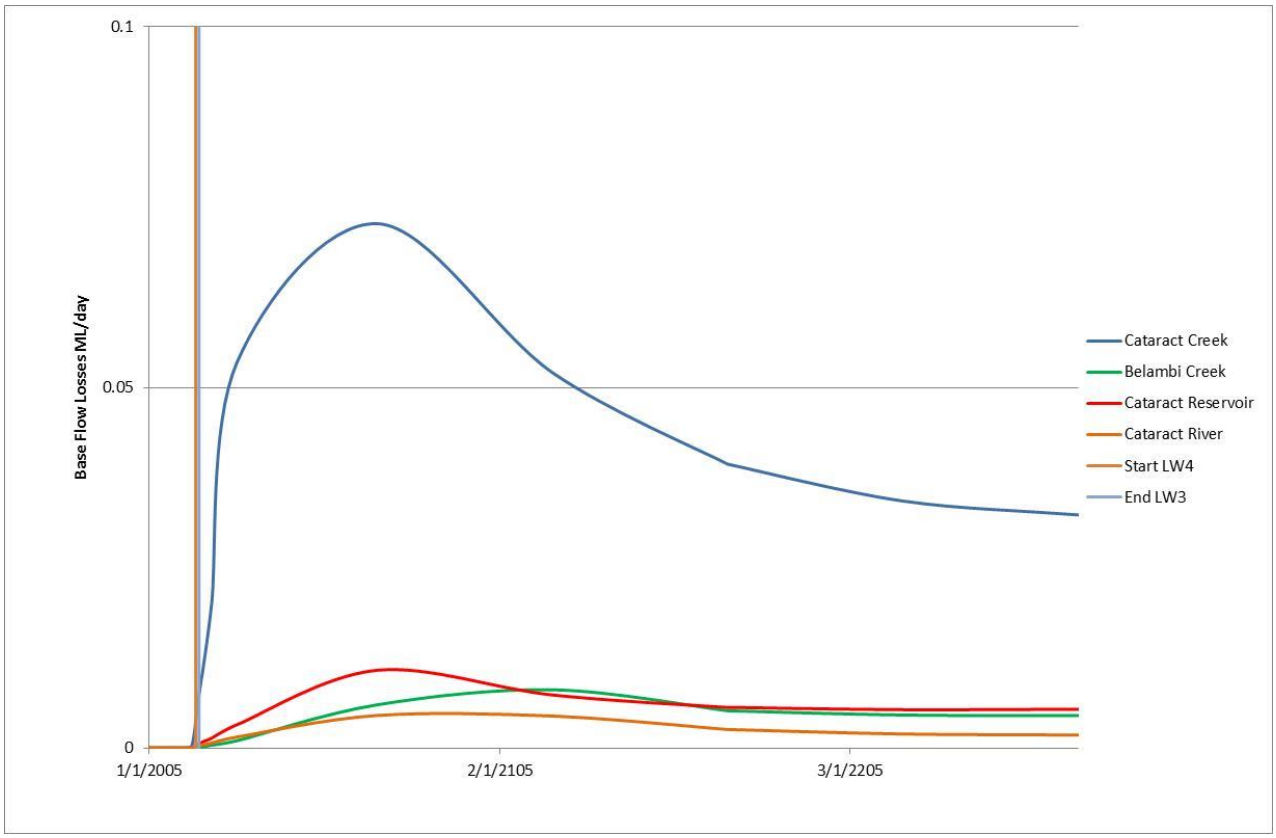


Figure 46 Russell Vale East Stream and Cataract Reservoir Depressurisation Related Base Flow Losses

2.6 Groundwater Inflow to the Workings

Groundwater reports to drain cells representing the working levels which include historical, current and proposed working levels. Table 4 shows the drain reaches which represent the relevant areas within the Wollongong Coal Russell Vale Mine.

The predicted modelled groundwater inflows to the proposed Russell Vale East and the old Bulli Seam workings at Russell Vale East and West workings for each stage of mining are shown in **Table 5** and **Figure 47.**

Table 4 Drain Cell Reaches

Coal Seam	Area - Development	Drain Reaches
Bulli	Wongawilli East	1107
	Wongawilli West	1117
Balgownie	Wongawilli East	1330
Wongawilli	Mains / Main Gate / Tail Gate	1501 1502 1503 1504 1505 1506 1507 1508 1509 1510 1511 1512 1513 1514 1515
	Longwall Panels	1529 1531 1534 1535 1536 1537 1538 1539 1540 1541 1546 1550 1551 1553 1554 1555 1556 1558 1559 1561 1562 1563 1564 1565

The proposed extraction at Russell Vale East will start with Longwall 6, progress to Longwall 11 and then re-locate and extract Longwalls 1 to 3, which are higher up in the catchment and also up dip of initial extraction in the Wongawilli Seam.

A background groundwater inflow of approximately 0.5ML/day is currently measured from the dormant Bulli Seam workings including that from the western side of Cataract Reservoir. These inflow rates are variable in the recorded flow data however the average rate for the period from 1/1/2013 – 31/12/2014 is 0.5ML/day (182.5ML/year). These rates decrease in eastern areas as groundwater makes its way vertically into Wongawilli Seam workings as mining progresses.

However, it should be noted that approximately 0.5ML/day is pumped out at Russell Vale portal from the Bulli seam workings from the Russell Vale East and West areas. It is assumed that this includes 0.2ML/day (73ML/year) of inflow that is thought to be generated in the up-gradient Cordeaux Colliery lease area as this area is partially flooded and there is a potential head gradient across the barrier with the western Bulli Seam workings in the order of 40m.

In addition, 0.2ML/day (73ML/year) of groundwater seepage inflow from Russell Vale East is also thought to be generated from the up-gradient Bulli Colliery.

Table 5 Predicted Groundwater Mine Inflows

Stage	Bulli Seam Inflow (ML/day) and (ML/year)	Predicted Russell Vale Wongawili Seam Inflow (ML/day) and (ML/year)	Total Mine Inflow (ML/day) and (ML/year)
Pre Longwall 4	0.52 / 190	0.16 / 58	0.68 / 248
Post Longwall 5	0.47 / 172	1.02 / 365	1.45 / 529
Post Longwalls 6 and 7	0.47 / 172	2.6 / 949	3.09 / 1004
Post Longwalls 9 to 11	0.47 / 172	2.5 / 913	3.01 / 1128
Post Longwalls 1 to 3	0.46 / 168	1.9 / 694	2.39 / 872

Figure 47 Predicted Total Groundwater Seepage Inflows

3. SENSITIVITY

3.1 Fracture Zone Horizontal Conductivity

It had been noted that the horizontal permeability factors are likely to be low, and a uniform scaling with a factor of 2 was applied to enhanced horizontal conductivities within the fracture zone in the GeoTerra / GES (2015) model version. However, the PAC outlined that the groundwater model was potentially not sensitive to variability of hydraulic conductivity in the horizontal direction within the fracture zone during the calibration period.

Accordingly, the model was re-run with enhanced horizontal conductivity in the fracture zone using the TMP function. Wherever vertical conductivities where enhanced, horizontal conductivities were also increase by a factor of 100.

The resulting increase in groundwater inflows reporting to drains within the Russell Vale area shown in **Figure 48** indicates that the increase in fracture zone horizontal conductivities results in an increase of mine inflows of approximately 2%.

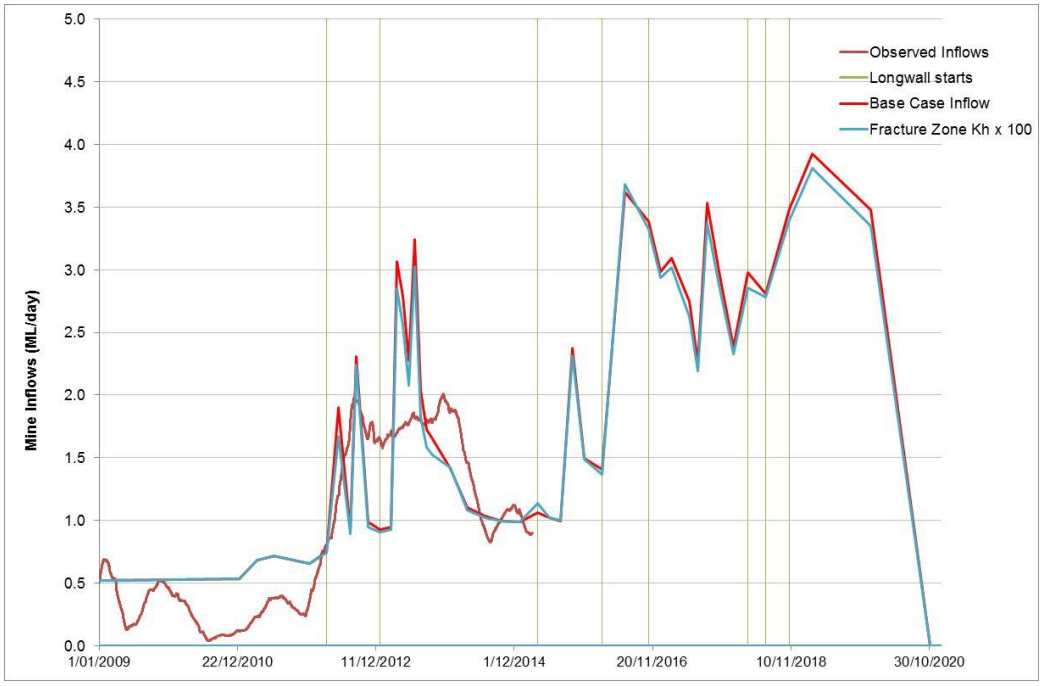


Figure 48 Mine Inflow Sensitivity to Increase Fracture Zone Horizontal Conductivity

3.2 Evaporation Rates

It was also noted in the PAC review that the evaporation rates used in the GeoTerra / GES (2015) model were full reported evaporation rates and may be too high, with the implication that this could affect stream base flow estimates and losses.

It is noted that as groundwater levels are generally below the extinction zone within Layer 1, the baseflow calculations would be relatively unaffected by the perceived high evaporation rates applied within the groundwater flow model.

Accordingly, a sensitivity run was undertaken with evaporation rates reduced to an arbitrary rate of 1m/yr as compared to the 1.825m/yr (basecase) used in GeoTerra / GES (2015).

Figure 49 indicates the results of re-appraisal using the lower evaporation rates and shows that the difference between the pre and post PAC review are negligible.

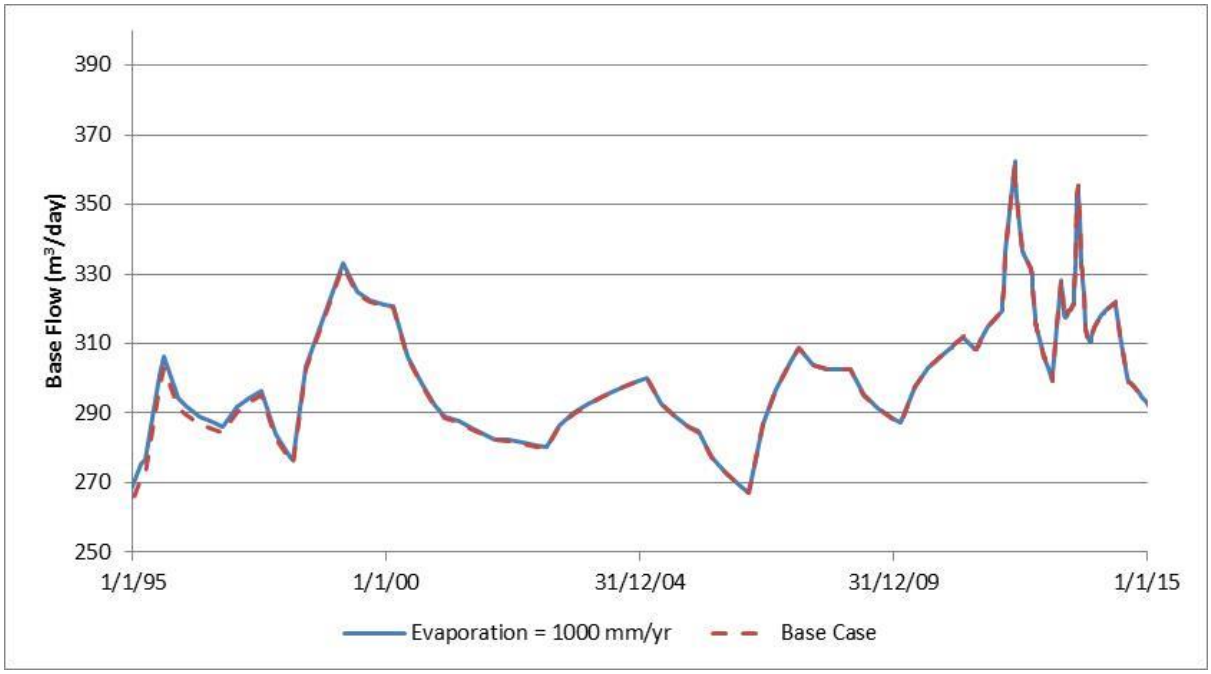


Figure 49 Cataract Creek Baseflow Sensitivity to Variable Evaporation

APPENDIX 6 EXPERT ADVICES ON GROUNDWATER AND SUBSIDENCE

Mackie Environmental Research Pty. Ltd.
ABN 62077235164

193 Plateau Rd.
Bilgola NSW 2107

Telephone: **(02) 89190182**

NSW Planning and Environment
Planning Assessment Commission
GPO Box 3415
Sydney NSW 2001

07/03/2016

Att. J. Woodward , P. Forward and A. Stoeckel

Re: Proposed longwall panels at Russell Vale coal mine – Review of groundwater studies

Further to instructions, I have completed a review of the reported groundwater impacts associated with the Russell Vale underground mine in the Southern Coalfield. The proponent Wollongong Coal (WC) has prepared a number of assessment documents of which my focus has been on the Preferred Project – Residual Matters Report[1] dated June 2014 (PPR-RM), the Response to Planning Assessment Review Report Part 2 Report[2] dated September 2015 and the subsequent reports prepared by Geoterra and Groundwater Exploration Services (GES)[3] following a revision of the groundwater model in early 2016. These documents provide information relating to the proposed mining operations, design and development of a regional groundwater flow model, simulation of mining operations and quantification of groundwater related impacts. Since the model is the platform from which groundwater related impacts have been assessed, I have essentially overviewed the translation from a conceptual flow model to the numerical model, and undertaken an appraisal of the numerical model and predicted outcomes.

1. Background to groundwater flow modelling

There are essentially two groundwater domains in the Southern Coalfield and in the area of interest:

- ***the surficial (and shallow) systems*** associated with the unconsolidated regolith and swamp lands. These systems tend to act as water stores and sources of surface runoff during periods of high rainfall;
- ***the underlying rock strata*** comprising interbeds of sandstone, siltstone and claystone within the Hawkesbury Sandstone, the underlying Narrabeen Group and the deeper Permian coal measures. These strata can exhibit low to moderate groundwater storage depending upon location and facies.

  The Hawkesbury Sandstone is the uppermost unit and hosts the steeply incised valleys common throughout much of the Southern Coalfield. It also hosts the water table or phreatic (zero pore pressure) surface in many elevated areas. However along parts of Cataract Creek, the Hawkesbury Sandstone is completely eroded leaving exposures of Bald Hill Claystone and Bulgo Sandstone to host the water table.

  The Permian coal measures comprise interbeds of sandstone, siltstone, claystone and laminite, together with the main coal seams including the Bulli, Balgownie and Wongawilli seams. Interburden strata generally exhibit low groundwater storage and transmission characteristics.

[1] See Hansen Bailey, June 2014.
[2] See Hansen Bailey, June 2015
[3] See Geoterra, 2016 and GES 2016a and 2016b

The water table within the rock strata typically resides at depths varying from zero adjacent to major drainage channels, to more than 50 m in elevated terrain. The regional geometry of the water table broadly reflects topography.

The water table in the shallow systems is often more variable with perching evident in many areas, particularly in upland swamp systems.

The proposed WC mining operations include eight longwalls as shown on the following Figure 1 - LW1 to LW3, LW6 and LW7, and LW9 to LW11 in the Wongawilli seam (longwalls LW4 and LW5 have already been mined). The longwalls are at depths ranging from 250 to more than 385 m (see Figure 2); Table 1 provides a summary of the depths of cover.

Table 1: Summary of proposed longwall depths of cover[4]

Longwall Panel	Panel Width (m)	Depths of cover (m)
1	131	255-320
2	125	255-330
3	150	250-340
4	150	300-360
5	150	265-345
6	150	270-345
7	131	270-340
9	150	330-380
10	150	335-390
11	150	350-385

Mining has historically been undertaken in the overlying Balgownie and Bulli seams as shown on Figure 1. The floors of these overlying old workings are approximately 20 m (Balgownie seam) and 30 m (Bulli seam) above the floor of the Wongawilli seam. Undoubtedly there is a high level of hydraulic connection between the Balgownie and Bulli seams in mined areas which is the product of subsidence above the Balgownie seam. There will also be a highly connected cracked regime above the Bulli seam where full extraction has historically occurred. Within this subsidence regime, vertical drainage will have been enhanced and a phreatic surface[5] will have migrated upwards through parts of the overlying Narrabeen Group and feasibly into the Hawkesbury Sandstone. The Bulli seam workings are reported to be relatively dry with localised ponding in places[6].

Proposed mining in the lowermost Wongawilli seam will generate a deeper zone of cracking which is expected to yield a highly transmissive connection to the Balgownie seam. In addition, re-activated movement within the overlying subsidence zone is likely to further enhance vertical drainage of the Narrabeen Group and the Hawkesbury Sandstone. Hence the proposed mining operations could be expected to act as a regional groundwater 'sink' both during and for some considerable time after mining operations cease.

Some indication of future water make is provided by the measured inflow arising from the mining of longwall panels LW4 and LW5 - reported to be about 1.1 ML/day distributed as follows:

- 0.3 ML/day from pre LW4 mining development headings (in the Wongawilli Seam);
- 0.2 ML/day for pre LW4 up dip inflow from up gradient adjacent workings in the Bulli and Balgownie Seams;
- 0.1 ML/day additional inflow from mining LW4;
- 0.5 ML/day from mining LW5.

[4] see Hansen Bailey 2014, Appendix B (SCT, Update of subsidence assessment)

[5] Phreatic surface surface is defined as the interface where pore pressures rapidly change from –ve to +ve (the water table is at zero pore pressure).

[6] See Section 8.4, from PPR-RM Appendix C (GeoTerra – GES)

Longer term (post mining) recovery of strata pore pressures will be constrained by the ability to isolate workings from the entry adits in each of the three seams. This is because the adit portals are located at elevations well below the regional pre-mining water table.

2. The conceptual flow model

The conceptual model prepared by the Proponent's groundwater consultants Geoterra and Groundwater Exploration Services (GES), is summarised in Figure 3. Fundamentally, rainfall and runoff provide inflows to the groundwater system by recharging the shallow regolith and swamp systems. These water stores promote both shallow localised flow domains and vertical infiltration downwards through the variably unsaturated vadose zone and ultimately to the fully saturated zone where a permanent water table resides.

Where mining has extracted coal (full extraction and longwall operations), the overlying strata have been subsided. As part of this process, an enhanced fracture flow regime has evolved with strata bed separations providing horizontal conduits for flow, and strain induced sub vertical cracking providing vertical connectivity between bed separations. This complex and tortuous fracture regime promotes downwards drainage of strata with flows reporting to goaves. An upwards migration of a phreatic surface accompanies the drainage.

The enhanced flow regime is often characterised by specific zones including detached roof material at the seam extraction level, an overlying highly connected fracture flow regime, a shallower constrained zone where connectivity is quite low, followed by an elastic zone where connectivity by cracking is largely absent.

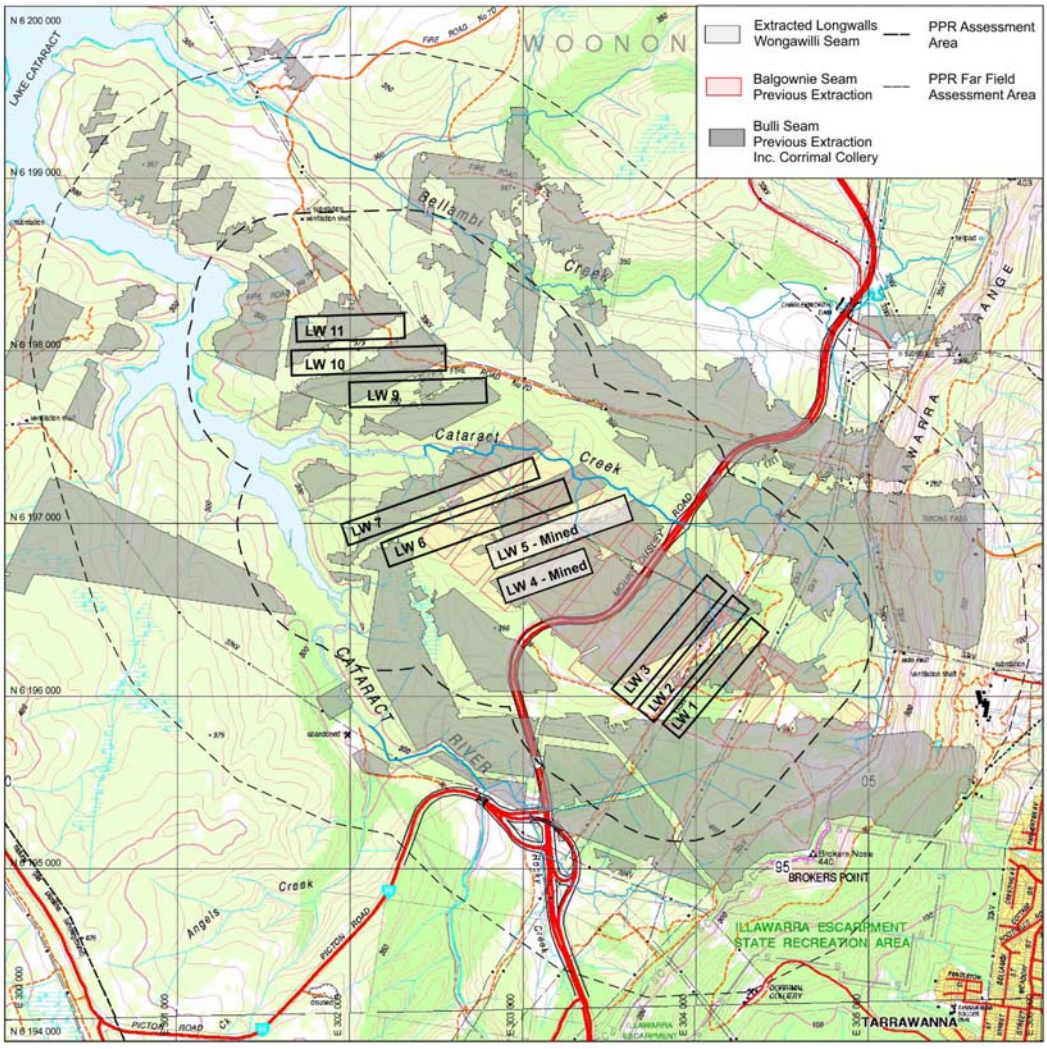


Figure 1: Longwall locations and extent of overlying workings[7]

[7] Figure from Hansen Bailey 2014, Appendix B (SCT, Update of subsidence assessment, Figure 11)

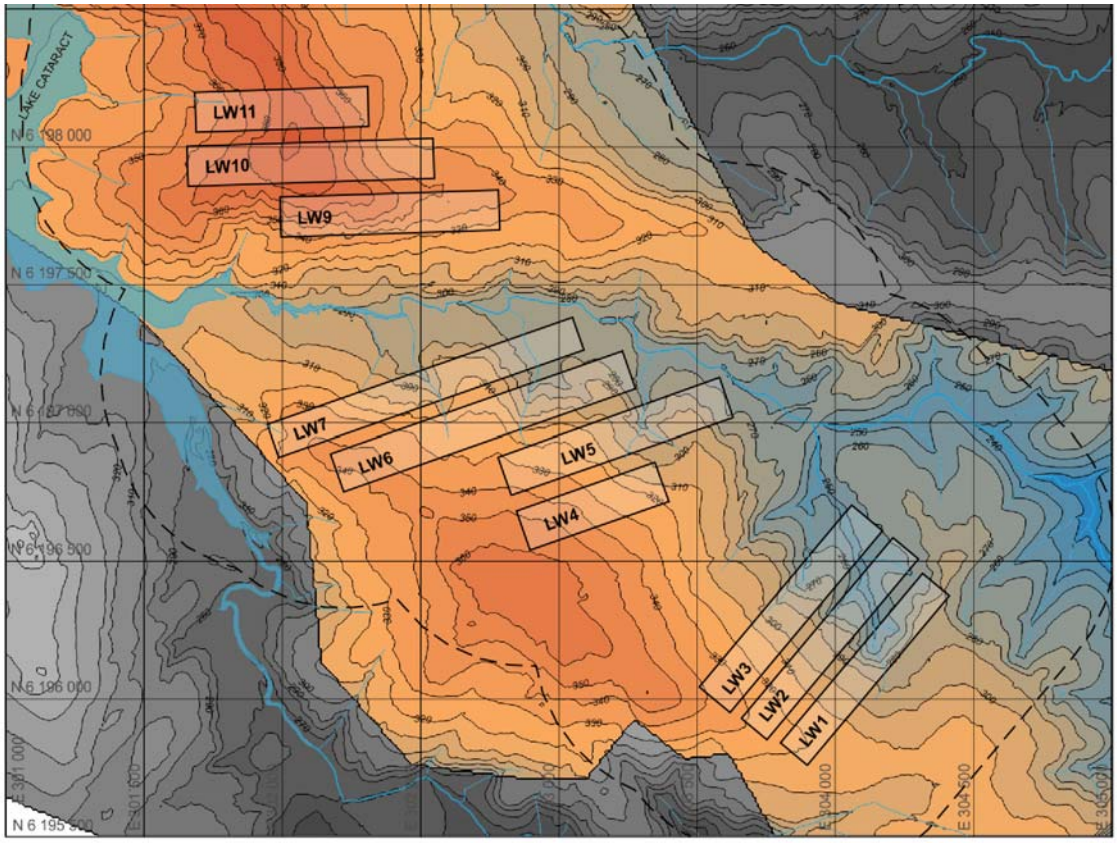


Figure 2: Depth of cover over longwall panels[8]

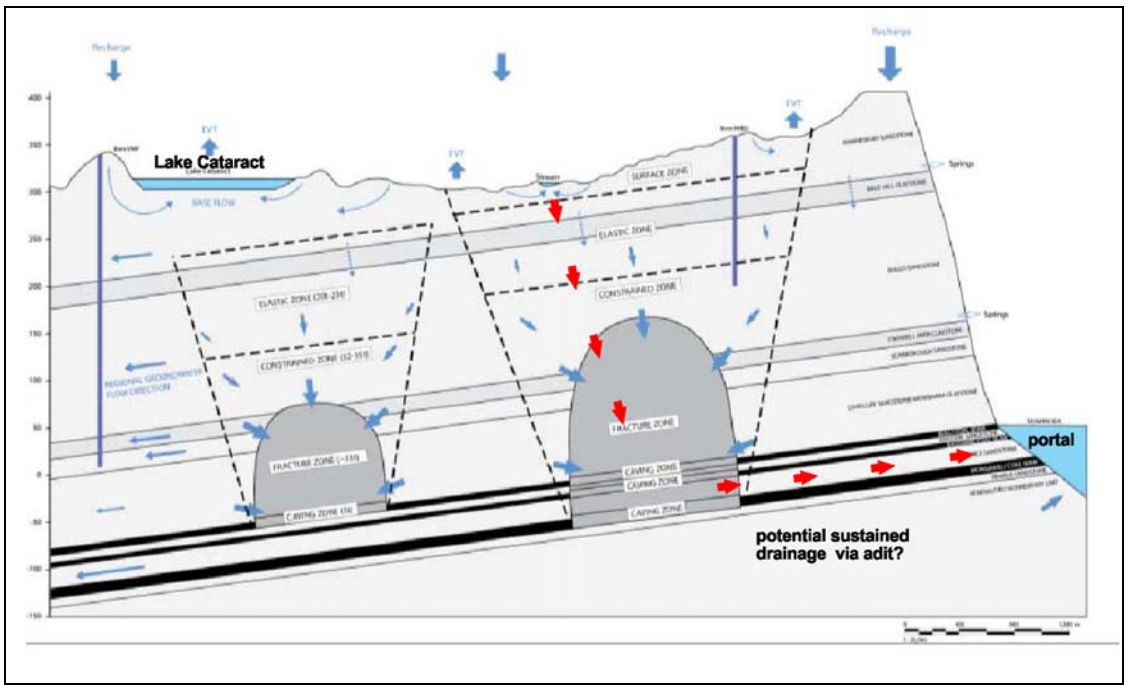


Figure 3: Conceptualisation of surface water and groundwater systems (PPR-RM, Figure 10 [9]). Red arrows indicate potential surface to adit leakage pathway.

[8] Figure from Hansen Bailey 2014, Appendix B (SCT, Update of subsidence assessment, Figure 10)

[9] Figure from PPR-RM Appendix C (GeoTerra - GES, Figure 31)

Prediction of crack occurrence, crack attributes and crack connectivity within the subsidence zone is especially difficult. Empirically based 'rule of thumb methods' are typically based upon longwall width, height and depth of cover while mechanistic methods employ numerical modelling of strata using mechanical properties. In the 2014 reported study[10], the Proponent initially utilised an empirical relationship published by Tammetta[11] to predict the maximum height of dewatering above the proposed longwall panels. Subsequently the Tammetta method was discarded in favour of piezometric observations and groundwater model calibration against the observed hydraulic gradients (see below).

Important elements of the conceptual model include leakage impacts on surface drainage channels and swamps, and the potential for sustained leakage post mining via the adit portal (shown by red arrows on Figure 3).

3. The groundwater flow model

Numerous variations of the groundwater flow model have been developed prior to and during the review period. The following discussion relates only to the most recent 2016 model because this model includes observations obtaining to numerous piezometers installed since my last review in 2015, together with a number of amendments to model components that contributed to questionable outcomes in that same model. It is noted that the significant amendments underpinning the 2016 model were introduced solely at the discretion of the Proponent and that these amendments have produced profoundly different pressure head distributions in some parts of the model domain when compared to previous models. I have inspected the 2016 model data files and can now confirm that they generate a regional flow system that is plausible.

There are three stages of modelling that have been undertaken by the Proponent. These include:

1. a pre-mining calibrated model on which the mining process has been imposed;
2. a mining process model representing extraction of the longwall panels;
3. a post mining period that examines the period of pore pressure and water table recovery (as an extended simulation of the mining process model).

These models do not include the very shallow and surficial systems associated with the regolith, swamps and any perched systems which are acknowledged to be both very difficult to characterise (hydraulically) and to represent at an appropriate scale in a groundwater flow model.

3.1 Model design and calibration

The model utilises a finite difference scheme known as Modflow-Surfact. The current model mesh simulates an area of some 392 sq.km. and accommodates 19 layers with cells of differing dimensions across the flow domain. Finer mesh discretisation has been adopted in the horizontal plane in areas around and close to the proposed longwall panels where 25 x 25 m cell dimensions have been employed. More distant areas host cells with much larger dimension (250 x 250 m). In the vertical plane, the discretisation varies from about 1m cell thickness where layers pinch out, to more than 300m thickness in the lowermost layer. Each of the three coal seams has been represented by a separate layer. The Modflow-Surfact code has been employed in the variably saturated mode.

The saturated zone hydraulic conductivities have been assessed through local field testing and from reported parameters at other regional coal mines. Tests have included falling/rising head tests, short term pumping tests, packer tests and airlift tests. Laboratory core testing has apparently been assessed (from other mining locations) in order to understand the likely lower bound for strata hydraulic conductivities in the absence of fracture enhancement. The overall database for hydraulic conductivities is reasonable.

Model calibration compares measured water table and potentiometric heads against model predicted values at these same locations. The measured values are based upon observations at some 26 piezometer locations including standpipe piezometers (14) in which the water table depth is physically measured, and vertical arrays of pore pressure sensors (12)[12] in which pressure heads are

[10] See Hansen Bailey, June 2014

[11] see Tammetta, P., 2013.

[12] see Appendix B of Geoterra-GES report in Hansen Bailey, June 2015

measured. In calibrating the model it is important to include periods in the observation record that contain drawdown responses attributed to mining – if available.

The Proponent states that the model calibration is acceptable. However there are two contributing factors to consider when assessing the suitability of calibration:

1. the calibration statistics of measured versus modelled potentiometric heads are biased to some extent by the shallow standpipe piezometers which only monitor the water table and do not reflect the deeper depressurisation gradients associated with mining unless of course mining has affected the water table;
2. calibration against depressurisation resulting from triple seam extraction (Wongawilli seam longwalls LW4 and LW5 plus overlying Balgownie and Bulli seam mining) is indirect - the only vertical array piezometer discussed in any detail in relation to calibration is GW1 located about 120 m from longwall LW5 and about 100 m from Cataract Creek. This is also the only piezometer that may have captured responses to stresses on the groundwater system associated with mining of longwalls LW4, LW5 and part of LW6. Figure 4 provides observed and simulated responses for pore pressure sensors installed at different depths at GW1. Equivalent model layer numbers have been assigned to the plots of observed data (continuous line) and model simulated responses (dashed line) in order to illustrate the relatively poor fit (also acknowledged by GES[13]). Differences between observed and predicted heads range from 10 to 30 m. Piezometers installed at other locations after mining of LW4 and LW5 have a very limited duration of baseline data; calibration against measured responses at these other locations is unreported.

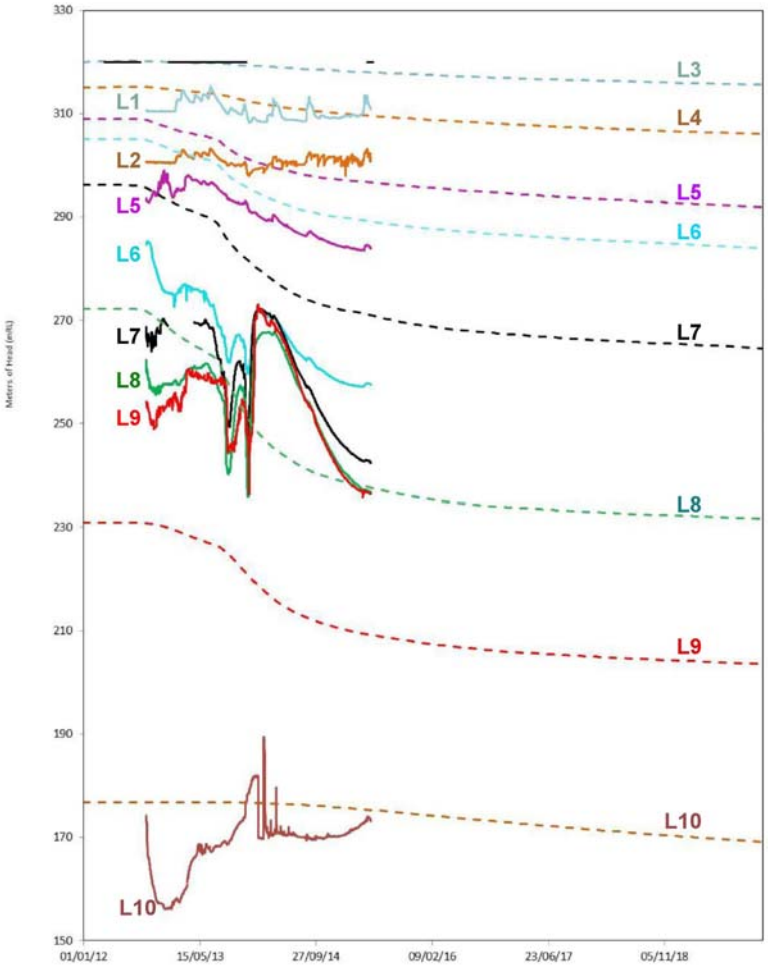


Figure 4: Summary calibration at piezometer GW1[14]

[13] see GES 2016b, page 4 last paragraph

[14] see GES 2016b page 5

Groundwater seepage rates measured during mining of longwalls LW4, LW5 and part of LW6 are reasonably replicated in the revised 2016 model.

3.2 Mining process transient model

The mining process simulation model adopts the pre-mining model water table as the starting position. This model utilises a so-called 'drain' boundary condition to represent the removal of groundwater from model cells located within the longwall panel areas at a reference elevation which is just above the floor of the Wongawilli seam. Activation times for drain cells representing the panels have been aligned with the planned mining schedule. Simultaneously, the hydraulic conductivities in strata overlying the coal seams have been enhanced to represent cracked strata associated with the subsidence regime thereby promoting accelerated drainage and depressurisation of those strata. This enhancement has been applied from layer 17 up to and including layer 3 of the model.

Mining in the Bulli seam has also utilised drain cells however these cells are activated well before the commencement of mining in the Wongawilli seam and remain activated throughout the period of mining.

Model outputs are provided as a series of drawdown plots and as a number of graphs indicating the predicted groundwater seepage to underground operations.

3.3 Recovery model

The recovery model is an extended transient simulation beyond the end of mining. That is, the model identified in Section 3.2 has been extended for a further 200 years with the drain cells simulating the proposed operations in the Wongawilli seam, removed from the model thereby allowing the phreatic surface associated with mining, to recover.

4. Overview of predicted impacts associated with the shallow groundwater systems

Shallow systems are associated with stream drainage channels and swamp lands. With the exception of baseflow losses to drainage channels (assuming groundwater interactions occur via porous media), impacts on these systems have not been addressed within the groundwater flow model. This is largely due to the perched nature and the scale of these systems which are acknowledged to be difficult to incorporate in a regional scale model. Additionally, flow pathways like discrete fracture networks associated with stream bed cracking and cracking beneath swamps cannot generally be represented in the groundwater flow model. Assessment of impacts on these shallow systems is therefore based largely upon experiences and observations associated with historical mining of the Bulli and Balgownie seams.

4.1 Diversion and loss of stream flows

Potential impacts of mining on drainage channels in the Southern Coalfield relate to diversion of surface water flows into subsurface crack networks that have evolved through strata movements associated with valley closure. While significant diversion and loss of flow under these conditions is known to have occurred at other locations (eg. Waratah Rivulet), recent mining of the Wongawilli seam (LW4 and LW5) has apparently not resulted in measurable loss of flow in Cataract Creek. However some diversion of flow has been inferred from the presence of iron staining observed in tributary channels to Cataract Creek[15]. Indeed the Proponent notes that 'Mapping of the stream bed and tributaries indicates that baseflow seepage changes have probably already occurred in Cataract Creek, prior to extraction of longwalls 4 to 6 (340 m) in the Wongawilli Seam, based on the high degree of iron hydroxide seepage and precipitation present in the upper reaches all the way down to the Cataract Reservoir.'[16] Given these observations it is conceivable that significant permanent redirection of surface flows could eventuate where seam to surface cracking occurs in close proximity to Cataract Creek and where bedding movements associated with valley closure provide lateral connection to the creek bed. The areas of concern in this regard are the eastern ends of longwall LW6 and LW7.

[15] see Hansen Bailey, 2015. Appendix H, page 107

[16] see Hansen Bailey, 2015. Appendix H, page 107

4.2 Cracking beneath swamps

Potential impacts on upland swamps through partial or complete drainage via subsurface cracking has been recognised by the Proponent with much of the focus on swamp CCUS4. The potential development of seam to surface cracking is acknowledged and offset strategies have been developed in the event that impacts are found to occur. The extent and rapidity to which these shallow groundwater systems will be affected will depend upon the presence and connectivity of the crack regime both laterally and vertically.

4.3 Height of cracking and dewatering above mined panels

There appears to be some confusion regarding the height of dewatering likely to prevail above mined longwall panels, especially where all three coal seams will be extracted. Earlier groundwater modelling (2014) included a zone of enhanced permeability that accelerated vertical drainage above extracted panels in accordance with the Tammetta empirical equation. That equation is based on single seam extraction and predicts the height of complete drainage via a connected crack regime above an extracted longwall panel based on the panel width, mining height and depth of cover.

In adapting the equation, the cumulative extraction height of seams was taken to represent the height of mining by the Proponent. Hence in some areas the height is based on double seam extraction while in other areas it is based on triple seam extraction. The results were summarised in the following Figure 5[17] which shows areas where complete drainage (initiated by cracking) is predicted to extend to surface. I note that areas of particular concern include the western ends of longwalls LW5, LW6 and LW7 which are in close proximity to Cataract creek being less than 100 m from that drainage line and where the depth of cover is the lowest for each panel.

The Proponent notes that the adapted Tammetta method is a conservative assessment of the potential height of dewatering-cracking insofar as swamps that overly mined longwalls LW4 and LW5 have not dewatered in the period since being undermined, nor has any measurable loss of flow been recorded in Cataract Creek. The Proponent also notes that any diverted flow that may have occurred from Cataract Creek would most likely report to the mine workings but 'the make up component of the inflows from stream flow losses and strata depressurisation is not known.'[18].

The current 2016 model discards the Tammetta equation, in favour of calibration against measured pore pressure gradients at a number of piezometer locations. The calibration is based on an imposed enhancement of vertical conductivities simulating connected cracking which extends from layer 17 in the model (Wongawilli seam) upwards to layer 3 in the model (lower Hawkesbury Sandstone). At the western end of longwall LW7 adjacent to Cataract Creek this leaves layers 1 and 2 undisturbed and equates to a maximum height of connected cracking extending from the seam to about 24 m below ground level.

Since the height of cracking has been assessed from model calibration against piezometers equipped with vertical pore pressure sensors, it is instructive to examine the calibration provided in the supporting documentation. In this regard, GW1 is the only piezometer discussed in any detail presumably since this transducer array has the longest history which captures groundwater pressure reductions as a result of mining LW4 and LW5.

GW1 is located near Cataract Creek in an area where Hawkesbury Sandstone and Bald Hill Claystone have been significantly eroded. Figure 5 shows the location of GW1 which is about 130 m from the finish line of longwall LW5 and about 175 m from Cataract Creek. The observed and model predicted responses are plotted on Figure 4. As noted in Section 3.1, the difference between observed and predicted piezometric elevations varies greatly and reflects in my view, a relatively weak correlation when mining related stresses are considered. Indeed the Proponent acknowledges this, noting that 'The model has been unable to fully simulate these physical changes, resulting in variability of observed pressures and lack of variability within the computed heads'[19]. These statements suggest the nominated height of cracking (determined by model calibration) is somewhat arbitrary.

---

[17] see Hansen Bailey 2014, page 89

[18] see Hansen Bailey 2014, page 90

[19] see GES 2016b, page 4

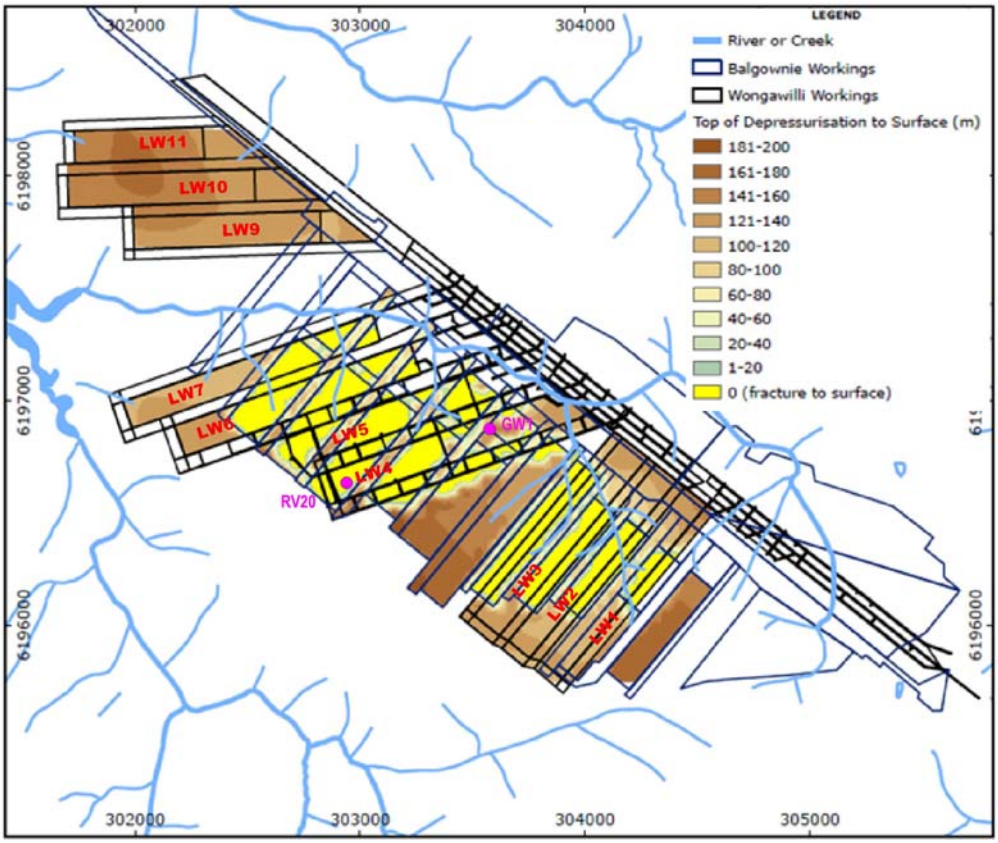


Figure 5: Predicted separation between maximum height of complete drainage and ground surface based on Tammetta equation and cumulative mining height – yellow areas indicate crack connection to surface

The likely height of cracking for triple seam mining is also alluded to at piezometer location RV20 situated at the western end of longwall LW4 over Wongawilli and Balgownie seam extraction and a Bulli seam pillar. Examination of individual pressure sensor responses (post mining of LW4) supports almost complete loss of pressure in the uppermost three sensors at 35, 65 and 85 m depths. There appears to be a maintenance of some pressure at 105m depth while the remaining sensor at a depth of 134m exhibits almost complete loss of pressure as shown on Figure 6. The Proponent notes that the low pressure heads measured above the 105 m sensor 'indicate this zone is highly fractured and hydraulically connected and does not support a positive piezometric profile.'[20].

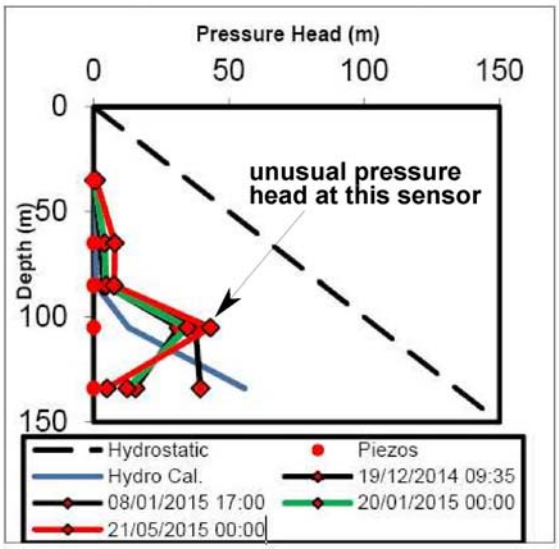


Figure 6: Pressure heads measured at RV20 where triple seam extraction has occurred[21]

[20] see Geoterra 2016, page 3

[21] see Hansen Bailey, 2015. Appendix H, page 36, Figure 16

The 40m pressure head observed at 105 m depth is not clearly explained but a head of this magnitude would reasonably be expected to translate to a 20 m pressure head in the sensor located 20 m above - at 85 m depth. Since the 85 m sensor is effectively depressurised, it could be argued that either the 105 m sensor output is incorrect or there is a lateral connection to a somewhat remote block of strata that is slow to depressurise. If lateral connection is the cause then seam to surface cracking is entirely plausible.

5. Overview of predicted impacts associated with the deep groundwater systems

5.1 Baseflow losses to drainages

The 2016 groundwater model has been used to estimate the baseflow leakage losses via porous strata over the course of mining. These losses are determined by interrogating river cells for flow exchanges before mining, and flow exchanges post mining. They are basically losses via the porous matrix hosting a particular drainage channel and are governed by the prevailing water depth or stage at a specific channel location, and the potentiometric head in the adjacent aquifer. If the head in the aquifer is higher than the creek stage elevation then the creek is gaining water. Conversely, if the head is lower than the creek stage elevation then the creek is losing water.

Increased vertical gradients predicted by the groundwater model over the period of mining (and beyond) are expected to reduce baseflows to Cataract Creek, Cataract River and Bellambi Creek by 0.069, 0.0045 and 0.0049 ML/day respectively. These losses are considered to be generally insignificant.

5.2 Seepage losses to Cataract Reservoir

The 2016 groundwater model supports an estimate of leakage from the reservoir to the underlying strata of about 0.0005 ML/day at the completion of mining, rising to 0.007 ML/day 50 years after cessation of mining. These rates are losses to the reservoir and are governed by the strata depressurisation induced by the proposed mining operations. They are plausible and considered to be insignificant.

5.3 Mine groundwater make

The 2016 groundwater model supports estimates of mine water make that rise to a peak rate of about 3.08 ML/day (1128 ML/year) at the completion of longwall LW7, declining thereafter to a rate of 2.4 ML/day after completion of mining.[22]

Wollongong Coal will require water access licenses to manage and dispose of the peak volumes of groundwater. The total licensable inflow is not discussed in the 2016 groundwater model report but adopting the adjustment that the Proponent seems to have applied to previous models, the total licensable inflow is calculated to be somewhere in the range 982 to 1128 ML/year. The current water access entitlement held by the Proponent is reported to be 365 ML/year[23] leaving a licensing deficit of some 617 to 763 ML/year.

Licensing for baseflow and reservoir leakage losses will also be required. A minimum provision of 15 ML/year will be required for losses via the porous rock matrix. This estimate does not include any provision for redirected surface waters from Cataract Creek or its tributaries, or for vertical leakage losses from upland swamp storage. Volumes associated with these redirected flow pathways are not calculated by the groundwater model. They are very difficult to quantify unless all losses report to the mine workings and measurement systems are in place to determine a water balance. No information is provided in the 2016 model reporting.

It is understood that the Proponent does not currently hold any relevant surface water licences.

[22] see GES 2016a, page 39, Table 5

[23] see Hansen Bailey, 2015 Appendix H, page 118

5.4 Long term recovery and adit spillage

Long term recovery of the phreatic surface associated with longwall extraction has been simulated by modifying the drainable storage parameter to reflect goaves, gate roads and main roads. All boundary conditions that were applied to longwall mining are relaxed and natural drainage from overlying interburden is then allowed to contribute to storage.

6. Key concerns

The most significant concern arising from my review is the potential loss of surface water flow in Cataract Creek via subsidence related cracking. Prerequisites for such a loss to occur include:

1. Seam to surface cracking that is interconnected and provides a vertically continuous pathway down to mine workings. Based upon the observed vertical pore pressure distributions at piezometer RV20, it is plausible that the longwall panel areas identified on Figure 5 by yellow shading will exhibit seam to surface connected cracking, particularly at the eastern ends of longwalls LW6 and LW7 where depths of cover are reduced compared to the cover that prevails at RV20.
2. Stream bed cracking and diverted flows. While creek bed damage to date appears to be low or negligible, there remains a risk that strata movements associated with valley closure could initiate cracking of the stream bed.
3. Connection between the two crack regimes. This may follow from valley closure movements with sliding of beds leading to development of horizontal flow pathways.

The 2015 Independent Risk Assessment concluded that the possibility of creek bed damage from subsidence related cracking was real. However the analysis appears to have been restricted to tributaries of Cataract Creek exclusive of Cataract Creek itself. As a worst case scenario, the Proponent considers re-direction of all surface flow from sub-catchments that are upstream of or overlying the proposed longwall panels. This area includes upland swamps.

To determine the reductions in stream flow resulting from cracking, these sub-catchments together with sub catchments associated with Cataract River and Bellambi Creek[24] were excluded from the catchment runoff model.'[25] This resulted in a reduction in total flow in Cataract Creek of 6.38 ML/day and in Cataract River and Bellambi Creeks of 0.56 and 0.4 ML/day respectively. These losses total 7.34 ML/day which represents 9.6% of the average flow from these catchments. The risk associated with these scenarios is classified as ***medium*** according to Risk ID AQH2121, BH2121 an d CH2121.

If Cataract Creek was to be included (assuming diverted flow and subterranean connection to the mine workings at the eastern end of LW6 and LW7), then the diverted flow losses could be substantially greater than has hitherto been assessed. This flow loss pathway appears to have been considered only in the context of adaptive management in the risk assessment. Just how this management approach would be invoked is unclear and raises significant concerns. Certainly, if such a diverted flow pathway occurs, experiences at other locations in the Southern Coalfields suggests remediation would prove difficult if not impossible.

Other concerns associated with the above relate to water access licences (surface and groundwater) which would need to be procured in a timely way should losses be identified. The logistics of this process are unclear.

[24] see Hansen Bailey, 2015,

[25] see Hansen Bailey, 2015, page 19

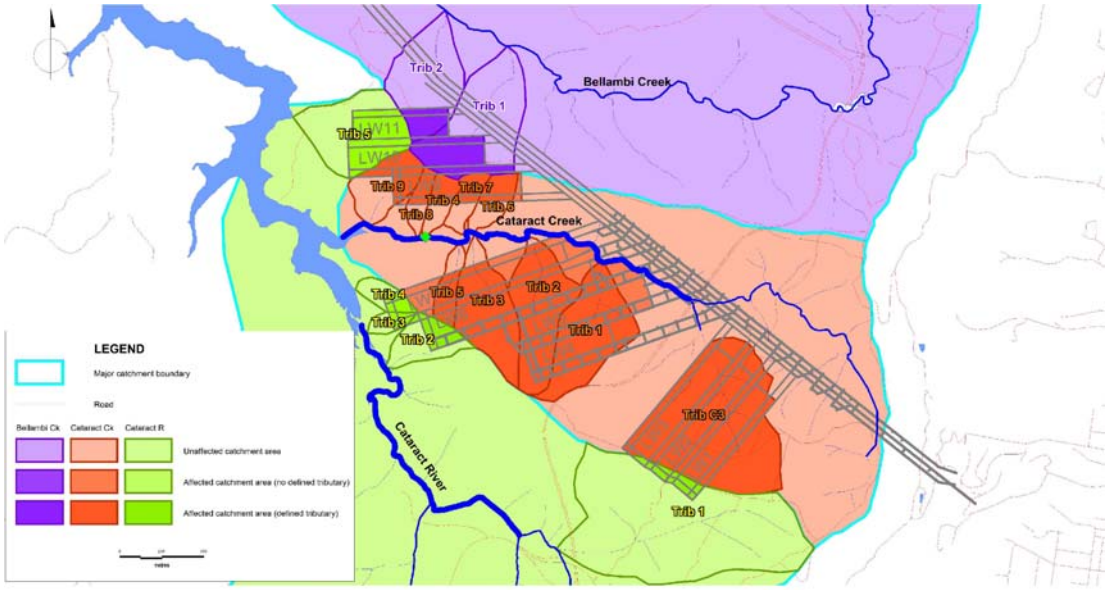


Figure 7: Catchment areas that are vulnerable to re-directed surface runoff through subsidence related seam to surface cracking (from Hansen Bailey 2015, WRM page 21)

Yours sincerely

Mackie Environmental Research Pty. Ltd.

C. Mackie

References:

Geoterra, 2016. Final response to PAC review. Email, February 2016

Groundwater Exploration Services (GES), 2016a. Russell Vale Colliery Underground expansion project – Groundwater modelling PAC review. Letter report to Wollongong Coal, February 2016.

Groundwater Exploration Services (GES), 2016b. Russell Vale Colliery Underground expansion project – Groundwater modelling PAC review – Technical Addendum. Letter report to Wollongong Coal, February 2016.

Hansen Bailey, 2014. Underground expansion project – Residual matters report. Report prepared for Wollongong Coal, June 2014.

Hansen Bailey, 2015. Response to Planning Assessment Commission review report. Report prepared for Wollongong Coal, September 2015.

Tammetta. P, 2013. Estimation of the Height of Complete Groundwater Drainage Above Mined Longwall Panels. Ground Water. September-October 2013, V51, No. 5, pp 723-734

Galvin and Associates Pty Ltd
ABN 27 086 258 871

8 March 2016

Ms L Briggs
Chair
Planning Assessment Commission
GPO Box 3415
Sydney NSW 2001

Dear Lynelle

Subject: Review of Subsidence Aspects Associated with Russell Vale Colliery Underground Expansion Project

I refer to your request of 21 January 2015 to provide advice to the Planning Assessment Commission (PAC) on mine subsidence related matters in regard to the above project and my response of 3 March 2015. I noted in that response that I was not in a position to undertake the level of inquiry required to provide comprehensive advice in the given timeframe. In particular, I had not had the opportunity to undertake a full field inspection and to review all relevant documentation in detail. Nevertheless, after reviewing select documentation provided by the Planning Assessment Commission and meeting on 18 February 2015 with the Commissioners who were reviewing this application, I was able to provide a range of overview advice.

Subsequently, the Proponent, Wollongong Coal Pty Ltd (WCL) has responded to the PAC Review Report of 2 April 2015 and I have had the opportunity to review relevant information and to make a field inspection.

The following summarises the status of the matters I raised in my 3 March 2015 report and in subsequent questions submitted through the PAC and provides commentary and advice arising out of the site inspection and other information that has come to hand.

1.0 RISK ASSESSMENT

In my report of 3 March 2015, I advised variously that:

- *The Environmental Assessment (EA) for the project comprises a number of reports from discipline experts. However, without the benefit of robust risk assessment, one cannot be sure that mine subsidence impacts and consequences have been fully assessed;*

PO Box 1228
MANLY NSW 2095
AUSTRALIA

Tel: +61 (2) 9976 2778
Mobile: +61 417 710 476

Email: Office@Galvin.net.au

- *the Commission should also seek input from a specialist in groundwater when assessing mine subsidence impacts;*[1]
- *the project should be subjected to robust risk assessment in respect of environmental impacts in general, and especially in regard to threats to drinking water;*
- *a much higher level of risk assessment is required to better establish the level of confidence that can be placed in predictions and the consequences should outcomes be more adverse than predicted; and*
- *a multidisciplinary approach is required to assessing risk.*

The PAC Review Report included a recommendation that:

> *The establishment of a risk assessment panel, constituted by an independent chair, Water NSW, the Dams Safety Committee, the Division of Resources and Energy and the proponent to oversee an integrated risk assessment, particularly focusing on links between subsidence and water (both groundwater and surface water) impacts of the proposal. This risk assessment, including associated work rerunning the groundwater modelling as recommended by Dr Mackie; and addressing the issues raised by the relevant agencies and experts (as highlighted in this report), needs to be completed before the application can be determined.*

The PAC Review Report identified that this was:

> *.....warranted in order to credibly establish the efficacy of an adaptive management regime to respond to potential impacts of the project.*

Subsequently, the scope of the integrated risk assessment was developed by WCL in consultation with key agencies and stipulated in the Terms of Reference for a so-called Independent Risk Assessment Panel (IRAP) to satisfy the PAC's recommendation. Among other things, the TOR required WCL to:

- *constitute an IRAP to conduct an ongoing assessment of the risks to Cataract Reservoir, groundwater, surface water and upland swamps during the extraction of longwalls associated with the Underground Expansion Project (UEP);*
- *develop a risk assessment methodology;*
- *utilise the latest available data to identify and assess the risks related to the extraction of the UEP longwalls;*
- *engage experts to assist and/or review the Risk Assessment report and any other specialist studies;*
- *consult with regulatory authorities and WaterNSW during the process.*

With the benefit of hindsight, it would have been beneficial to have described the attributes of *robust* risk assessment. An essential element for robust risk assessment, as reflected in risk assessment guidelines such as *MDG1010 –Risk Management Handbook for the Mining*

[1] Dr Colin Mackie was commissioned in response to this recommendation.

Industry (MDG-1010, 1997, 2011) is the use of a team with appropriately varied and relevant experience for risk identification. I was intending and expecting that the risk assessment team would include outside expertise in order to tap into other knowledge and experience; promote discussion and critical evaluation; test assumptions, calculations, and analyses; and provide an independent layer of assurance that all meaningful hazards had been identified and appropriately assessed for likelihood and consequence and that proposed controls were sensible and likely to be effective. A risk assessment by oneself of one's own work, even if a recognised expert in the field, does not constitute a truly independent or high level risk assessment.

This situation was countered to a considerable extent by the external experts reviewing the integrated risk assessment and a range of underpinning reports prepared by the authors of the EA and by the various agencies having input into this process. The integrated risk assessment was supported by a series of event trees that were constructed when all the Proponent's internal experts were present during the period of 22 to 26 June 2015. Subsequently, some aspects of the risk assessment did not involve all of the internal experts. For example, the workshop of 17 July, which was focused on risks that might affect water quality, only included the subsidence expert, while that on 28 July, which was focused on risks with effects on water quality, only involved the groundwater/surface water expert. The ecology expert was not present for either workshop, albeit that all experts were present for a review workshop on 5 August that examined the risk assessment as a whole and confirmed the information in the risk register. Only the groundwater/surface water expert was involved in the final review conducted by teleconference on 14 August. [2]

The integrated risk assessment is reported to have had three primary endpoints, namely:

- *Quantity of water available for drinking water purposes in Cataract Reservoir;*
- *Quality of water available for drinking water purposes in Cataract Reservoir; and*
- *Ecosystem effects of water quantity and quality on water dependent species, with a particular emphasis on upland swamps.*[3]

The context of the integrated risk assessment did not extend to the effects of water quantity and quality on fauna and on water dependent species along watercourses.

The integrated risk assessment was based on quantitative descriptions of levels of likelihood that were expressed in terms of annual probability. However, levels of consequences were defined in qualitative terms. For example, reductions in water quantity (which is a critical factor in this matter) were classified in terms of *very large, large, moderate, small* and *negligible*. Similarly, reductions in water quality were classified as *significant, major, moderate, small* and *minimal*. These descriptors can mean different things to different people. Hence, the risk outcomes lack objectivity for those not involved in the risk assessment process.

The IRAP reported that detailed comments on the risk assessment and associated documentation were provided by IRAP to WCL on 10 September 2015 and that, as at 28 September 2015, these had been addressed in the final risk assessment and associated documentation. The IRAP concluded that:

[2] Page 10 and 11 of Final Report: Integrated Risk Assessment for the UEP. Broadleaf.
[3] Page 21 of Final Report: Integrated Risk Assessment for the UEP. Broadleaf.

> *It is the IRAP's opinion that the risk assessment has been conducted by appropriately qualified experts in the fields of mine subsidence engineering, groundwater, surface water and ecology. It is understood that the WCL experts worked on the project together for a considerable period of time, which provided them the experience and the knowledge required to conduct the "integrated" risk assessment, which aims to ensure that the risks associated with underground mining on the quantity and quality of groundwater and surface water as well as upland swamps have been assessed and appropriate controls are identified.*
>
> *Following an extensive review of the risk assessment and the relevant documentation, it is the opinion of IRAP that the risk assessment is 'integrated' and has been based upon an approach that is sufficiently detailed and at an appropriate level to evaluate the risks*

The Department of Planning and Environment has advised that it *is satisfied that WCL is implementing the IRAP process in accordance with the TOR.*[4]

WaterNSW advised the PAC that:

> *WaterNSW considers that IRA process for the proposal was thorough and it identified all risks, associated likelihood and consequences.*
>
> *WaterNSW's remaining issues of concern .....can be addressed via conditions of approval and a minor change to the mine layout.*[5]

The Dam Safety Committee (DSC) advised on 10 September 2015 that:

> *DSC staff are satisfied with the Integrated Risk Assessment that has been undertaken on behalf of WCL and feel that the process undertaken was rigorous and far reaching as is possible given the nature of the risks being assessed.*[6]

2.0 HEIGHT OF FRACTURING

In my report of 3 March 2015, I recommended that the PAC seek input from a specialist in groundwater when assessing mine subsidence impacts, advising that:

> *One of a number of reasons for being of this view, is the reliance placed in the EA on a methodology proposed by Tammetta (2013) for calculating the height of groundwater depressurization due to mining induced caving and fracturing. Whilst this methodology may represent an advance in predicting subsidence impacts on groundwater, it is contentious in mine subsidence and groundwater circles. I do not subscribe fully to it. In its submission of 30 July 2014, the (then) Sydney Catchment Authority (SCA) noted that the uncertainties that the height of depressurization may approach the surface are of great concern. I have no feel for the extent of concern*

[4] Letter of 7 September 2015 David Clarkson, WCL
[5] Letter of 11 December 2015 to PAC
[6] Email of 10 December 2015 from Heather Middleton to David Clarkson, WCL

> *(consequences) should the height of depressurization reach the surface. However, the information I have reviewed is insufficient to give me confidence that the height of depressurization will not reach the surface. Hence, the importance of considering the consequences in the event that this did occur.*

In response to questions raised by the PAC in relation to *Response to Planning Assessment Commission Review Report Part 2*, the PAC has received advices from two of the contributors to the EA. One has advised that the maximum height of depressurisation is now determined using a piezometer network installed by WCL and that:

> *It should be noted that the piezometer network installed above Russell Vale East to measure the height of depressurisation has been expanded during the period that the Project Application has been running. The holes aimed specifically to target available areas of double and triple seam pillar extraction and longwall mining have been installed as resources and time lags for approval have allowed. Some of the early reports relating to estimating the heights of depressurisation predate the installations and subsequent monitoring and the learnings that came from this work.*[7]

The other advice on this matter goes into more detail as to the interpretation of the piezometer data and the conclusions that can be drawn from it.[8] It advices variously that:

> *The conceptual model of caving, fracturing and associated strata depressurisation used in the [2015] groundwater model was principally based on the observed VWP head versus pressure data within the Russel Vale Colliery.*
>
> *The relevant site data was initially incorporated into the Tammetta (2012) strata fracturing / strata depressurisation theory that was developed for single seam mining over an extracted longwall panel. However, the derived theoretical values did not correlate with the observed in-situ VWP depressurisation profile/s.*
>
> *Where multiple seam extraction was conducted, the Tammetta (2012) theory was then modified by adding the cumulative thickness of all workings. This approach overestimated the height of depressurisation measured by the piezometers.*
>
> *Subsequently, the Ditton and Merrick (2014) theory of strata fracturing / strata depressurisation (which was developed for single seam mining over a longwall panel) was compared to the observed VWP data, and this theory also did not reliably predict the observed height of depressurisation using a RAMP function with a linear decline of enhanced vertical conductivity (weighted layer thickness) that did not match the observed groundwater pressures in the site VWPs, primarily in the Bulgo Sandstone.*
>
> *As a result, the [2015] model utilised a modified version of a vertical conductivity RAMP function enhancement whereby a greater degree of enhancement was made within the Lower and Mid Bulgo Sandstone (as shown in Figure 2).*[9]

and

> *The revised (GeoTerra / GES, 2015) groundwater report for the Preferred Project Report subsequently assessed that surface to seam depressurisation was not predicted*

[7] SCT advice of 5 February 2016 to David Clarkson.
[8] GeoTerra advice of 27 January 2016 to WCL.
[9] Response to PAC Q14.

to potentially occur at the end of the proposed mining of the Wongawilli Seam at Russell Vale East.

.....

Depressurisation to surface is not predicted at the end of mining. However, it is predicted to occur 100 years after mining to the east of Cataract Creek adjacent to but not over LW5. This is because the Hawkesbury Sandstone has been eroded through to the Bulgo Sandstone along this reach of the creek. The predicted groundwater model stream baseflow losses associated with the potential surface to seam depressurisation adjacent to LW5 from Cataract Creek are XX Ml/year and therefore not a significant proportion of total flows.

.....

Subsequent to receipt, interpretation and incorporation in the study of additional VWP data after late 2014, and utilising a ramping function in the (Geoterra / GES 2015) model, which was based on in-situ VWP pressure head distributions, the "risk" of the LW7 region in or near Cataract Creek depressurising to surface was no longer predicted. The potential risk of surface to seam depressurisation was present in Geoterra / GES (2015), however, in a small area to the west of Cataract Creek and east of LW5, and over LWs1-3 as explained in the previous (paragraph 2) answer. [10]

Detailed critique of the latest advice to the PAC and the reports and analysis that underpin it is a matter for Dr Mackie. However, from a general engineering perspective, the advice gives rise to a number of questions from me in relation to the limited amount, duration and nature of the piezometer monitoring data on which critical conclusions have been drawn. Of particular concern is:

- The high reliance placed on piezometer site RV20, which is located at the western and deepest end of Longwall 4.
- The lack of baseline data for this site – it was not installed until after Longwall 4 had been extracted.
- Interpretation of results for this site – the PAC has been advised[11] that *the low piezometric heads measured above the 105mbgl VWP*[12] *at the 35, 65 and 85 mbgl VWPs indicate this zone is highly fractured and hydraulically connected and does not support a positive piezometric profile.* Hence, I question why this is not, in fact, confirming that fracturing developed all the way through to surface.
- It is also reported in the same PAC advice, however, that at RV20, the height of depressurisation extends to between 105mbgl and 134mbgl and that there is a perched horizon that maintains up to about 40 m of head as represented by the 105mbgl VWP intake. If that is the case, the question arises as to why 20 m of water head was not measured at 85mbgl (unless the 105mbgl site is within a confined aquifer).

I cannot relate these reported values with the earlier reported conclusion that depressurisation to surface is not predicted at the end of mining. If the height of fracturing is at or close to the surface over the deeper western end of Longwall 4, then careful consideration will need to be given to cross connections to this fracture network from surface and groundwater sources,

[10] Response to PAC Q16.
[11] Response to PAC Q13.
[12] mgbl – metres below ground level. VWP – vibrating wire piezometer

especially at the eastern ends of Longwall Panels 5, 6 and 7, which are adjacent to Cataract Creek and up to 90 m shallower. In this regard, the integrated risk assessment records (see AH 111, BH 111 and CH 111) that:

> *Horizontal shear zones do not provide hydraulic connectivity to the mine workings. It (sic) may provide connectivity to zone of depressurisation above the mine workings.*

The risk assessment records the current control for changes to groundwater regime (AH 111, BH 111 and CH111) to be:

> *Monitoring will continue to be undertaken to detect abnormal flows (high or low), allowing adaptive management intervention to adjust mining activities.*

Other than significantly reducing mining height and/or panel width (or not mining), I am unaware of how mining activities could be adjusted as part of adaptive management in order to prevent fracturing extending all the way to the surface. Either of these control is likely to have serious adverse consequences for productivity and costs and hence, for financial viability.

The integrated risk assessment reports that:

> *Under the worst case scenario, subsidence induced cracking is predicted to reduce total flow in Cataract Creek by 6.38 ML/day. Similarly, total flows in Cataract River and Bellambi Creek are predicted to decrease by 0.56 ML/day and 0.40 ML/day. Therefore, the total flow to Cataract Reservoir is predicted to decrease by 7.34 ML/day under the modelled worst case scenario. Under existing conditions, the total average stream flow in Cataract Creek, Cataract River and Bellambi Creek is estimated to be 76.34 ML/day. The worst case scenario represents a 9.6% reduction in the total average stream flow provided by these catchments.*[13]

These values have particular relevance to the submission of WaterNSW regarding recommended conditions of approval. In particular:

> *WaterNSW disagrees with the DPE's assertion that the predicted extreme water loss is negligible. Water loss of 7.3 Ml/day is unacceptable to WaterNSW, particularly during dry periods.*

This disagreement may reflect the lack of definition of the terms *very large, large, moderate, small* and *negligible* in the integrated risk assessment in regard to reduction in water quantity.

In summary, based on the information I have reviewed, a reasonable degree of uncertainty still surrounds the potential for fracturing to extend all the way to the surface over portions of the application area and, if it did, how it could be responded to by adaptive management or be remediated.

[13] Page 19 of Integrated Risk Assessment

3.0 CORRIMAL FAULT AND DYKE D8

Subsequent to my report of 3 March 2015, a detailed assessment was undertaken of Corrimal Fault and Dyke D8 at Russel Vale East.[14] The assessment concluded that:

> *The Corrimal Fault tapers to become insignificant with less than 1 m of throw at seam level some 540 m from the edge of the reservoir at an overburden depth greater than 300 m.....*
>
> *.....Previous mining in the Bulli Seam .....indicates that there is no disruption to mining layouts and no significant offset in the coal seam along the alignment of the Corrimal Fault beyond the area of the proposed Longwall 7.*
>
> *.....The fault either does not extend under the reservoir at all or has such a small throw as to be insignificant for all practical purposes.*[15]

The DSC has advised that:

> *DSC would have no difficulty approving extraction of longwall 7 if the Corrimal Fault is absent or can be demonstrated to be terminating at longwall 7. Even if the Corrimal Fault is demonstrably present in LW 7, DSC has no concerns with extraction of the Eastern 2/3 of LW7, but may insist on leaving a hydraulic barrier of solid coal against the fault for protection against ingress.*[16]

If the project is approved, the conditions of approval need to define the meaning of the words *absent* and *terminating*. Are these meanings absolute or are they qualified as in the assessment report to mean *such a small throw as to be insignificant for all practical purposes*?. If the latter, then it is recommended that the term *small throw* be defined by a value to the satisfaction of the DSC.

The conclusion of the assessment that *the lateral offset of the proposed longwall goafs from the reservoir along the alignment of dyke D8 is sufficiently large at 1.7 km for there to be no credible risk to the stored waters of Cataract Reservoir* from the dyke appears reasonable.

4.0 SEALS

The DSC advised on 10 September 2015 that:

> *DSC staff are confident that WCL have demonstrated that in the unlikely event of a connection to the Mine developing, that water from the outflow could be contained for an extended period (up to 10 years) in the workings that currently exist underground and would therefore have ample time to install effective seals where required.*[17]

The risk of seal failure was removed from the Risk Register (dated 24 September 2015) derived from the Integrated Risk Assessment on the basis that:

---

[14] SCT Report WCRV4466A, 19 August 2015.
[15] Page i of SCT Operations Report WCRV4466A
[16] Email of 10 September 2015 from Heather Middleton to David Clarkson, WCL
[17] Email of 10 September 2015 from Heather Middleton to David Clarkson, WCL

Sealing of the mine adit is included in the risk assessment as a control for managing inflows (risk BS23 and BS24) rather than as a risk in and of itself.[18]

In my opinion, this reasoning needs careful reconsideration. If sealing of a mine adit constitutes a control, then this control needs to be risk assessed to determine its likely practicality and effectiveness and, hence, residual risk. In this particular instance, sealing of a mine adit is likely to present significant challenges for a number of reasons, two of which are:

- Sealing an adit located toward the base of the escarpment may have the potential to induce landslides due the escarpment being charged with water pressure over time; and
- Should a seal fail, there is a potential for an outrush (inrush) of water through residential and public areas downhill from the adit.

Although the integrated risk assessment and the DSC response to it were based on sealing the adits, it appears that an earlier report[19] and another report in the intervening period[20], both by SCT Operations, were premised on the adits remaining open and water outflows being managed by a water treatment system. For example, WCL was advised by SCT Operations in response to comments from the IRAP that:

There is not considered to be any long term practical benefit in trying to seal the mine portals in an attempt to prevent outflow to the surface. In the unlikely event that there is an uncontrolled flow into the mine, there is a significant volume available down dip within the existing mine to develop and implement an effective management strategy such as treating the water to drinking water standards and using the mine volume as an underground storage facility.[21]

Ultimately the mine will flood when the pumps are turned off. The issue is the rate of water inflow and, therefore, outflow. If management of outflow requires treating the water to drinking standards, then any conditions of approval may need to factor the ongoing costs of this control measure in the Closure Plan for the mine.

5.0 BARRIER TO STORED WATERS OF CATARACT RESERVOIR

The PPR is reported to be based on leaving a protective barrier between the proposed longwall panels and the stored waters of Cataract Reservoir that has a width approximating 0.7 times depth (equivalent to a 35° angle of draw).

The concept of leaving a solid protective barrier against surface infrastructure is well established in subsidence engineering. The width of this barrier is mandated in some mining jurisdictions and is commonly based on a 35° angle of draw (or 0.7 times depth). This has been the case in South Africa, for example. It has been generally adopted in the Newcastle Coalfield of NSW.

[18] Page 15 of Risk Register: Integrated Risk Assessment for the UEP. Broadleaf. 24 September 2015
[19] Appendix E of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015.
[20] Appendix G of Russell Vale UEP - Response to PAC Review Report, Part 2. 28 September 2015.
[21] Ibid.

In the case of Longwall 7 at Russell Vale Colliery, however, bord and pillar workings and some limited pillar extraction workings occur within the so-called protective pillar, which has a width of some 200 m. I concur with the stability assessment undertaken for these workings, which indicates that overloading of the workings is a credible possibility. It has been estimated that if this were to occur, surface subsidence of up to about 600 mm is possible over the workings.[22] The analysis does not address the angle of draw associated with this subsidence event, which is likely to result in some (minor) subsidence of the base of the reservoir.

The analysis concludes that the subsidence associated with the workings becoming overloaded *would not be expected to cause any increase in hydraulic conductivity between the reservoir and the mining horizon.*[23] I concur in respect of direct vertical conductivity. However, I do not subscribe to the proposition that *the consequence of an increase in vertical compression [due to the pillars yielding] is that the hydraulic conductivity above the start of Longwall 7 is likely to be reduced by pillar compression.* Any such increase will be associated with high stress concentrations in the immediate roof and floor of the pillars and dissipate with distance into the roof and floor.

The report concludes that:

> *Having stepped back from the FSL of the reservoir by a distance of 0.7 times depth (about 200 m), there is no credible way that inflows of any consequence can come into the mine from stored waters.*[24]

The potential for inflow through a combination of horizontal and vertical conduits is discussed in the next section of this advice to the PAC.

6.0 CONTRIBUTION OF HORIZONTAL SHEARS TO MINE INFLOW

The potential for horizontal shears to contribute to mine inflow was a matter raised by the IRAP. In responding to the IRAP, the Proponent's consultant reported that:

> *Recent work at Sandy Creek Waterfall and other similar sires has greatly increased the understanding of how basal shear planes develop both naturally and in response to nearby mining.*
>
> .....
>
> *The hydraulic conductivity of basal shear planes has not been routinely measured so it is difficult to be sure of the magnitude of hydraulic conductivity at a scale that can easily be included into numerical modelling.*
>
> .....
>
> *By providing horizontal barriers to mining of the order of 0.7 times depth, historical experience has been that any inflows are reduced to sufficiently low levels to be effectively indistinguishable from other sources of inflow. Much smaller barriers*

[22] Section 5.5.2 of Appendix E of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015.
[23] Section 5.5.3 of Appendix E of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015.
[24] Section 6 of Appendix E of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015.

> *equivalent to 10° angle of draw (0.17 times depth) to pillar extraction have proven to be effective historically and were for many years the standard. However, several experiences of uncontrolled inflows have indicated that these relatively smaller barriers at shallow depth can be compromised by geological structure and the larger 0.7 times depth barriers are generally adopted today as being more acceptable.*[25]

As already discussed, a barrier with a width of 0.7 times depth has been proposed between the western end of Longwall 7 and Cataract Reservoir, albeit that there are bord and pillar workings within this barrier that may yield in time to come. The effect of pillar yielding on hydraulic conductivity has not been discussed in the Proponent's application but I would imagine it to be minor. The Proponent's consultant had previously advised that:

> *The hydraulic conductivity of undisturbed rock in the overburden strata at Russell Vale Colliery is of the order of $1x10^{-9}$ m/s. At this hydraulic conductivity, it is not credible to have high rates of uncontrolled inflow even for a barrier based on 0,17 times overburden depth to the Bulli Seam.*[26]

The widths of the barriers currently proposed between the eastern ends of longwall panels 5, 6 and 7 and Cataract Creek appear to be of the order of 0.3 times depth. Hence, as recognised in the integrated risk assessment, horizontal shear zones may provide connectivity to zone of depressurisation above the mine workings

The response to the IRAP goes on to state:

> *Mine water balance includes any contribution from flow along horizontal bedding planes as well as from multiple other sources. Further work targeting the hydraulic conductivity of bedding plane shears is required to quantify the actual magnitude of basal inflows because such inflows are likely to more directly take water from stored waters and creeks, but overall, the magnitude of inflows into Russell Vale East has been relatively small from all sources and flow along basal shear planes including basal shear planes that were mobilised by previous mining is expected to be only a relatively small proportion of this total inflow. The presence of such shear planes in an environment where they are known to exist but total inflows are relatively modest suggests that the magnitude of inflows along these basal shear planes is unlikely to be very significant. Nevertheless further work aimed to quantify the hydraulic characteristics of these shear planes is recommended as the opportunity arises.*[27]

Against this background, it appears that the Proponent has been judicious in making worse case estimates of water loss into the Cataract Reservoir due to subsidence related cracking over longwall catchments. Currently unexplained surface water losses in the Western Coalfield of NSW also support such an approach, albeit that another mechanism to horizontal shear may be accountable for this impact.

---

[25] Section 5 of Appendix G of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015
[26] Section 3 of Appendix D of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015
[27] Section 5 of Appendix G of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015

7.0 OTHER POINTS OF NOTE

The fact that most of the area of interest has already been subjected to one or more episodes of surface subsidence and that cumulative effects and impacts are not known with certainty presents a challenge to setting trigger levels for responding to future subsidence. In this regard:

- The criteria outlined in DoP (2010) for strain required to fracture rock cannot be applied directly to future measured values (as appears to be proposed[28]) because the amount of incremental strain that may have already developed is unknown.
- The proposal by WaterNSW that any consent should only permit mining up to a point where the valley closure is predicted to be 200mm[29] needs to be assessed with caution for a number of reasons. These include firstly, that predictions of valley closure can be unreliable. Secondly, it is not known how much valley closure has already occurred and, therefore, what tolerance there is to further valley closure without resulting in unacceptable impacts. Rather, more emphasis may need to be given to trigger levels based on observed and measured impacts of valley closure (such as surface cracking and horizontal shear planes).

Should you have any queries arising from this advice, please do not hesitate to contact me.

Yours sincerely

Emeritus Professor JM Galvin

FTSEA, FIEAust CPEng, FAusIMM CP(Min)

[28] Page 31 of Appendix A of Russell Vale UEP – Response to PAC Review Report, Part 2. 28 September 2015
[29] Letter from WaterNSW to PAC dated 11 December 2015.

REFERENCES

DoP. (2010). Bulli Seam Operations - Planning Assessment Commission Report. ISBN 978-0-9806592-6-9, pp. 474. Sydney: Department of Planning, NSW Government.

MDG-1010. (1997). *Risk Management Handbook for the Mining Industry.* Sydney: NSW State Government.

MDG-1010. (2011). *Minerals Industry Safety and Health Risk Management Guideline.* Sydney: NSW State Government.

Tammetta, P. (2013). Estimation of the Height of Complete Groundwater Drainage Above Mined Longwall Panels. *Groundwater, 51* (5).