

20 June 2013

The Director Mining and Industry Projects
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Clay Preshaw

Dear Sir

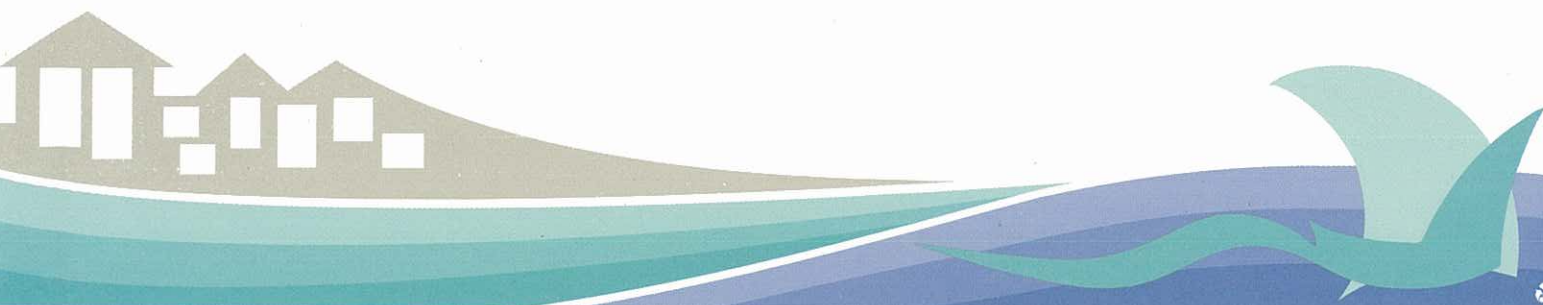
Exhibition Wallarah 2 Coal Project EIS - Application No. SSD-4974

Thank you for the opportunity to make a submission in response to the public exhibition of the abovementioned EIS. Wyong Shire Council in conjunction with Gosford City Council, has engaged Pells Sullivan Meynink Engineering Consultants (PSM) to review the EIS having regard to the implications of mining on the water catchment. In this regard, PSM has focussed their comments on the following aspects:

- Impact on groundwater
- Impact on surface water
- Impact on flooding
- Impact of subsidence
- Risk assessment and adaptive management of issues

A complete copy of PSM's report is attached with the findings summarised below. Wyong Shire Council objects to the current proposal based on the findings and recommendations contained in PSM's report.

In addition to the report by PSM, Wyong Council has engaged Earth Systems to review the EIS having regard to the potential environmental and planning issues related to the project, with the exception of those aspects reviewed by PSM. Wyong Shire Council objects to the current proposal based on the findings and recommendations contained in the Earth Systems report, a complete copy of which is attached. The findings and recommendations of Earth Systems are also summarised below and address the following aspects:



- Structure and approach of the EIS
- Stakeholder engagement
- Water quality impacts
- Air quality impacts
- Greenhouse gas emissions
- Noise and vibration impacts
- Ecological impacts
- Traffic and transport
- Visual amenity
- Archaeology and cultural heritage
- Impacts beyond the Director General's Requirements
- Management and monitoring

It should be noted that as of Wednesday 19 June, 2013, the "water trigger amendment" to the EPBC Act was passed through the Senate. The Bill is now awaiting assent by the Governor-General, with the changes under the Bill set to commence the day after assent.

The Bill's passage now means the Commonwealth is responsible for ensuring water systems are not impacted by major coal seam gas and coal mining projects. Under the Bill, a person, a constitutional corporation or the Commonwealth (or agency) commits an offence if they take an action involving coal seam gas development or large coal mining development, and the action has, will have or is likely to have a significant impact on a water resource, unless they first obtain approval for the action for the Commonwealth environment minister under the EPBC Act.

The approval trigger will apply to an action which has, or is likely to have, a significant impact on water resources whether in its own right or when considered with other developments.

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The existing EPBC Act provides definitions of "coal seam gas development" and "large coal mining development" as any activity involving coal seam gas extraction or any coal mining activity (respectively) that has, or is likely to have, a significant impact on water resources. The definition of a water resource in this amendment is the same as currently used in the Water Act 2007. A water resource relates to ground water and surface water, and includes organisms and ecosystems that contribute to the physical state and environmental value of the water resource.

According to the Department of Sustainability, Environment, Water, Population and Communities guidelines on the definition of a "significant impact", a significant impact is an impact that is important, notable or of consequence, having regard to its context or intensity. A significant impact on water resources may be caused by one development action relating to coal seam gas or large coal mine, or the cumulative impact of such actions. Under the National Partnership Agreement, factors which may directly or indirectly bring about a significant impact on water resources could include those that:

- change in the quantity, quality or availability of surface or ground water;
- alter ground water pressure and/ or water table levels;
- alter the ecological character of a wetland;
- result in rivers or creeks diverted or impounded;
- alter drainage patterns;
- reduce biological diversity or change species composition;
- alter coastal processes, including sediment movement or accretion, or water circulation patterns;
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the environment such that biodiversity, ecological integrity, human health or other community and economic use may be substantially adversely affected; or
- substantially increase demand for, or reduce the availability of water for the environment.

Although the Amendment post-dates the Wallarah 2 Coal Project EIS submission, it would apply to any developments (such as this Project) that are currently referred for a decision that is in the approval process, where the Independent Expert Scientific Committee has not yet given advice.

The transitional arrangements provide that if the process of having a development assessed under the EPBC Act has already commenced, the Minister has 60 days (from the commencement of the Bill) to decide whether the project requires approval in relation to the new water trigger. The Minister then has to advise and consult with the proponents affected on the proposed decision for a period of 10 days before a final decision is made.

Following is a summary of each of the issues, however, both the PSM reports and the Earth Systems report need to be read in their entirety.

1 IMPACT ON GROUNDWATER

The EIS underestimates the potential impact on groundwater. The conclusions reached in the EIS are primarily the result of the input parameters adopted for their numerical modeling. These input parameters are primarily driven by the unsuitable method by which the makeup of the rock and its defects have been sampled and are not consistent with available data or modeling within the EIS. Further, the modeling assumes recharge of the water system based on average climatic conditions.

The EIS implies that water inflow to the mine, of up to 2.5ML/day would largely come from water stored in the ground. However, it avoids the fact that water stored in the ground comes from somewhere, and is currently in equilibrium with natural recharge. A valid way to consider this matter is encapsulated in the following quotation from Dr Rick Evans, principal hydrogeologist of Sinclair Knight Merz, viz:

"There is no free lunch here. It's very simple – every litre of water you pump out of the ground reduces river flow by the same amount".

Australian Financial Review,
24 May 2007

Other points to note are:

- Precisely what portions of which rivers will be affected by leakage losses from the near surface alluvial lands into the deeper rock mass cannot be defined;
- The time it will take for the impact of underground extraction to reflect in surface flows cannot be determined;
- The EIS states that the mine will not fully recover groundwater pressures for over 500 years.

These points, combined with the uncertainty on the input parameters to the groundwater modeling suggest there is a high probability that leakage losses from the alluvial lands will impact the surface water. Given the high likelihood or even near certainty that climate impacts would be sufficiently severe at some point implies that it may affect visible flows for long periods.

On balance, the findings from the EIS are at the least a limited and probably unconservative view of potential impacts. This means that, at present, it is not known with an acceptable level of confidence what the likely impacts of the Wallarah 2 longwalls will be on groundwater resources, and on groundwater that feeds into the streams of the Dooralong and Yarramalong Valleys.

2 IMPACT ON SURFACE WATER

The EIS underestimates the impact on surface water. Loss of surface water from streams in either the Yarramalong and/or the Dooralong Valley will have a direct impact on the availability of water in the Wyong River downstream of the proposed mine which is used as part of the water supply to the Wyong and Gosford Local Government Areas. Further, loss of surface water will also affect businesses such as turf farming and supply of water to local bores.

The assessment of loss of surface water is entirely dependent on the inputs to groundwater modeling and the impacts on groundwater flow by the mine. The EIS concludes that there will be very little impact on leakage from the near surface alluvial lands due to the very low permeability of the rock below the alluvial lands and, that what loss does occur will be readily compensated for by surface recharge.

These statements are based on two assumptions. Firstly, that average climactic conditions prevail and secondly, a favourable view of the permeability of the rock below the alluvial lands. The latter point is discussed above under the topic of groundwater modeling, but suffice to say there is considered to be a high level of uncertainty and a lack of factual evidence to confirm the parameters used.

With regard to the first point above, for the EIS to be relevant, it must also consider the variation in inputs to the surface water supply in extended dry periods. The review in the PSM report considers the flow in Jilliby Jilliby Creek between 1972 and 2013 to illustrate the sensitivity of the stream flow to climate and to small variations in flow volumes, viz:

- The median flow rate in the creek is about 4.5 ML/day.
- Flows of less than 1ML/day occurred for 24% of the time
- Flows of less than 0.1 ML/day occurred for 10% of time.

The predicted water inflow to the mine of up to 2.5ML/day represents more than half of the average flow for Jilliby Jilliby Creek and is greater than the flows recorded for 40% of the time since 1972.

These flows are put into perspective when records of consecutive days, since 1972, where low flows are considered. The five longest periods of consecutive days when flow was less than 1 ML/day and 2 ML/day range from 112 up to 190 days. This shows that when dry periods occur, the flow in the creeks can be expected to be at a level that may be readily affected by leakage losses from the alluvial lands.

Further, a review of the climate during this period reveals that while some periods of drought did occur such as the Millennium Drought, it does not include the experience of the more intense droughts of World War 2, and the time of Federation.

3 FLOODING

The results of the flood assessment appear reasonable given the limits of the prediction of subsidence and can be considered as "best practice".

The discussion on the impacts of the W2CP on flooding are made in relation to the 1% AEP event (1 in 100 year) and would only fully come into effect after mining has been completed. It is important to note that the assessment of flooding is dependent on the expected subsidence and so any change to mine plans, or the prediction of subsidence through any validation process will result in changes to the extent and impact of flooding.

Results of the flood modeling for the 1% AEP flood event indicate that subsidence from the current W2CP mine plan is likely to result in only relatively minor increases in the depth and extent of flooding compared to current, pre-mining estimates with a total of about 35Ha of additional land becoming affected across the whole W2CP area.

The changes to flooding extents will have an adverse effect on up to 10 properties. The impact is assessed to be up to 5% of additional land area inundated for 4 of these Properties and up to 20% of additional land area for the remaining 6 properties.

In terms of impacts on residential dwellings, a total of 5 properties that were not previously impacted by the 1 in 100 year flood level are now impacted by flood water depths of between 4cm and 1.27m above floor level. These are assessed as being Major impacts in the system of '*Flood Impact Categories*' adopted by the EIS. In addition to these dwellings, a further one dwelling is Categorised as being subject to a Major Impact, in this case the expected 1 in 100 year flood level increase by up to 41cm above current, pre-mining predictions.

In the moderate flood impact category, a total of 8 dwellings will see a rise in the currently predicted inundation levels due to the 1%AEP event by between 3cm and 17cm. A further 3 dwellings will have the level of clearance, or freeboard between the predicted flood level and dwelling floor level reduced to values of between 4cm and 28cm.

Minor impacts are expected to occur to a total of 10 dwellings and comprise increased levels of flooding above floor level by between 1cm and 4cm and reduced levels of freeboard above flood levels.

Further to the dwellings described above, a total of 14 dwellings are expected to have no significant change in flood impacts while a total of 49 properties will see a slight reduction in flood impacts.

Other impacts of the subsidence on flooding are flood peak flows are anticipated to be slightly reduced with a minor increase in the duration of the peak, although the EIS notes these as being insignificant.

Flooding will impact a total of 30 primary and secondary access roads in the project area. Of these 6 primary access route low points will be adversely impacted by the mine. Adverse impacts comprise increased duration of flooding of between 1hour and up to 27 hours. The latter time pertains to the crossing (D50) located toward the southern end of Jilliby Road just north of the intersection with Watagan Forest Drive.

Mitigation of the impacts of flooding can readily be undertaken by the WACJV. Detailed plans for each location and/or dwelling are not provided at this stage of the process and are only required after approval has been given.

At this time, the only indication of the extent of potential mitigation is in relation to the Major and Moderate Impact Categories.

Preliminary descriptions of possible mitigation works presented in the EIS comprise:

- Raising or relocating dwellings;
- Raising Sandra Street to increase the upstream flood retarding storage;
- Construction of grassed earthen levees around dwellings to provide a minimum freeboard of 0.3m; and
- Construction of new replacement dwellings.

The purchase of dwellings is mentioned as an option, but is not linked to any dwellings in the EIS, nor is any mechanism or process for such an option canvassed.

In terms of primary access points, the six adversely affected locations can be raised after subsidence has occurred to mitigate the adverse effect. In some instances, the works may require new culvert works to facilitate passage of flood waters past the obstacles.

Council is concerned regarding the longer term maintenance requirements of any mitigation measures.

The discussion on potential flood mitigation measures remain at a feasibility level but are considered appropriate and to constitute "best practice" for this level of appraisal. Detailed assessment will be required if planning approval is given and this must ensure all the Director General's requirements are met.

4 IMPACT OF SUBSIDENCE

Subsidence is the prime and most readily notable impact of underground longwall mining. The extent and magnitude of subsidence has a controlling influence on potential damage to property and the extent and nature of flooding and movement of surface water.

The prime result of mining are the expected number and severity of impacts across the 245 properties within the area affected by the predicted subsidence, viz:

- 83% of properties being unaffected;
- 12% requiring very minor to minor repair;
- 5% requiring substantial to extensive repair; and
- <0.5% requiring a complete rebuild (ie. about 1 property).

These impacts are based on predictions of subsidence comprising:

- Vertical subsidence up to 2.6m with less subsidence predicted in residential areas to the east and more subsidence within forested areas to the west.
- Tilts up to 15mm/m concentrated above the edges of the panels and over forested areas.
- Tensile strains up to 4mm/m concentrated near the edge of panels. About 99% of these strains are expected to be less than 2.5 mm/m.
- Compressive strains up to 5.5 m/m concentrated about 50m inside the panel edges. About 99% expected to be less than 3.3 mm/m.
- Far field movements up to ~60 mm horizontally at a distance of around 1km from mining diminishing to less than 25 mm at a distance of 2 km.

The subsidence prediction used for W2CP was developed using three key components:

1. The predictive model developed using the empirical Incremental Profile Method (IPM) by the specialist subsidence consultant MSEC;

2. The method used to calibrate the empirical predictive model by the consultant Strata Control Technology (SCT); and
3. Chain pillar performance.

Firstly, the situation at the proposed W2CP is unique in as much as it would be a deep underground coal mine in Newcastle Coal Measures, which have traditionally been mined at relatively shallow depths. It is from these experiences that the IPM has had to draw empirical data from. That is, the experience from shallow underground coal mining in similar geology to the W2CP from the Newcastle Coal fields along with the experience from mining at similar depths to the W2CP from the Southern Coal Fields, which are in a different geological environment.

As a result, the predictions of subsidence by MSEC, based on the empirical IPM approach was calibrated against computer based modeling by SCT and it is the result of this combination of empirical mining experience and computer modeling calibration that forms the prime aspect of the review herein.

In summary PSM concludes that:

- Based on their discussions with W2CP, PSM understands that something like 4 to 5 panels would need to be extracted before a full model calibration exercise could be undertaken to assess the validity of the subsidence prediction and modeling undertaken.
- The reliability and accuracy of the SCT method is unknown as:
 - There is a reliance on extrapolated inputs to which the method has been shown to be sensitive.
 - The model is calibrated to site-specific data, and not to a small number of measurements from other sites.
 - The sensitivity to most input parameters is not presented.
- Due to the empirical nature of the method the Incremental Profile Method (IPM) is only as reliable as the data to which is it calibrated, in this case the SCT model results. Therefore the reliability and accuracy of the IPM is in doubt.

This is to some extent recognised by MSEC who in the EIS state:

"A thorough calibration...will only be achieved after subsidence monitoring data is obtained and analysed".

- The use of one predictive model to calibrate another is generally unwise and not widely regarded as best practice.
- The IPM is stated as being conservative and likely to over predict impacts. The evidence for this conservatism and the expected magnitude with respect to W2CP are not provided. Indeed all indications are that the model development is centred around matching expected conditions and not exceeding or over-predicting them.

- There is a reliance on pillar compression after extraction resulting in a smoother subsidence profile. However, the basis for this assumption appears to conflict the Geological Report (Appendix G), where significant variation in both roof and floor conditions is expected across the site.
- The EIS acknowledges that pillar compression may not occur but does not quantify the impacts or changes in impact should this not occur.
- First longwall will prove that this pillar compression assumption is valid.
- No less than 3 longwalls (L1N to L3N) and more likely 4 to 5 longwalls are required before the pillar compression theory can be verified.

PSM accepts that these predicted impacts are in agreement with expectations based on measured subsidence impacts elsewhere, and the Newcastle and Southern Coalfields in particular.

PSM is in general agreement that should the predicted level of subsidence occur, the type distribution and severity of impacts on houses, buildings and infrastructure is likely to be similar to that stated in the EIS.

PSM does not agree that the prediction represents a conservative estimate of subsidence impacts as all the evidence presented in the EIS suggests the prediction represents the most likely impacts.

PSM considers that the model, calibration and application of the prediction does not provide sufficient guidance as to the sensitivity and reliability of the method and may, therefore, fail the Director General's "reasonable level of confidence" test.

In general PSM did not find any omissions or evidence to suggest that subsidence due to W2CP is likely to be significantly different to that predicted by the EIS. PSM's main concern is the lack of certainty around the predictive method and the likely variation in prediction based on observed variations that are already known and potentially those unknown.

5 RISK ASSESSMENT AND ADAPTIVE MANAGEMENT

In terms of groundwater impacts and to a lesser extent surface subsidence, the EIS presents an abridged assessment of the potential impacts and hazards posed by the W2CP. This situation arises as the EIS only considers risks that have been modeled by the specialist consultants and is thereby limited by the specialist assumptions and either lack of or limited sensitivity assessments. This is not considered appropriate at this stage of the assessment where transparency as to the entire gamut of potential impacts should be canvassed.

Further, the consequence rankings at the high end of assessment have been combined and limit the risk assessment process by requiring that severe, long term and/or potentially irreversible impacts must also be wide spread to warrant a high ranking.

In order to begin to allow the impacts of the project to be managed via adaptive management, the understanding of the impacts and risks must be robust and comprehensive, and quantitative in nature, not qualitative as is the case here.

The risk assessment should consider the level of risk associated with all aspects of the W2CP, and in particular those that:

- Are associated with a high level of severity in terms of consequence,
- Have a high degree of uncertainty surrounding the assessment/modeling,
- Have consequences that either may not/cannot be able to be remediated, mitigated or managed once they are observed, or
- Represent a significant degree of community concern.

The results of a rigorous, qualitative risk assessment could then be considered with respect to acceptable levels of risk, and/or a cost/benefit assessment. The latter of which may, of course result in high consequence impacts with a low risk and/or cost impact being disregarded in the final assessment of the project. However, as stated above, they all need to be considered and presented so an informed judgement/decision can be made.

In terms of the aspects of the project covered in this report, PSM recommend the following be subject to a detailed risk assessment process.

1. Ground Water Impacts – test the sensitivity of the baseflow water losses with respect to hydraulic conductivity, level of subsidence induced by mining and environmental factors such as drought.
2. Subsidence Impacts – test the magnitude and location of subsidence effects with respect to items such as variability of the roof conditions of the mine and strength of pillars.

If the impacts of the mine are to be managed via adaptive management then a risk assessment is essential in order for the process to be:

- Correctly focused; and
- Establish realistic and measurable targets.

Following this, and possibly with the assistance of a cost/benefit assessment, for an adaptive management plan to be effective it must be based on targets for monitoring and assessment that are:

- specific;
- measurable; and
- agreed between all parties.

Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process.

Agreed responses may be as minor as "continue to monitor / watch" to potentially quarantining coal below the alluvial areas or even as strong as "cease mining".

6 STRUCTURE AND APPROACH OF THE EIS

The EIS should fully consider and assess the different phases of the mine. The EIS does not adequately assess construction impacts, focusing primarily on operations. Impacts and issues associated with air quality, water quality and transport are likely to be significantly different during construction. The EIS does not adequately consider closure planning and no assessment of potential closure impacts has been undertaken. The EIS does not demonstrate that the Project would be closed in a manner that safeguards the environment and community assets.

The Proponent's risk assessment and cost benefit analysis is based on the results of the EIS. The risks, benefits and costs associated with the Project need to be re-rated based on the knowledge gaps and uncertainties that remain and the findings of further recommended studies.

An Environmental Management System has not been developed for the Project, nor is there a commitment to develop such a system.

The project proponent has not committed to regular independent environmental audits throughout the project life cycle. However, the project proponent has committed to developing an Annual Review Report to systematically assess performance and identify areas for improvement.

7 STAKEHOLDER ENGAGEMENT

The Proponent has still failed to adequately engage with the community during the environmental assessment process and consequently limited consultation has been conducted. The EIS does not provide sufficient information on the concerns raised by the community during consultation.

8 WATER QUALITY

The EIS does not assess impacts on surface water quality associated with the construction phase of the Project, nor does it provide management and mitigation measures for any potential impacts. There is no contingency for the Project if development does impact on water quality or hydrology.

The mined materials and wallrock of the deposit have not been assessed in terms of their ability to leach acid and metalliferous drainage (AMD). This is a significant oversight as AMD / saline drainage can be one of the most long-lived environmental impacts from coal mining.

The surface water monitoring program does not include a sampling point immediately downstream of the proposed Wallarah Creek tributary discharge site

The EIS does not provide contingency for overflow of untreated mine water from the Mine Operations Dam (MOD) in the event that overflow may occur.

The baseline assessment for groundwater quality appears to have included measurement of only pH and TDS, neglecting other key analytical parameters and therefore not providing a suitable baseline.

Mitigation measures for groundwater impacts are limited to repairing damaged bores from subsidence and replacing water supply if groundwater drawdown exceeds expectations. Mitigation for groundwater quality is not directly articulated.

9 AIR QUALITY

The methodology for air quality impact assessment does not appear to have been undertaken in a manner consistent with applicable legislation (DECC, 2005). Some modeling appears to include only Project emissions rather than Project emissions with baseline conditions. This provides a misleading assessment of likely dust levels that will be experienced by surrounding communities. Construction impacts and impacts associated with certain climatic conditions are not clearly outlined.

Predicted Project-related emission concentrations from dispersion modeling assume Project implementation of best practices. These estimates are only relevant provided these controls are implemented. It is unclear whether the EIS commits the Project to these management and mitigation measures.

10 GREENHOUSE GAS

Greenhouse gas emission mitigation strategies are very brief and do not demonstrate a sufficient level of commitment by the Proponent to reduce emissions. As such the Greenhouse Assessment does not adequately address the terms listed in the Director-General's Environmental Assessment Requirements and the Supplementary Director-General's Requirements.

11 NOISE AND VIBRATION

It is unclear whether the control measures identified in the Noise and Vibration specialist study are Project commitments or recommended best practices. The results of noise modeling are only valid if the recommended attenuation measures are committed to and implemented.

While noise modeling indicates that construction and operational noise will not be a major issue for the Project, modeling predicted that there may be some exceedences of Project Specific Noise Criteria (PSNC). Additional mitigation measures are not identified to prevent these exceedences.

12 ECOLOGY

In general, an adequate ecological baseline (terrestrial and aquatic) has been provided, however, it lacks detail in regard to threatened species population distribution and abundance estimates.

Ecological surveys should have been conducted over a broader survey area to reflect impacts associated with all project components.

Offsets required under the EPBC Act threatened species identified within the Project Boundary were not calculated using the new EPBC Act Policy Guidelines of 2012.

13 TRAFFIC AND TRANSPORT

A Rail Study has been conducted as part of the 2013 EIS to address the gaps in information regarding transport impacts identified in the 2010 EIS. This is a more comprehensive assessment of the transport route of the coal.

14 VISUAL AMENITY

The visual assessment conducted for the Project provides a good site analysis and identification of key viewpoints, assessment of potential visual impacts and recommendations for mitigation measures to minimise impacts of the Project.

15 ARCHAEOLOGY AND CULTURAL HERITAGE

In general, a comprehensive survey and report of the Aboriginal cultural and historic heritage of the areas surveyed within the Project Boundary has been prepared apart from some areas with accessibility restrictions.

16 COMMUNITY HEALTH AND SAFETY

Uncertainties and knowledge gaps identified in this report including air and water quality impacts indicate that the assessment of community health and safety impacts and risks and their necessary management and mitigation measures are unlikely to be sufficiently comprehensive.

17 IMPACTS BEYOND DIRECTOR GENERAL'S REQUIREMENTS

Contingency plans for potential disasters, whether naturally occurring or human induced, have not been included in the EIS. This is an oversight.

The Buttonderry Waste Management Facility is mentioned in the EIS in respect to visual amenity, however, the potential environmental risks (gas and leachate leakage) associated with the proximity of this facility to the project are not discussed.

18 MANAGEMENT AND MONITORING

The EIS is not accompanied by management and monitoring plans. It is understood that these have not yet been prepared. Good industry international practice and / or best practice requires an Environmental Management and Monitoring Plan to be prepared as part of the EIS process. Ideally this should be accompanied by a budget indicating that the Project is sufficiently resourced to undertake this work. It is not possible to fully assess the impacts of the Project without an adequately articulated management and monitoring plan.

Notwithstanding the above it is understood that the latest guidelines provide for Management Plans to be prepared much later in the process.

In recent years a trend has developed for adopting, so-called, Adaptive Management to deal with uncertainties in respect to future impacts on groundwater and surface water systems from mining operations. This developed to the point that adaptive management involved changing the targets that were established in environmental impact statements in response to what actually occurred in the field. This was done in conjunction with the establishment of groundwater monitoring systems and the visual and flow monitoring in creeks and rivers.

The fallacy of this approach was determined by the Land and Environment Court in a recent case (2013) in regard to the proposed expansion of Berrima Colliery. The judges found as follows with respect to Adaptive Management:

Adaptive management regime

The intention of the Water Management Plan is to provide an adaptive management regime, under which management actions would be modified in response to the results of the monitoring program. Preston CJ held that,

“in adaptive management, the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.”

It follows that it is necessary for there to be precise limits imposed on the cumulative operations of the colliery.

The judges went on to quote Judge Preston in a previous case in relation to the need for implementation of the precautionary principle when there is uncertainty in respect to future environmental impacts. They stated:

Preston CJ held in *Telstra* at [150], the following, in regard to the precautionary principle and the shifting of the evidentiary burden of proof:

‘If each of the two conditions precedent or thresholds are satisfied – that is, there is a threat of serious or irreversible environmental damage and there is the requisite degree of scientific uncertainty – the precautionary principle will be activated. At this point, there is a shifting of an evidentiary burden of proof. A decision-maker must assume that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that this threat does not in fact exist or is negligible effectively reverts to the proponent of the economic or other development plan, programme or project.’

We are satisfied that the precautionary principle is activated as the risk of significant environmental harm currently remains uncertain,.....

The judges determined that the proposed expansion of Berrima Colliery should not proceed on the basis of Adaptive Management as was proposed by the colliery owners.

Council considers that the legal findings summarised above should be taken into account in respect to the proposed Wallarah 2 project, because future impacts on groundwater and surface waters are likely to be substantial to both town water supplies in drought periods, and to agriculture and flora and fauna under even average climatic conditions. Furthermore, there are substantial uncertainties in respect to a number of these impacts, making it possible, and even probable that the impacts will be greater than assessed by the EIS.

CONCLUSION

It is considered that the proposal should not be approved for the reasons outlined above, in particular based on the precautionary principle.

In the event, however, that it is intended to progress the application, the matters set out in the attached table need to be addressed.

Further, the following conditions pertaining to Council's water and sewer services should be imposed:

- No disposal of brine or mine water to the sewer
- Connection of potable water to Buttonderry and Tooheys Road sites
- Sewage connection to Buttonderry and Tooheys Road sites
- Connections to be in accordance with Council's requirements.

Yours faithfully



Din Armstrong
Director
DEVELOPMENT & BUILDING

TABLE 1
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|--|-----------------------------------|---|
| Subsidence | High | <p>Accurate measurement of surface subsidence is expected to be undertaken by the mine if and when mining occurs. This must be calibrated against an accurate map of conditions prior to mining.</p> <p>The record must also include detailed survey of all properties, infrastructure and structures that may be affected by subsidence along with comprehensive dilapidation assessments.</p> <p>Agreement with all stakeholders and landowners must be gained as to the extent and infrastructure to be assessed for impact due to subsidence.</p> |
| Subsidence Model | High | <p>A hold point after an agreed number (possibly 5) of longwalls have been extracted and the SCT and MSEC models validated and recalibrated as necessary.</p> |
| Subsidence – potential variability in modeling results. | Medium | <p>The influence of UCS – Sonic correlation UCS – modulus correlation and stress regime on the prediction of subsidence must be validated – as is proposed by the EIS.</p> |
| Subsidence – impact of pillar yielding on subsidence and the ability to validate predictions | Medium | <p>A comparison of impacts with and without the influence of pillar yielding. A program of pillar performance measurement including convergence measurements and extensometer readings.</p> |
| Mine Plan | Medium | <p>It is likely, or even inevitable that the Mine Plan and layout of longwall panels will change during the life of the mine. This is particularly so after the process of validation of the subsidence modeling has been completed following initial mining of the first longwall panels (minimum of 4).</p> <p>Modification to the Mine Plan and longwall panel layout will alter the extent and location of subsidence and the location of impacts on flooding, access routes and stream flows.</p> <p>A clear process must be setout for the assessment and approval of revised mine plans and must include Council. Assessments of the impacts of Mine Plan change include subsidence magnitude and extent, potential impact on groundwater modeling, impact on flooding and stream flows/ponding.</p> |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|---|-----------------------------------|--|
| Sampling of rock mass – impacts on groundwater modeling | High | <p>In order to confirm the EIS assumption and reduce uncertainty on the extent and connectivity (tortuous) of the defect system within the "aquatard" which is relied upon in the modeling factual data should be provided. If this data is not available then within the existing mine database, or other sources additional exploration cored boreholes drilled at an angle to the horizontal plane of say 60° should be implemented. Drilling would need to be undertaken in the Dooralong Valley and in the lower reaches of the Yarramalong Valley to target rocks below the alluvial soils. Drill holes to extend to at least the base of the "constrained zone" from subsidence modeling. The location and number of such holes is not recommended here, but should be of sufficient number to provide confidence in the result when used in conjunction with other available data.</p> <p>These angled holes could also be used to undertake further in-situ permeability testing by means such as Packer or Constant Head testing.</p> |
| Permeability of Patonga Claystone – impacts on groundwater modeling | High | <p>Specific testing of the permeability of the rock mass below the alluvial soils in the valleys be undertaken to confirm EIS assumptions, or otherwise. The assumptions, and hence impacts of the EIS groundwater modeling must be confirmed prior to mining below any alluvial areas.</p> <p>Testing to be in inclined, cored boreholes. Holes must be logged to allow permeability testing to be carefully targeted to allow assessment of vertical and horizontal defects. Possible methods to test the rock mass permeability comprise;</p> <ul style="list-style-type: none"> • Packer testing. • In-situ Constant Head testing. • Full scale in-situ pump testing targeting the impacts of dewatering below the Patonga Claystone formation. We acknowledged that these tests are expensive and time consuming and alternate methods may be appropriate. We recommend the former two methods be employed as a first phase of testing. <p>Testing should comprise a suitable number of locations and successful tests to be meaningful. The final number is likely to be subject to the results of the works at the time. A minimum of 6 test holes is suggested.</p> |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|------------------------------|-----------------------------------|---|
| Impact on Groundwater Levels | High | <p>Should the mine be approved a comprehensive system and regime of groundwater level monitoring must be implemented.</p> <p>This will require a robust system of new and existing monitoring wells and/or piezometers that are able to survive the predicted subsidence impacts.</p> <p>Monitoring points must be read on a frequent basis and compiled into a central database which is not only open for access by Council, but the data must be reviewed and assessed for its 'meaning' on a regular basis.</p> <p>This system should be augmented by measurement of levels and yields from water bores in the valleys.</p> |
| Impact on Stream Flows | High | <p>Monitoring of streamflow and inputs that influence alluvial lands water table recharge must be ascertained to allow assessment of the impact of groundwater leakage/loss. Aspects that must be monitored include:</p> <ul style="list-style-type: none"> • Rainfall and runoff across the catchment area for Wyong River and Jilliby Jilliby Creek, • Stream Flows – measured at multiple points along the various streams. As a minimum this must comprise <ul style="list-style-type: none"> ○ Jilliby Jilliby Creek upstream of the mine area, upstream and downstream of the confluence with Little Jilliby Jilliby Creek and just upstream of the confluence with Wyong River. ○ Wyong River upstream of the mine area - say at Duffy's Point, just upstream and downstream of the volcanic intrusion along the southern edge of the mine – say about 500m upstream of Chandlers Creek and about 700/800m upstream of Kidmans Lane, just upstream and downstream of the confluence with Jilliby Jilliby Ck. ○ Little Jilliby Jilliby Creek just upstream of the confluence with Jilliby Jilliby Creek and say just as the creek enters the upper forested area. <p>These points could also be used to monitor water quality as necessary.</p> |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|-----------------------------------|-----------------------------------|---|
| Flood Remediation to Access Roads | Medium | <p>The impact of potential remedial works to access roadways must be understood prior to undertaking such works with regard to the impacts on future flood levels. Models for the 1%AEP and 20% AEP must be developed, assessed and agreed.</p> <p>Further, the method and design of remedial works and the maintenance implications for the future must be understood and agreed with Council.</p> |
| Stream Stability (and ecology) | Medium | <p>Specific and measurable/quantifiable targets must be agreed and established concerning stream stability and the impacts on erosion (as well as flora and fauna) so all parties understand where they stand if the mine is approved.</p> <p>This is particularly so given the very difficult nature of assessment of what is adverse and what is not as a result of the mine.</p> |
| Risk Assessment | High | <p>A detailed and comprehensive risk assessment must be undertaken to provide a framework against which reasonable adaptive management programmes can be developed, and assessed.</p> |
| Adaptive Management | High | <p><u>Specific, measurable and agreed</u> targets or levels from monitoring MUST be established prior to any underground works to allow all stakeholders certainty about what the aims of any adaptive management programme are. These should be based on the results of a comprehensive quantitative risk assessment and possibly cost/benefit assessment.</p> <p>Targets may include loss of stream flows, lowering of water levels/pressures in monitoring bores and levels of subsidence.</p> <p>Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process. Agreed responses may be as minor as "continue to monitor / watch" to as strong as "cease mining" or to quarantine sensitive areas from mining.</p> <p>It may be considered that it is not possible to sufficiently confirm through monitoring the level of streamflow loss. In that case it may be that a proportion of the mine inflow water is deemed to be from streams and an agreed method and distribution of this proportion of mine water is treated and repatriated to streams, users/residents and areas of significant flora.</p> |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|---|-----------------------------------|--|
| Independent Impact Monitoring Authority | Medium | <p>An independent body be established to install, monitor and maintain all the groundwater, surface water and surface level impacts of the mine both during and after operation – this is particularly so given the EIS stated length of impact on groundwater and uncertainty on the speed with which pillar yield may impact subsidence.</p> <p>This body <u>must</u> be guaranteed funding to not only establish the monitoring system, but to maintain it as the impacts of subsidence and the long mine life will require significant repairs and timely replacement of equipment and monitoring points/instruments. Indeed, replacement of instrument/monitoring points should not take longer than say 2 months to maintain continuity of measurements.</p> <p>It is also recommend the monitoring authority be given either a direct, or at the least oversight role in the assessment of impacts and on the assessment of compensation for damage/loss or the development of remedial works/measures to control/limit the impacts of the mine – judged against the specific targets of the Adaptive Management Plan – and as such must be able to undertake, or direct the mine to undertake additional investigations and/or assessments with regard to subsidence, groundwater and surface water.</p> <p>The records and recommendations of the authority should be available on the public record.</p> |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|---|-----------------------------------|---|
| Air Quality | High | Air quality impacts are assessed utilising relevant methodologies to ensure that detailed impact assessments of project phases are conducted effectively. |
| Greenhouse Gas | Medium | A more realistic assessment of greenhouse gas (GHG) impacts is provided by including Scope 2 and 3 emissions sources in the analysis of the GHG impacts and updating impacts of the Project on anthropogenic global warming. |
| Water Quality | High | Surface water quality is investigated further to ensure that all sources of contaminants are identified and that water sources are effectively monitored for changes associated with the Project. A geochemical assessment for potential AMD / salinity is conducted, including development of contingency plans for the management and treatment of the Mine Operations Dam. |
| EPBC Water Amendment | High | The EPBC Act Water Trigger Amendment (2013) is considered by the Proponent. |
| Ecology | Medium | Further detailed surveys for biodiversity are conducted, including extended flora survey to establish a robust flora baseline for the Subsidence Impact Limit. The Biodiversity Offset Strategy for threatened species is revised to ensure it addresses the current Policy and that currently proposed offsets for fauna habitats are reviewed for suitability. |
| Mine Design and Layout | Medium | Internal haulage routes are confirmed to allow assessment of potential impacts of heavy vehicle movement. |
| Stakeholder Engagement | High | A robust Stakeholder Engagement Plan is developed that is inclusive of commitments to ongoing consultation and a structured grievance procedure. |
| Rehabilitation and Closure | High | A comprehensive Rehabilitation and Closure Plan is prepared. |
| Risk Assessment and Cost Benefit Analysis | Medium | The Risk Assessment and Cost Benefit Analysis are reviewed and revised based on detailed findings of further recommended work. |
| Disaster Risk Management | High | A Disaster Risk Management Plan is developed to cover natural and human-induced emergencies associated with the Project. This Plan should be inclusive of specific Contingency Plans to manage particular events, including the management / treatment of the Mine Operations Dam (MOD) and spontaneous combustion. |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|--------------------------------------|-----------------------------------|--|
| Community Health and Safety | Medium | <p>The Community Health and Safety assessment is reviewed and revised based on the findings of the further work recommended.</p> <p>Potential impacts upon the Buttonderry Waste Management Facility associated with the development of the Project are fully considered.</p> |
| Management, Monitoring and Reporting | High | <p>Management and Monitoring Plans are prepared for each aspect of assessment prior to commencement of the Construction phase to clearly outline how impacts will be mitigated and managed.</p> <p>An independent expert is commissioned by the Proponent to conduct Environmental Audits of the project on a regular basis throughout the project life cycle.</p> <p>An Environmental Management System based on ISO14001:2004 'Environmental management systems -- Requirements with guidance for use' is developed and implemented for the Project.</p> |



Pells Sullivan Meynink

Engineering Consultants
Rock-Soil-Water

G3 56 Delhi Road
North Ryde NSW 2113
P: 61-2 9812 5000
F: 61-2 9812 5001
mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM2015-004R
Date: 21 June 2013

Director
Development and Building
Wyong Shire Council
PO Box 20
WYONG NSW 2259

ATTENTION: LIN ARMSTRONG

Dear Lin,

**RE: CONTRACT NO. CPA/219532 – WALLARAH 2 COAL PROJECT EIS REVIEW
– GROUNDWATER, SURFACE WATER, FLOODING AND SUBSIDENCE
IMPACTS**

Pells Sullivan Meynink (PSM) is pleased to submit our report for the above project.

If you require any further information please contact the undersigned.

For and on behalf of
PELLS SULLIVAN MEYNINK

DEREK ANDERSON

Distribution: Electronic Copy [Wyong Council]
Original held by PSM

Wyong Shire Council

CONTRACT NO. CPA/219532 – WALLARAH 2 COAL PROJECT EIS REVIEW

**GROUNDWATER, SURFACE WATER, FLOODING AND SUBSIDENCE
IMPACTS**

PSM2015-004R June 2013

EXECUTIVE SUMMARY

The following summarises the main findings of the report presented herein. The findings are based on the proposed W2CP underground longwall coal mine which comprises the following:

- Permanent decline access tunnel from Buttonderry site to the mining area.
- Permanent Main Headings between the northern and southern zones of longwall panels and along the north eastern edge of the first longwall panels to be mined.
- Permanent works designed not to collapse or subside.
- A total of 33 longwall panels to be mined over the first 28 years of operation, which on average may be expected to take about a year each to mine.
- Relatively wide, by mining practices chain pillars left between each longwall panel. After coal is extracted from each longwall panel, the rock above the roof of the panel collapses forming the goaf and results in surface subsidence above the mined area. The coal forming the chain pillars is designed to yield and 'soften' the expression of surface subsidence into a more even profile.

It is assumed the reader has a basic knowledge of the layout of the proposed W2CP and a rudimentary understanding of longwall coal mining.

REGULATORY

WACJV has sought Development Consent for the W2CP underground mine under the new Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Division provides for a new planning assessment and determination regime for State Significant Development in NSW. The earlier submission sought by WACJV in 2010 was undertaken through the now repealed Part 3A of the EP&A Act.

PSM understand that under this Consent application, detailed plans, such as Subsidence Management Plans (SMP's) are not required to be prepared until much later in the approvals process.

With regard to SMP's, a new set of guidelines is currently being prepared by the NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS, 2011 - formerly Department of Primary Industries - Mineral Resources (DPI-MR)) for '*Preparation of a Subsidence Management Plan application where a project approval under the EP&A Act 1979, with an extraction plan condition, is in force*'. However, at this time we understand that the current *Guideline for Applications for Subsidence Management Approvals* (DTIRIS, 2003) remains valid.

SUBSIDENCE

Subsidence is the prime and most readily notable impact of underground longwall mining. The extent and magnitude of subsidence has a controlling influence on potential damage to property and the extent and nature of flooding and movement of surface water.

The prime result of mining are the expected number and severity of impacts across the 245 properties within the area affected by the predicted subsidence, viz:

- 83% of properties being unaffected;
- 12% requiring very minor to minor repair;
- 5% requiring substantial to extensive repair; and
- <0.5% requiring a complete rebuild (ie. about 1 property).

These impacts are based on predictions of subsidence comprising:

- Vertical subsidence up to 2.6m with less subsidence predicted in residential areas to the east and more subsidence within forested areas to the west.
- Tilts up to 15mm/m concentrated above the edges of the panels and over forested areas.
- Tensile strains up to 4mm/m concentrated near the edge of panels. About 99% of these strains are expected to be less than 2.5 mm/m.
- Compressive strains up to 5.5 m/m concentrated about 50m inside the panel edges. About 99% expected to be less than 3.3 mm/m.
- Far field movements up to ~60 mm horizontally at a distance of around 1km from mining diminishing to less than 25 mm at a distance of 2 km.

The subsidence prediction used for W2CP was developed using three key components:

1. The predictive model developed using the empirical Incremental Profile Method (IPM) by the specialist subsidence consultant MSEC;
2. The method used to calibrate the empirical predictive model by the consultant Strata Control Technology (SCT); and
3. Chain pillar performance.

Firstly, the situation at the proposed W2CP is unique in as much as it would be a deep underground coal mine in Newcastle Coal Measures, which have traditionally been mined at relatively shallow depths. It is from these experiences that the IPM has had to draw empirical data from. That is, the experience from shallow underground coal mining in similar geology to the W2CP from the Newcastle Coal fields along with the experience from mining at similar depths to the W2CP from the Southern Coal Fields, which are in a different geological environment.

As a result, the predictions of subsidence by MSEC, based on the empirical IPM approach was calibrated against computer based modelling by SCT and it is the result of this combination of empirical mining experience and computer modelling calibration that forms the prime aspect of the review herein.

In summary we conclude that:

- Based on our discussions with W2CP, we understand that something like 4 to 5 panels would need to be extracted before a full model calibration exercise could be undertaken to assess the validity of the subsidence prediction and modelling undertaken.
- The reliability and accuracy of the SCT method is unknown as:
 - There is a reliance on extrapolated inputs to which the method has been shown to be sensitive.
 - The model is calibrated to site-specific data, and not to a small number of measurements from other sites.
 - The sensitivity to most input parameters is not presented.
- Due to the empirical nature of the method the Incremental Profile Method (IPM) is only as reliable as the data to which it is calibrated, in this case the SCT model results. Therefore the reliability and accuracy of the IPM is in doubt.

This is to some extent recognised by MSEC who in the EIS state:

“A thorough calibration...will only be achieved after subsidence monitoring data is obtained and analysed”.

- The use of one predictive model to calibrate another is generally unwise and not widely regarded as best practice.
- The IPM is stated as being conservative and likely to over predict impacts. The evidence for this conservatism and the expected magnitude with respect to W2CP are not provided. Indeed all indications are that the model development is centred around matching expected conditions and not exceeding or over-predicting them.
- There is a reliance on pillar compression after extraction resulting in a smoother subsidence profile. However, the basis for this assumption appears to conflict the Geological Report (Appendix G), where significant variation in both roof and floor conditions is expected across the site.
- The EIS acknowledges that pillar compression may not occur but does not quantify the impacts or changes in impact should this not occur.
- First longwall will prove that this pillar compression assumption is valid.
- No less than 3 longwalls (L1N to L3N) and more likely 4 to 5 longwalls are required before the pillar compression theory can be verified.

We accept that these predicted impacts are in agreement with expectations based on measured subsidence impacts elsewhere, and the Newcastle and Southern Coalfields in particular.

We are in general agreement that should the predicted level of subsidence occur, the type distribution and severity of impacts on houses, buildings and infrastructure is likely to be similar to that stated in the EIS.

We do not agree that the prediction represents a conservative estimate of subsidence impacts as all the evidence presented in the EIS suggests the prediction represents the most likely impacts. We consider that the model, calibration and application of the prediction does not provide sufficient guidance as to the sensitivity and reliability of the method and may, therefore, fail the Director General's "reasonable level of confidence" test.

In general we did not find any omissions or evidence to suggest that subsidence due to W2CP is likely to be significantly different to that predicted by the EIS. Our main concern is the lack of certainty around the predictive method and the likely variation in prediction based on observed variations that are already known and potentially those unknown.

GROUNDWATER

The conclusions reached by EIS are primarily the result of the input parameters adopted for their numerical modelling. These input parameters are primarily driven by the unsuitable method by which the makeup of the rock and its defects have been sampled and are not consistent with available data or modelling within the EIS. Further, modelling assumes recharge of the water system based on average climatic conditions.

The EIS implies that water inflow to the mine, of up to 2.5ML/day would largely come from water stored in the ground. However, it avoids the fact that water stored in the ground comes from somewhere, and is currently in equilibrium with natural recharge. A valid way to consider this matter is encapsulated in the following quotation from Dr Rick Evans, principal hydrogeologist of Sinclair Knight Merz, viz:

"There is no free lunch here. It's very simple – every litre of water your pump out of the ground reduces river flow by the same amount".

Australian Financial Review,
24 May 2007

Other points to note are:

- We cannot define precisely what portions of which rivers will be affected by leakage losses from the near surface alluvial lands into the deeper rock mass;
- We cannot say, with confidence, how many years it will take for the impact of underground extraction to reflect in surface flows; and
- The EIS states that the mine will not fully recover groundwater pressures for over 500 years.

These points, combined with the uncertainty on the input parameters to the groundwater modelling there is a high probability that leakage losses from the alluvial lands will impact the surface water. Given the high likelihood or even near certainty that climate impacts

would be sufficiently severe at some point implies that it may affect visible flows for long periods.

On balance, the findings from the EIS are at the least a limited and probably unconservative view of potential impacts. This means that, at present, it is not known with an acceptable level confidence what the likely impacts of the Wallarah 2 longwalls will be on groundwater resources, and on groundwater that feeds into the streams of the Dooralong and Yarramalong Valleys.

FLOODING

The results of the flood assessment appear reasonable given the limits of the prediction of subsidence and can be considered as “best practice”.

The discussion on the impacts of the W2CP on flooding are made in relation to the 1% AEP event (1 in 100 year) and would only fully come into effect after mining has been completed. It is important to note that the assessment of flooding is dependent on the expected subsidence and so any change to mine plans, or the prediction of subsidence through any validation process will result in changes to the extent and impact of flooding.

Results of the flood modelling for the 1% AEP flood event indicate that subsidence from the current W2CP mine plan is likely to result in only relatively minor increases in the depth and extent of flooding compared to current, pre-mining estimates with a total of about 35Ha of additional land becoming affected across the whole W2CP area.

The changes to flooding extents will have an adverse effect on up to 10 properties. The impact is assessed to be up to 5% of additional land area inundated for 4 of these Properties and up to 20% of additional land area for the remaining 6 properties.

In terms of impacts on residential dwellings, a total of 5 properties that were not previously impacted by the 1 in 100 year flood level are now impacted by flood water depths of between 4cm and 1.27m above floor level. These are assessed as being Major impacts in the system of ‘*Flood Impact Categories*’ adopted by the EIS. In addition to these dwellings, a further one dwelling is Categorised as being subject to a Major Impact, in this case the expected 1 in 100 year flood level increase by up to 41cm above current, pre-mining predictions.

In the moderate flood impact category, a total of 8 dwellings will see a rise in the currently predicted inundation levels due to the 1%AEP event by between 3cm and 17cm. A further 3 dwellings will have the level of clearance, or freeboard between the predicted flood level and dwelling floor level reduced to values of between 4cm and 28cm.

Minor impacts are expected to occur to a total of 10 dwellings and comprise increased levels of flooding above floor level by between 1cm and 4cm and reduced levels of freeboard above flood levels.

Further to the dwellings described above, a total of 14 dwellings are expected to have no significant change in flood impacts while a total of 49 properties will see a slight reduction in flood impacts.

Other impacts of the subsidence on flooding are flood peak flows are anticipated to be slightly reduced with a minor increase in the duration of the peak, although the EIS notes these as being insignificant.

Flooding will impact a total of 30 primary and secondary access roads in the project area. Of these only 6 primary access route low points will be adversely impacted by the mine. Adverse impacts comprise increased duration of flooding of between 1 hour and up to 27 hours. The latter time pertains to the crossing (D50) located toward the southern end of Jilliby Road just north of the intersection with Watagan Forest Drive.

Mitigation of the impacts of flooding can readily be undertaken by the WACJV. Detailed plans for each location and/or dwelling are not provided at this stage of the process and are only required after approval has been given.

At this time, the only indication of the extent of potential mitigation is in relation to the Major and Moderate Impact Categories.

Preliminary descriptions of possible mitigation works presented in the EIS comprise:

- Raising or relocating dwellings;
- Raising Sandra Street to increase the upstream flood retarding storage;
- Construction of grassed earthen levees around dwellings to provide a minimum freeboard of 0.3m; and
- Construction of new replacement dwellings.

The purchase of dwellings is mentioned as an option, but is not linked to any dwellings in the EIS, nor is any mechanism or process for such an option canvassed.

In terms of primary access points, the six adversely affected locations can be raised after subsidence has occurred to mitigate the adverse effect. In some instances, the works may require new culvert works to facilitate passage of flood waters past the obstacles.

Council must be conscious of the longer term maintenance requirements of any mitigation measures.

The discussion on potential flood mitigation measures remain at a feasibility level but are considered appropriate and to constitute “best practice” for this level of appraisal. Detailed assessment will be required if planning approval is given and this must ensure all the Director General’s requirements are met.

LOSS OF SURFACE WATER

Loss of surface water from streams in either the Yarramalong and/or the Dooralong Valley will have a direct impact on the availability of water in the Wyong River downstream of the proposed mine which is used as part of the water supply to the Wyong and Gosford Local Government Areas. Further, loss of surface water will also affect businesses such as turf farming and supply of water to local bores.

The assessment of loss of surface water is entirely dependent on the inputs to groundwater modelling and the impacts on groundwater flow by the mine. The EIS concludes that there will be very little impact on leakage from the near surface alluvial lands due to the very low permeability of the rock below the alluvial lands and, that what loss does occur will be readily compensated for by surface recharged.

These statements are based on two assumptions. Firstly, that average climactic conditions prevail and secondly, a favourable view of the permeability of the rock below the alluvial lands. The latter point is discussed above under the topic of groundwater modelling, but suffice to say there is considered to be a high level of uncertainty and a lack of factual evidence to confirm the parameters used.

With regard to the first point above, for the EIS to be relevant, it must also consider the variation in inputs to the surface water supply in extended dry periods. The review in this report considers the flow in Jilliby Creek between 1972 and 2013 to illustrate the sensitivity of the stream flow to climate and to small variations in flow volumes, viz:

- The median flow rate in the creek is about 4.5 ML/day.
- Flows of less than 1ML/day occurred for 24% of the time
- Flows of less than 0.1 ML/day for 10% of time.

The predicted water inflow to the mine of up to 2.5ML/day represents more than half of the average flow for Jilliby Creek and is greater than the flows recorded for 40% of the time since 1972.

These flows are put into perspective when records of consecutive days, since 1972, where low flows considered. The five longest periods of consecutive days when flow was less than 1 ML/day and 2 ML/day range from 112 up to 190 days. This shows that when dry periods occur, the flow in the creeks can be expected to be at a level that may be readily affected by leakage losses from the alluvial lands.

Further, a review of the climate during this period reveals that while some periods of drought did occur such as the Millennium Drought, it does not include the experience of the more intense droughts of World War 2, and the time of Federation.

PONDING

Current predictions of subsidence indicates three locations where increased bowls of storage in ponds along Jilliby Jilliby Creek (2 No.) and Little Jilliby Jilliby Creek (1 No.) are expected to result in longer and/or more frequent periods of drying downstream and similarly of wetting upstream of the newly created pond.

The expected extent to which the stream and adjacent lands may be impacted upstream and downstream of the pond is difficult to predict, but is not expected to be more than 500m and in all likelihood would be less than say 100m. Given the generally cleared/settled nature of the floodplain areas, the potential for drying conditions to adversely impact native flora and fauna is minimal. Any impacts should be able to be effectively managed with suitable monitoring and timely response in mitigating any adverse effects.

These conditions are expected to prevail until such time as the streams re-establish a continuous stream bed. This is highly likely to occur where the ponds occur in the more silty and sandy alluvial soils along the creeklines, but may be much restricted if the ponds occur in areas of heavy clay. The timeframe for these changes depends on the soil types and also the flow velocity and frequency where the stream is ephemeral.

The potential for ponding in Wyong River is considered negligible under the anticipated subsidence.

Subsidence profiles along the Hue Hue Creek have not been provided and so assessment of impacts of mining have not been made.

BOREFIELDS

Borefields have been developed at Woy Woy, Somersby, Mangrove Creek, Ourimbah and Mardi for use by the CCWC as a drought contingency measure. Of these, only the single, 150m deep bore at Mardi is potentially going to be impacted by the W2CP. This bore is about 3km from the southern extent of the mine.

The Mardi bore is thought to extend into the rock of the Tuggerah Formation, or possibly to the top of the Munmorah Conglomerate. The main coal seam in this location is at a depth of about 450m to 500m.

The EIS predicts piezometric drawdown levels in the location of bore will not occur during the period of mine operations. However, drawdown of up to 5m may occur after a long period of time (500 years after mining).

These predictions appear to assume that nearly all of the water inflow to the mine is from that stored in the ground. Hence the predicted drawdown is expected to represent a worst case. If, as we consider likely, a portion of the water flowing into the mine comes from the alluvial lands above the mine, then the impacts at locations such as the Mardi bore will be less than predicted by the EIS.

EROSION AND ENVIRONMENTAL IMPACT

The EIS notes that there is active erosion occurring along the banks of the Jilliby Jilliby Creek, but also that the impacts of the project on surface water resources can be mitigated through implementation of:

- Property Flood Management Plans a water quality monitoring programme for streams in the W2CP area; and
- A stream stability monitoring and management programme.

As with the subsidence and flooding, the W2CP is not required to prepare detailed management plans at this stage of the process but has included some indication on the approach and works within the specialist reports. Broadly the set of works and frequency suggested is considered appropriate but requires a significant amount of detail to allow any worthwhile appraisal to be undertaken of its likely effectiveness. However, it is not clear whether the approach is to be entirely “reactive” in nature, or whether it will include some form of “pro-active” works.

We recommend that the WACJV should endeavour act to prevent erosion rather than repair it where appropriate, as this would be best practice.

The ability of the mine, locals, Council, or other authority to say what is adverse and what would or could have been expected to occur pre-mining will be virtually impossible to ascertain and so the question is what should be done in terms of mitigation or preventative works. This also impacts on who is responsible for undertaking the works. In order to prevent this, and other similar issues from resulting in futile and circular arguments that result in nothing being achieved or done, specific and measurable/quantifiable targets must be agreed and established so all parties understand where they stand if the mine is approved.

RISK ASSESSMENT AND ADAPTIVE MANAGEMENT

In terms of groundwater impacts and to a lesser extent surface subsidence, the EIS presents an abridged assessment of the potential impacts and hazards posed by the W2CP. This situation arises as the EIS only considers risks that have been modelled by the specialist consultants and is thereby limited by the specialist assumptions and either lack of or limited sensitivity assessments. This is not considered appropriate at this stage of the assessment where transparency as to the entire gamut of potential impacts should be canvassed.

Further, the consequence rankings at the high end of assessment have been combined and limit the risk assessment process by requiring that severe, long term and/or potentially irreversible impacts must also be wide spread to warrant a high ranking.

In order to begin to allow the impacts of the project to be managed via adaptive management, the understanding of the impacts and risks must be robust and comprehensive, and quantitative in nature, not qualitative as is the case here.

The risk assessment should consider the level of risk associated with all aspects of the W2CP, and in particular those that:

- Are associated with a high level of severity in terms of consequence,
- Have a high degree of uncertainty surrounding the assessment/modelling,
- Have consequences that either may not/cannot be able to be remediated, mitigated or managed once they are observed, or
- Represent a significant degree of community concern.

The results of a rigorous, qualitative risk assessment could then be considered with respect to acceptable levels of risk, and/or a cost/benefit assessment. The latter of which may, or course result in high consequence impacts with a low risk and/or cost impact being disregarded in the final assessment of the project. However, as stated above, they all need to be considered and presented so an informed judgement/decision can be made.

In terms of the aspects of the project covered in this report, we would recommend the following be subject to a detailed risk assessment process.

1. Ground Water Impacts – test the sensitivity of the baseflow water losses with respect to hydraulic conductivity, level of subsidence induced by mining and environmental factors such as drought.
2. Subsidence Impacts – test the magnitude and location of subsidence effects with respect to items such as variability of the roof conditions of the mine and strength of pillars.

If the impacts of the mine are to be managed via adaptive management then a risk assessment is essential in order for the process to be:

- i. Correctly focused; and
- ii. Establish realistic and measurable targets.

Following this, and possibly with the assistance of a cost/benefit assessment, for an adaptive management plan to be effective it must be based on targets for monitoring and assessment that are:

- specific;
- measurable; and
- agreed between all parties.

Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process.

Agreed responses may be as minor as “continue to monitor / watch” to potentially quarantining coal below the alluvial areas or even as strong as “cease mining”.

MANAGEMENT PLAN DEVELOPMENT/APPROVAL CONDITIONS

Measures to mitigate and/or remediate the impacts of subsidence, increased flooding of dwellings and erosion are discussed in the EIS. However, the discussions are relatively general in nature and can only be considered appropriate for the feasibility stage of the project.

The EIS and regulatory requirements are such that detailed Subsidence Management Plans (SMPs) need only be developed in consultation with landowners, Council and other stakeholders for adversely affected properties and streams after any approval has been granted. This would be expected to invoke the “Adaptive Management” approach for the project, for which there are very significant concerns given the level of uncertainty and lack of a comprehensive risk assessment for all of the possible project impacts.

This report provides guidance on matters such as monitoring, validation and further assessment requirements, particularly in areas where information is unclear or uncertainty on data and/or impacts is high.

The guidance provided is intended for consideration by approving authorities in the assessment of the EIS and, if applicable the setting of conditions for the approval of the W2CP.

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1. INTRODUCTION

The report presented herein provides a review of the Environmental Impact Statement (EIS) prepared by Hansen Bailey on the Wallarah 2 Coal Project (W2CP) for the proponent, Wyong Areas Coal Joint Venture (WACJV).

The review particularly considers specialist reports presented in the Appendices to the EIS in relation to the likely impacts of the proposed longwall coal mine development on:

- ground subsidence
- the groundwater regime
- surface flooding
- the surface water regime.

The reader should also be aware of PSM's earlier review (Reference 2) of the proponents original Environmental Assessment (EA) presented in 2010. Parts of that document remain relevant to this assessment as many aspects of the EIS are similar to the EA and are repeated where appropriate.

Further to the above, the findings of the Parliamentary Assessment Committee (PAC) report published November 2010 (Reference 3) and the subsequent assessment and refusal by the NSW Department of Planning (Reference 4) dated March 2011 should be noted. In particular, the Director General (NSW Dept. Planning) reports that:

Recommended conditions presented in the PAC's report rely heavily on an adaptive management approach to impacts from the project, and the development and implementation of a significant list of environmental management plans. Many of these issues have also been raised in public authority submissions, which have suggested an inability to conclusively determine the environmental impacts of the project based on the information provided in the Environmental Assessment.

The Director General also notes that:

The Department accepts that there will always be a level of uncertainty associated with predictive modeling and assessment of large-scale development proposals, and that the adaptive management approach is an effective tool that is used to refine, mitigate and manage the long term impacts of mining in NSW. However, the Department stresses that a reasonable level of confidence around the type and magnitude of likely environmental impacts must be achieved before adaptive management and management plans can be applied.

In scenarios where there is significant uncertainty and/or a substantial consequence arising from the uncertainty, the only responsible practice to assess the impact of the uncertainty is to undertake a detailed risk assessment considering the likelihood of an event as well as the consequences of each scenario.

2. SCOPE OF WORK

The scope of work for this study was set out in our letter PSM2015.002L (March 2013) comprises the assessment of the following.

- i. The impacts of the project and the resultant surface subsidence on surface water and ground water within and adjacent to the mining area.
- ii. The adequacy and accuracy of subsidence predictions.
- iii. Impacts on deep aquifer systems and water table elevations at the ground surface.
- iv. Adequacy of any proposed Groundwater Management Plan and any conditions recommended should development consent be granted for the project.
- v. Contingency plans to manage any release of oxidised metals due to fracturing of drainage lines.
- vi. The adequacy of any measures proposed to manage or mitigate any unwanted or unexpected effects of subsidence under the alluvial floodplain of Jilliby, Jilliby Creek or Little Jilliby Jilliby Creek where new wetlands/depressions are potentially created.
- vii. Adequacy of groundwater monitoring processes.
- viii. Potential loss of water from streams caused by leakage to deeper hard rock systems.
- ix. Confirm whether the EIS provides a comprehensive and technically robust assessment of potential groundwater, surface water, flooding and subsidence impacts from the Project
- x. Identify any potential important aspects or issues that have not been fully and adequately investigated and assessed
- xi. Identify areas of uncertainty and further investigations and assessments required prior to Project determination and/or during the construction, operation and closure stages of the Project
- xii. Assess as far as possible whether the information provided in the EIS has been prepared in a manner consistent with Australian and International standards and best practice guidelines

3. BACKGROUND

The W2CP proposes to develop an underground longwall coal mine below parts of the Yarramalong and Dooralong Valleys and the Hue Hue Creek catchment, all upstream and west of the F3 Freeway. Figure 1 shows the proposed areas for underground extraction as well as the location of the surface works at the Buttonderry site and the Toohey's Road site.



Figure 1: Mine location

Coal is to be extracted using longwall mining commencing in the eastern part of the mine and generally working to the west. The mine workings will be to a depth of between about 350m to 450m below the populated valley areas up to a maximum of about 690m below some of the higher, forested ridgeline areas above the valleys, particularly toward the western part of the mine.

Figure 2 shows a diagrammatic representation of the stratigraphy at the proposed mine.

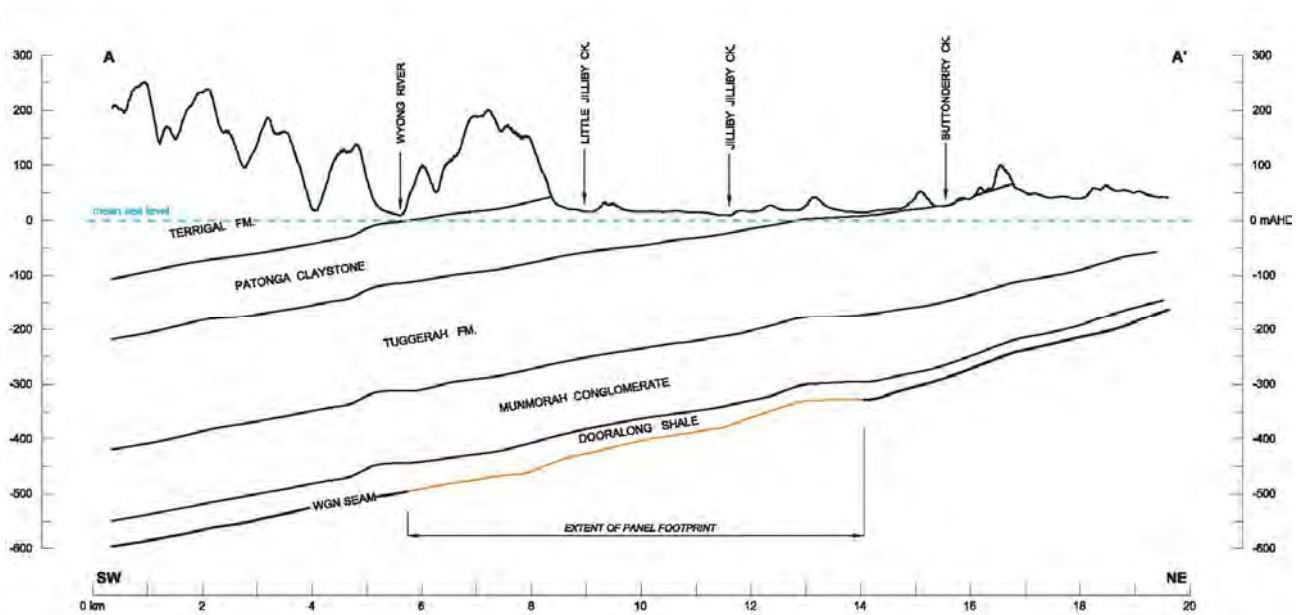


Figure 2: Diagrammatic cross-section of coal seams

Coal is to be removed from the mine via a conveyor in a drift tunnel from the north-east part of the mine (below the Buttoderry Site) to the surface facilities at the Tooheys Road site. From there, the as-mined coal will be transported off site by rail. No washery is required.

4. MINE PLAN

The proposed W2CP mine plan comprises a total of 46 longwall panels of which 33 are proposed to be mined in the first 28 years. Figure 3 shows the proposed layout of the longwall panels.

Mining is to commence at the north-eastern part of the underground workings and extend to the west with the initial mining to be undertaken in the Hue Hue Mine Subsidence District. Figure 4 shows the proposed mining sequence.

The proposed mine plan comprises:

- extracted coal height 3 to 4.5m
- longwall panels widths between
 - 125m wide and 175m at the initial Hue Hue panels
 - 175m and 205m in the floodplain areas
 - up to 255m in the western forested hills
 - longwall panels lengths of between 1.4km and 3.4km
- solid chain pillars of coal left between longwall panels of 45m to 75m width.

Further, while the first 11 longwall panels are being mined, development works for the “permanent” main headings will continue to the west and southwest below the alluvial valleys and Wyong State Forest.

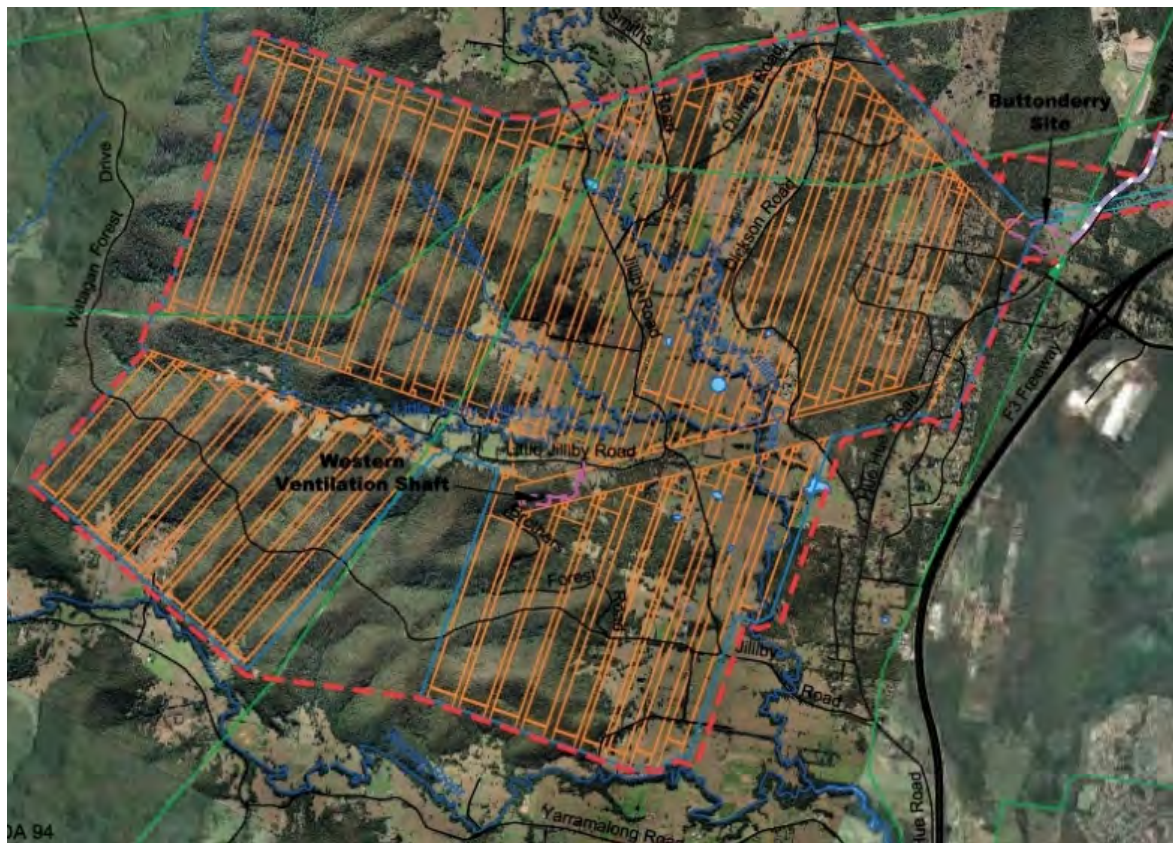


Figure 3: Proposed Mine Layout

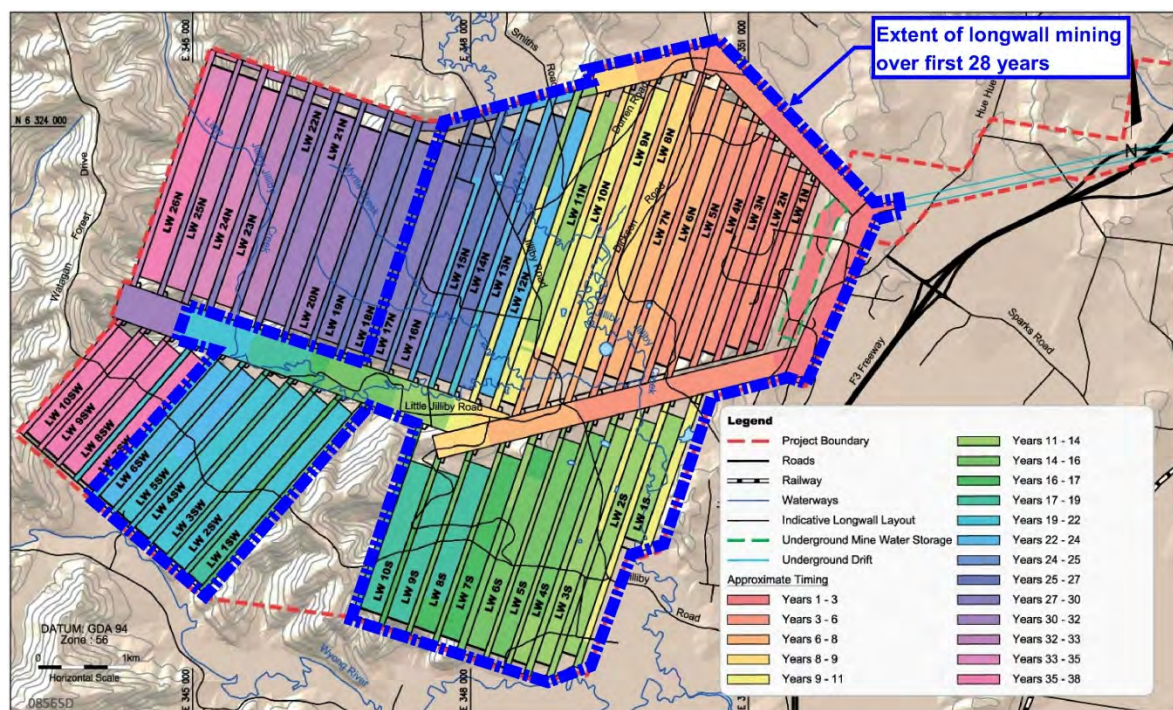


Figure 4: Proposed Mining Sequence

5. REGULATORY

WACJV has sought Development Consent for the W2CP underground mine under the new Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Division provides for a new planning assessment and determination regime for State Significant Development in NSW. The earlier submission sought by WACJV in 2010 was undertaken through the now repealed Part 3A of the EP&A Act.

PSM understand that under this Consent application, detailed plans such as Subsidence Management Plans (SMP's) are not required to be prepared until much later in the approvals process.

With regard to SMP's, a new set of guidelines is currently being prepared by the NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS, 2011 - formerly Department of Primary Industries - Mineral Resources (DPI-MR)) for '*Preparation of a Subsidence Management Plan application where a project approval under the EP&A Act 1979, with an extraction plan condition, is in force*'. However, at this time we understand that the current *Guideline for Applications for Subsidence Management Approvals* (DTIRIS, 2003) remains valid.

6. RISK ASSESSMENT

Appendix F of the EIS sets out a simplistic risk assessment for the environmental risks associated with the project. In this report, we have focused on the subsidence and in particular groundwater components of that assessment.

The risk assessment presented in Appendix F is based on the framework which is repeated below in Tables 1A to 1C. While this framework appears acceptable, the consequences set out for the natural environment at the higher, or serious end (ranking 1 and 2) appear to limit the ability of the assessment to properly assess the consequences.

This view is based on the fact that the two highest rankings are lumped together and lead the assessment to only consider "widespread and unconfined" impacts. The EIS is unclear if this implies that the potential loss of creek flows in the Dooralong Valley (for example) is, or isn't a widespread or unconfined issue. The end result is that this type and scale of impact has only been given a ranking of 3 in the risk assessment in Appendix F.

Further to the above, the risk assessment is essentially an abridged one in that it only presents scenarios that reflect the assumptions of the specialist studies and consequently inherently reflect the limitations or lack of sensitivity assessment in those studies. These issues are discussed further in the following Sections of this report.

TABLE 1A
MATRIX FOR ASSESSING LEVEL OF RISK

| Likelihood | Consequence | | | | |
|------------|-------------|-------------|-------------|-------------|-------------|
| | 1 | 2 | 3 | 4 | 5 |
| A | Extreme – 1 | Extreme – 2 | High – 6 | High – 10 | Medium – 15 |
| B | Extreme – 3 | Extreme – 4 | High – 9 | Medium – 14 | Medium – 19 |
| C | Extreme – 5 | High – 8 | High – 13 | Medium – 18 | Low – 22 |
| D | High – 7 | High – 12 | Medium – 17 | Low – 21 | Low – 24 |
| E | High – 11 | Medium – 16 | Medium – 20 | Low – 23 | Low – 25 |

TABLE 1B
LIKELIHOOD SCALE

| Level | Descriptor | Description | Indicative Frequency (expected to occur) |
|-------|----------------|---|--|
| A | Almost certain | The event will occur on an annual basis | Once a year or more frequently |
| B | Likely | The event has occurred several times or more in your career | Once every three years |
| C | Possible | The event might occur once in your career | Once every ten years |
| D | Unlikely | The event does occur somewhere from time to time | Once every thirty years |
| E | Rare | Heard of something like the event occurring elsewhere | Once every 100 years |

TABLE 1C
CONSEQUENCES SCALE

| Severity Level | Consequences Types | | | | |
|----------------|---|---|---|--|---|
| | Health & Safety | Natural Environment | Social/ Cultural Heritage | Community/Govt/ Reputation/Media | Legal & Regulatory |
| 5 | No medical treatment required or requiring first aid treatment at the most | Minor environmental effects (near the source, confined and quick to reverse) | Minor medium-term social impacts on local population. Mostly repairable | Minor, adverse local public or media attention or complaints | Minor legal issues, non-compliances and breaches or regulation. Low potential for impact |
| 4 | Objective but reversible disability requiring hospitalisation | Moderate, short-term effects on environment (near the source, reversible and confined) | On-going social issues. Permanent damage to items of cultural significance | Attention from media and/or heightened concern by local community. Criticism by NGOs | |
| 3 | Moderate irreversible disability or impairment (>30%) to one or more persons | Serious but confined medium term environmental effects near the source | On-going serious social issues. Significant damage to structures/items of cultural significance | Significant adverse national media/public/NGO attention | Serious breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible |
| 2 | Single fatality and/or severe irreversible disability (>30%) to one or more persons | Very serious, long-term environmental impact that is widespread and unconfined, leaves major damage | | Serious public or media outcry (international coverage) | Major breach of regulation. Major litigation. High potential for prosecution |
| 1 | Multiple fatalities, or significant irreversible effects to >50 persons | | | | Significant prosecution and fines. Very serious litigation including class actions. Suspended or reduced operation |

7. SUBSIDENCE PREDICTION

This section contains our view of the accuracy and adequacy of subsidence predictions. It is primarily based on material presented in Appendices G and H and with reference to Appendix C where required. These appendices are:

Appendix C. Geology Report – prepared by (WACJV)

Appendix G. Subsidence Modelling Study – prepared by (SCT)

Appendix H. Subsidence Impact Assessment – prepared by MSEC

Our assessment includes discussion undertaken with W2CP representatives on 17 June 2013 and consideration of the review by B.K Hebblewhite of the work presented in appendices G and H. Reference to additional material used in this review is shown as required.

Predicted Impacts

Predicted impacts are provided in Appendix G and H and summarised as follows:

- Subsidence up to 2.6m with less subsidence predicted in residential areas to the east and more subsidence within forested areas to the west, Figure 5.
- Tilts up to 15mm/m concentrated above the edges of the panels and over forested areas, Figure 6.
- Tensile strains up to 4mm/m concentrated near the edge of panels, Figure 7. About 99% of these strains are expected to be less than 2.5 mm/m, Figure 7.
- Compressive strains up to 5.5 m/m concentrated about 50m inside the panel edges, Figure 8. About 99% expected to be less than 3.3 mm/m.
- Far field movements up to ~60 mm horizontally at a distance of around 1km from mining diminishing to less than 25 mm at a distance of 2 km.

Far field movements are due to regional movement towards mining in response to the 'sag' of the ground due to subsidence. Far field movement is mainly horizontal, directed towards the goaf and diminishes exponentially with distance from mining as shown in Figure 5. Strains are usually relatively small (less than 0.5mm/m) reflecting an *en masse* movement of the ground. Far field movement is difficult to predict and generally undertaken by examining historical data and the distance of mining. The current historical data set used by MSEC to estimate horizontal movement (and provided in Appendix H) is reproduced in Figure 9.

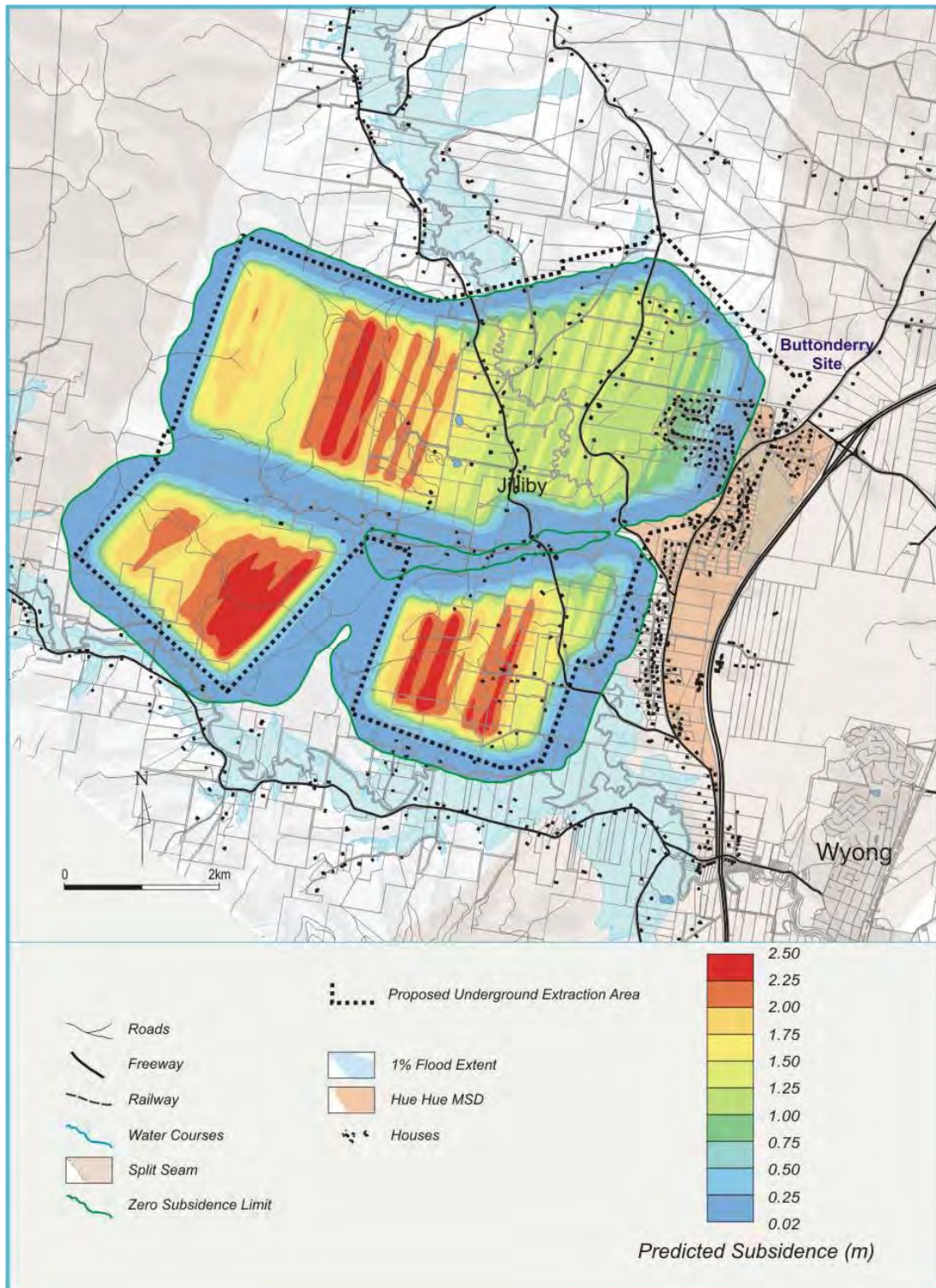


Figure 5: Predicted Total Subsidence Contours

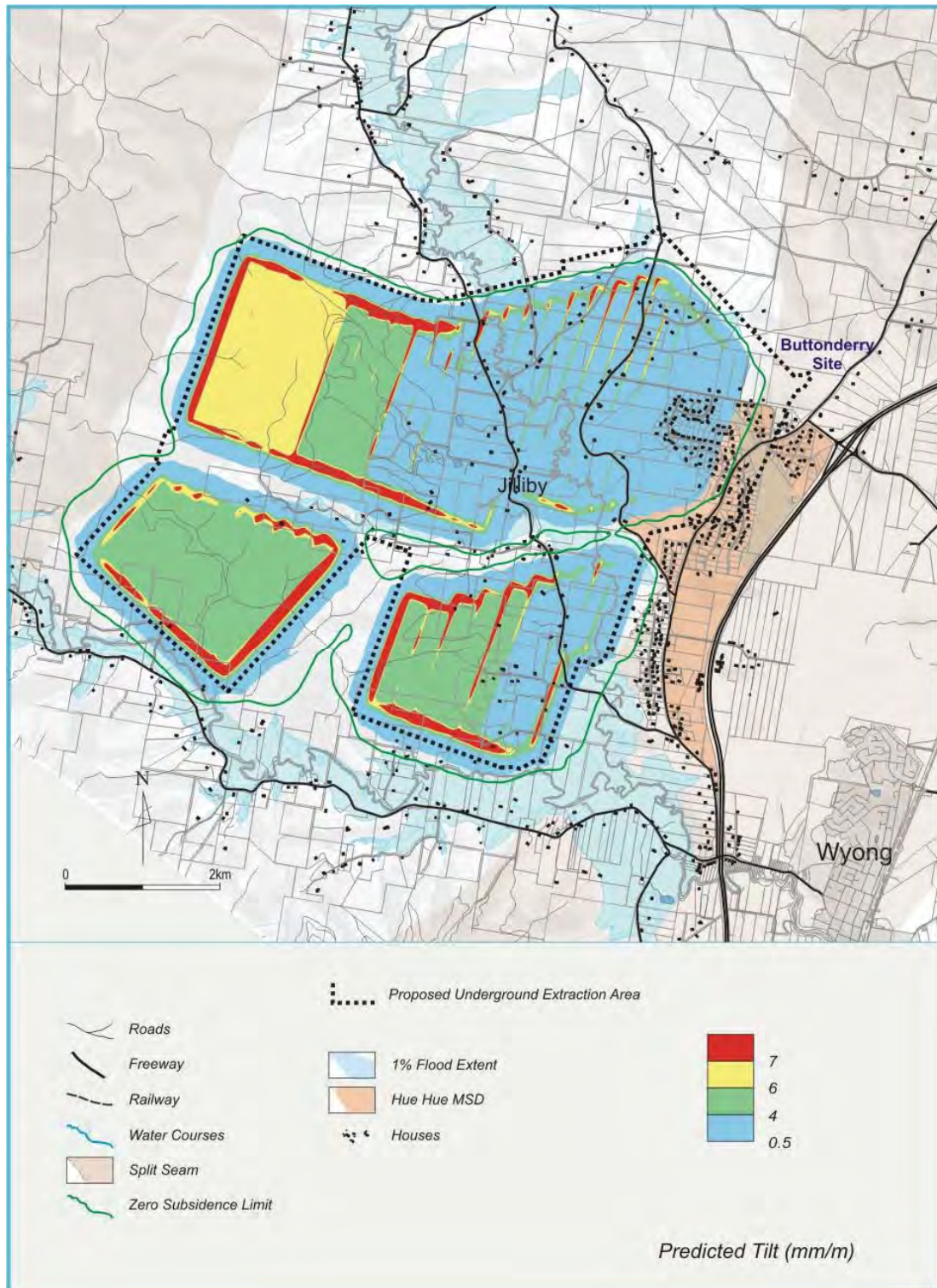


Figure 6: Predicted Total Tilt Contours

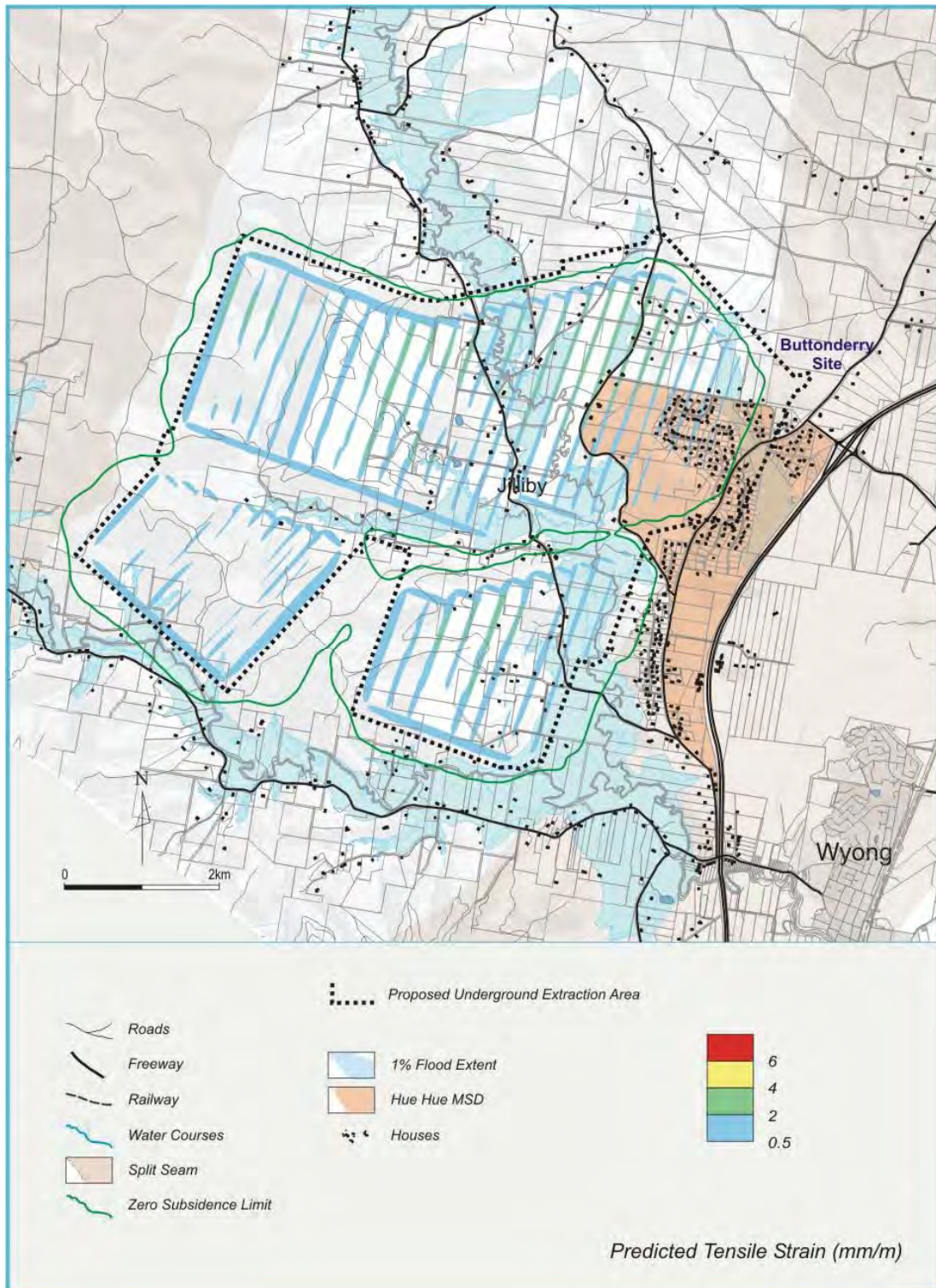


Figure 7: Predicted Total Tensile Strain Contours

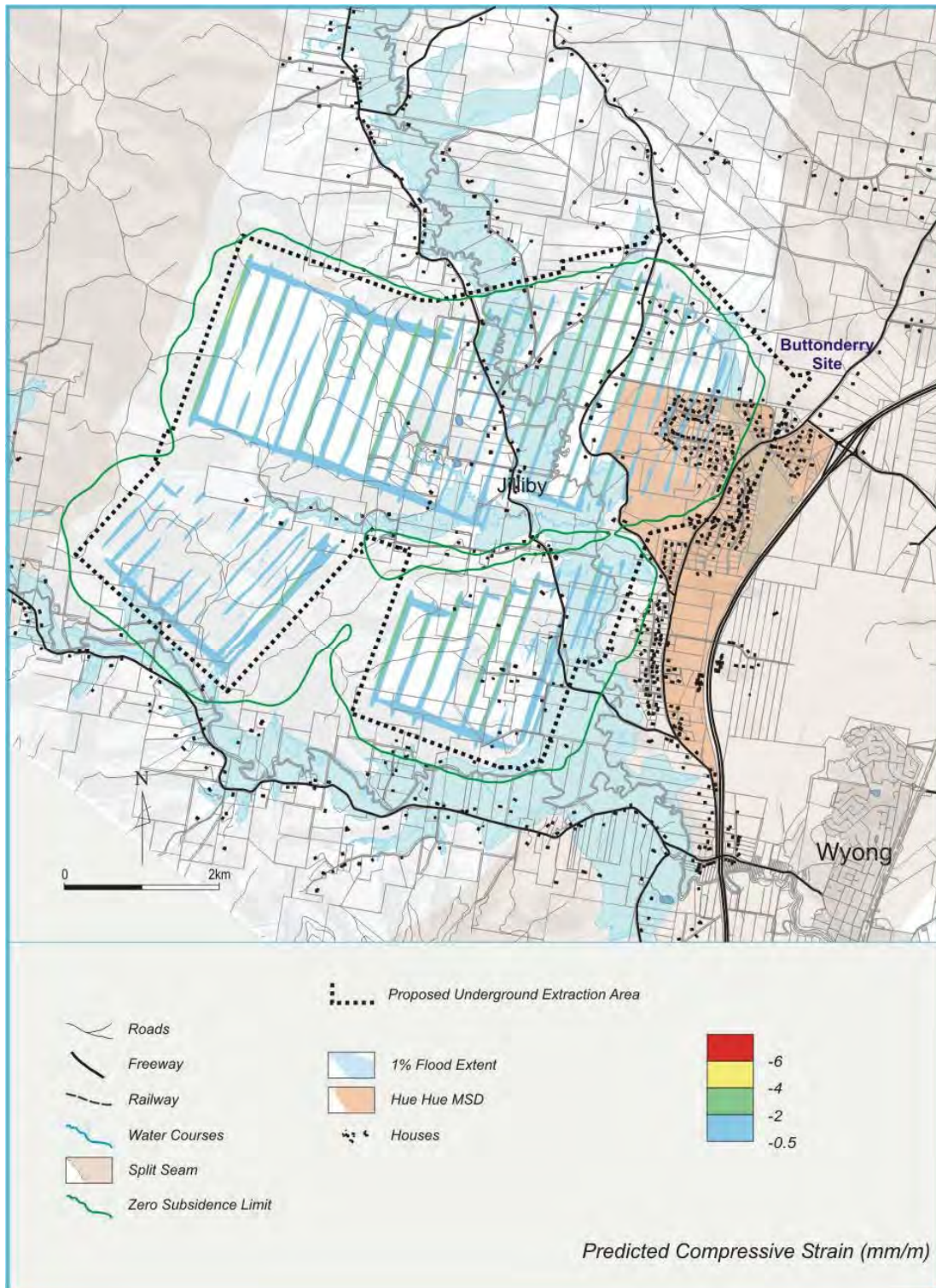


Figure 8: Predicted Total Compressive Strain Contours

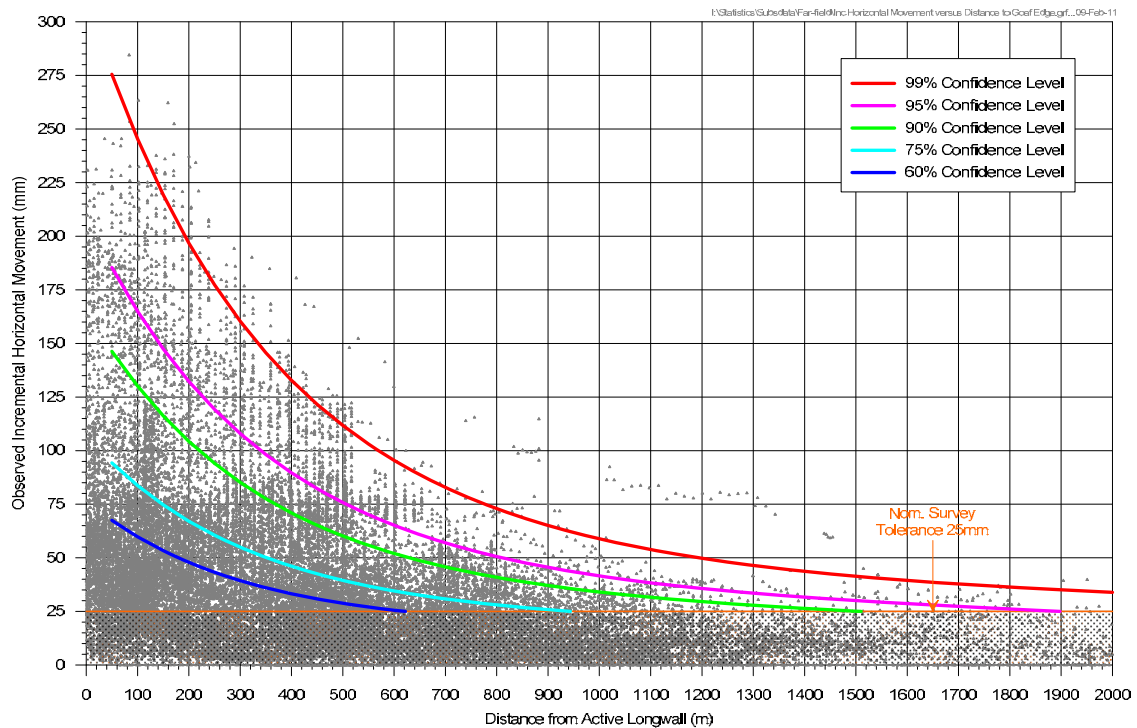


Figure 9: Expected far field horizontal movement based on historical measurements

In terms of impacts, MSEC predictions indicate that of the 245 houses within the study area:

- No houses will exceed the Mine Subsidence Board (MSB) tilt limit of 4mm/m within Hue Hue Mine Subsidence District (MSD).
- Some minor damage is anticipated elsewhere with 13 houses predicted to exceed the MSB tilt limit of 7mm/m within the Wyong MSD.

The expected number and type/extent of repair is shown in Table 2. A summary of impacts expected for other key infrastructure is shown in Table 3.

TABLE 2
ASSESSED IMPACTS FOR THE HOUSES WITHIN THE SUBSIDENCE AS STATED BY THE EIS

| GROUP | REPAIR CATEGORY | | | |
|----------------|------------------------|---------------------------|--------------------------------|---------|
| | NO CLAIM OR ADJUSTMENT | VERY MINOR - MINOR REPAIR | SUBSTANTIAL - EXTENSIVE REPAIR | REBUILD |
| All houses | 202 | 30 | 12 | ≅ 1 |
| (total of 245) | (83%) | (12%) | (5%) | (<0.5%) |

MSEC anticipates that modifications to the mine plan may occur prior to the approval and commencement of mining and therefore its predictions are subject to change. Such changes, however, are not anticipated by MSEC to result in significant changes to the number and severity of affected houses as shown in Table 3.

TABLE 3
SUBSIDENCE EFFECTS SENSITIVITY ANALYSIS AS STATED BY THE EIS

| ASPECT | CONSEQUENCES |
|----------------------------------|---|
| Rock formations and steep slopes | The increased tilt is minor compared to the natural gradient and therefore, slope failure is unlikely. Tension cracking on steep slopes may occur, but will still be lower than the cracking observed elsewhere at shallower depths of cover. |
| Roads | The change in grade is unlikely to significantly affect the drainage of roads. The extent of cracking will increase. |
| Road bridges | Tilts and curvatures remain very low and are unlikely to cause any impacts. Bridges will need to be able to tolerate the higher valley movements. The movement joints may need to be modified if they cannot withstand the higher closure movements. |
| Water Infrastructure | Subsidence effects are too low to cause impacts on Treelands Drive Reservoir and pipelines, including Mardi - Mangrove Creek Dam Pipeline. |
| Transmission lines | Increased stresses on the 330 kV transmission line towers needs to be taken into account when designing mitigation measures for these towers. Subsidence effects are too low to materially impact the 132 kV transmission line. Preventative measures such as roller sheaves and intermediate poles may be necessary. |
| Telecommunications cables | The maximum tilt increases to 30 mm/m which is unlikely to result in significant impacts to telecommunications cables if suitable management strategies are implemented. The conventional ground strain will increase to 4 mm/m tension and 6 mm/m compression, well below that effectively managed elsewhere. |
| Rural buildings | Tilts are unlikely to impact the stability and integrity of structures. Increased curvatures will increase the incidence of impacts on structures. However, these impacts will be minor in nature and could be repaired using normal building maintenance techniques |
| Farm Dams | Change in freeboard will increase to a maximum of 500 mm. This is unlikely to affect dam stability, but may alter the dam storage capacity. Doubling strain and curvature will increase the incidence of cracking in farm dams. Cracking is not expected to be significant and can be repaired where necessary. |
| Residences | Increased tilts and curvatures will result in a higher incidence of impacts and more significant impacts. Residences are expected to remain safe (i.e. unlikely to experience "sudden and immediate" impacts). |
| Water Tanks | Increased tilts will result in a higher incidence of serviceability impacts. These can be rectified by re-levelling the tanks. Increased curvatures and strains are unlikely to affect water tanks because they are raised above the ground. |
| Recreational facilities | There are expected to be 44 pools experiencing tilts greater than 3 mm/m. A number of pools are likely to suffer damage requiring remediation. The maximum tilt experienced by tennis courts is unlikely to affect the serviceability of the courts. |

7.1. The Predictive Method Approach

The subsidence prediction used for W2CP may be divided into three key components:

1. The predictive model.
2. The method used to calibrate the predictive model.
3. Chain pillar performance.

A description of each of these components with respect to the Wallarah 2 proposal (W2P) follows.

7.2. The IPM Model

The predictive model employed at W2CP is the Incremental Profile Method (IPM). The IPM is an empirically based method which relies upon the interpolation of a large number of reliable measurements of mine subsidence impacts including subsidence, panel geometry, extraction height, depth of cover and panel sequence amongst others. The means of interpolation is undertaken on an observational basis whereby empirically relationships are derived largely through statistical analysis and not by physical, geological or mechanical means.

When calibrated to reliable measurements relevant to the site to which it is applied, the IPM is generally considered industry best practice. Standard profiles obtained using the MSEC IPM are shown in Figure 10.

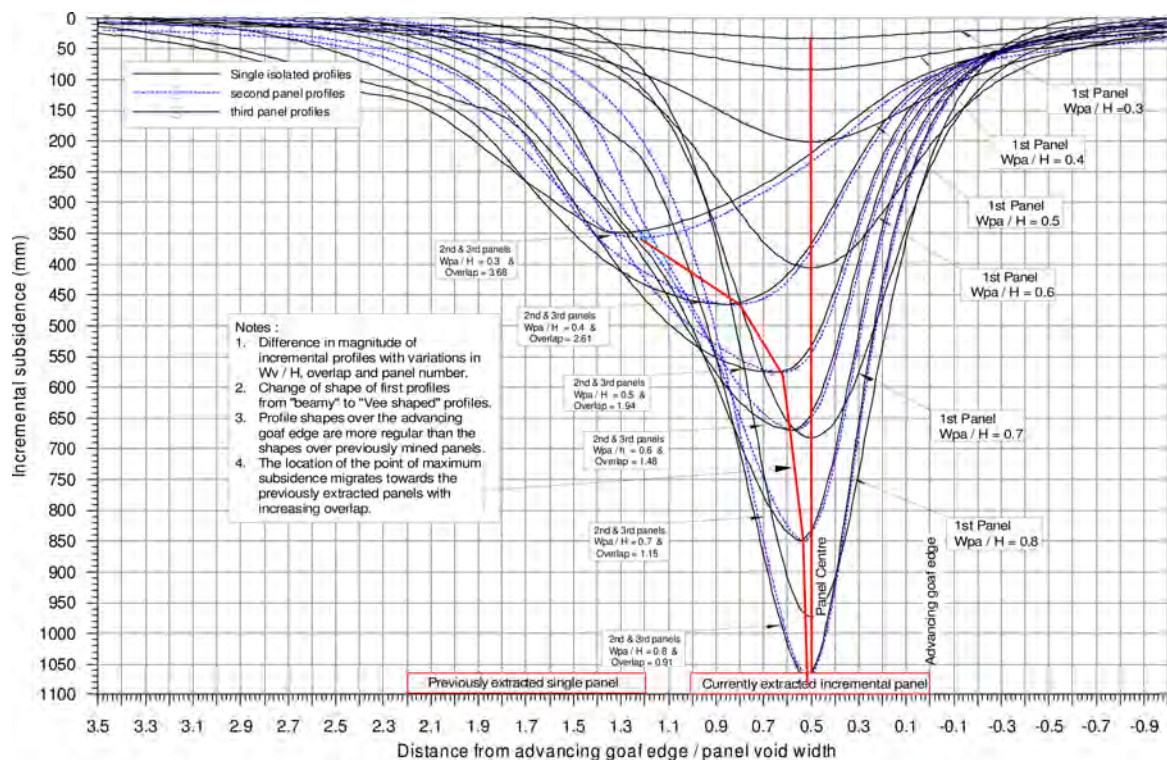


Figure 10: Incremental Subsidence Profiles obtained using the Incremental Profile Method

The accuracy of the IPM depends upon the robustness of the empirical relationships and the quality and suitability of the data. The MSEC (2007) IPM method is known to contain at least 11 parameters which must be derived from a sufficient quantity of data relevant to the site for which the prediction is being undertaken.

The MSEC 'empirical database' typically contains such parameters as:

- Longwall geometry including depth of cover and panel width.
- Measured surface response such as subsidence, tilt and strain.
- Extraction height, panel sequence and centreline offset distance.

The MSEC IPM does not include consideration of geotechnical or geological parameters such as lithology, strength, joint characteristics and the like. However, if the database is sufficiently large then refinement in terms of region specific response (due to, for example, regional geology) can be incorporated to some extent. The MSEC IPM is known to have a wider application over the Southern Coalfield due to the significantly higher proportion of subsidence impact measurements from this area.

The IPM developed by MSEC is divided into two parts:

1. 'Conventional subsidence' which is that component principally related to longwall geometry and observed subsidence and independent of topography (this has sometimes been referred to previously as 'systematic subsidence')
2. 'Unconventional subsidence' which is that component which appears to be influenced by topographic effects whereby hills valleys cause additional movements, such as a reduction in subsidence (sometimes termed 'upsidence') or additional horizontal movements, such as valley closure.

Unconventional subsidence requires a secondary set of empirical relationships which are commonly related to valley width, valley depth and perpendicular and transverse offsets to mining. MSEC recognises that conventional subsidence is captured more reliably by their IPM than unconventional subsidence.

In many cases the MSEC IPM has been found to reliably predict subsidence which increasing accuracy for sites which correspond to a larger proportion of the empirical database.

There are instances, however, where the IPM has not adequately predicted subsidence. A recent example of this occurred at Tahmoor, NSW in 2008. In this case actual subsidence was approximately twice that predicted by the MSEC IPM, the prediction itself being already considered "conservative". This failure of the IPM occurred despite the mine having its own extensive empirical subsidence database of 23 previous longwall panels and their recorded impacts.

Extensive geomechanical modelling of Tahmoor by SCT (Gale, 2011) examined the sensitivity of subsidence to a range of parameters not included in the IPM, including:

- Unconfined Compressive Strength (UCS)
- In-situ stress
- Bedding and joint density (frequency)
- Joint stiffness
- Joint strength

All of the above were found to have an influence on subsidence to varying degrees. A reasonable fit was eventually confirmed based on significant reductions in joint stiffness and strength. The approach used by Gale (2011) is essentially identical to that used to calibrate the MSEC presented in the EIS in Appendix G and discussed in Section 0.

MSEC have acknowledged in the EIS that their current empirical database is not adequate for W2CP as it does not contain sufficient data to reliably predict the following combination of site conditions.

- Proposed W2CP depths of cover of up to 690 m, which considerably exceeds the depths of cover for most mines in the Newcastle Coalfield and the Southern Coalfield, where depths of cover typically extend up to 550 m.
- The MSEC empirical database is weighted towards the Southern Coalfield with typical extraction thickness of approximately 3.0 m and typically bounded by reasonably strong strata, whereas the W2P includes plans to operate at extraction thicknesses of between 3.0 m and 4.5 m bounded by comparatively weak strata in some areas.
- Geological evidence showing no significant evidence of thick, strong, continuous conglomerate units commonly found in the Newcastle Coalfields and generally considered responsible for a reduction in conventional subsidence.
- Geological evidence suggesting a relatively weak roof-pillar-system compared to that in the Southern Coalfields.

In response to the above MSEC has undertaken an alternative means of IPM calibration as described below.

7.3. The IPM Calibration Method

WACJV commissioned SCT to undertake a series of numerical analyses to predict subsidence at specified locations. The studies were based on stress analysis techniques to predict the geo-mechanical behaviour at selected locations based on the following:

- The strata was idealised as a series of horizontal layers in 2D section based on logging and testing of a few (three) select boreholes
- Strength variation across the sites was inferred from sonic velocity correlated to UCS measured in these boreholes.
- In-situ stress and elastic modulus were estimated by generic specific correlations with UCS.
- The section was discretised into 1 m by 1 m regions within which constant conditions are assumed such as strength.
- Numerical analysis techniques were then used to predict the responses of the 2D section to changes, namely the simulated extraction of coal at the target depth.

The theoretical response is understood to be dictated in part by the geotechnical models used in the finite difference analysis package, FLAC, augmented by changes developed by SCT. We understand that this model process is identical to that presented by Gale (2011) with modification based on site specific measurements of material properties, insitu stress and geometry.

The model is shown to reasonably predict the measured surface and subsurface displacement at Ellalong longwall 2 and surface displacement at South Bulli, Appendix H. Both of these cases present different longwall depth, geometry and geology to proposed mining.

Three site specific realisations of their model are presented by SCT for predictive purposes. There are:

- The 'Hue Hue' Road case representing 125m and 155m wide panels below the Hue Hue Mine Subsidence District.
- The 'Valley' case representing 175m wide below the Dooralong Valley.
- The 'Forest' case representing 255m panels below the Jilliby State Conservation Area.

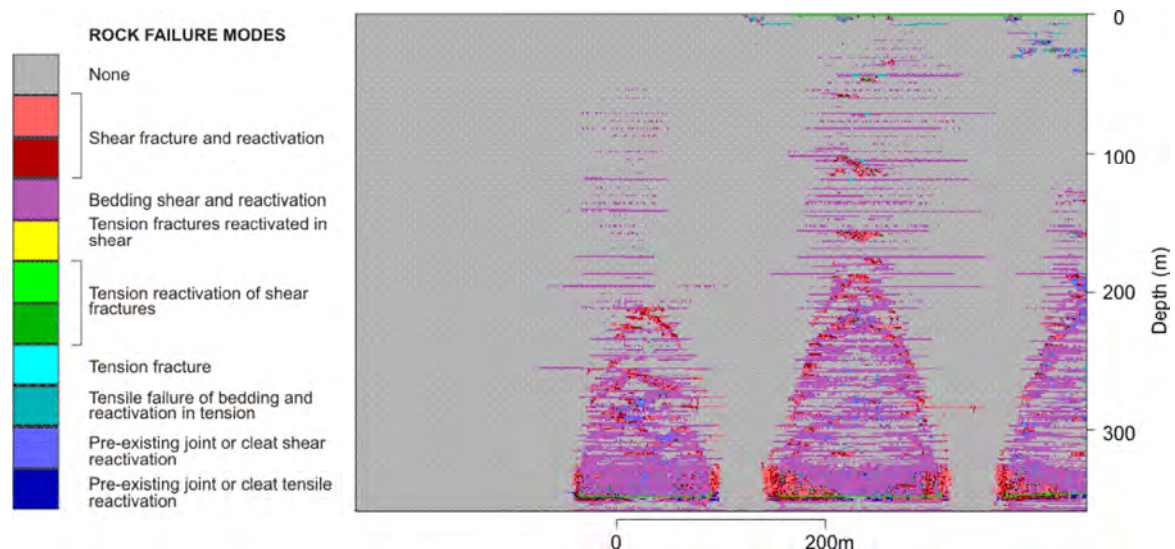


Figure 11: Modelled Rock Fracture Development for the Hue Hue Case (3m extraction)

The SCT model is complex and information provided in the EIS is limited. A more comprehensive description of the SCT model is available in (Gale, 2011) where it was used to predict excessive subsidence experiences at Tahmoor Colliery. Results from Gale (2011) show that:

- SCT Model results can be influenced by strength, lithology, horizontal stress, variations in the frequency of bedding and jointing, joint stiffness and joint friction.
- In some cases variation of these impacts can result in a subsidence prediction varying by a factor of 2.

This discussion is not meant to imply that actual subsidence at W2CP will be or is likely to be twice that predicted. However this study does indicate that the SCT model is sensitive to a significant number of input parameters. Therefore the SCT model is likely to be sensitive to the correlations used in EIS modelling, such as the sonic velocity-UCS correlation, and the other site correlations, such as Young's Modulus and in-situ stress. The sensitivity of these parameters has not been reported in the EIS and therefore the potential error of the SCT model, and by implication the IPM, is unknown.

Additional limitations include:

- SCT models are 2D representations and therefore do not capture the 3D effects of topography, in-situ stress, pillar shape or changes in material properties.
- The models are based on extrapolation of a limited number of UCS tests (3 boreholes), inferred in-situ stress direction and site-wide correlations of Young's Modulus and in-situ stress magnitude.
- The models are based on simplified failure criteria based on a constant proportion of inferred UCS.
- The models do not provide estimates of sensitivity to input parameters at W2CP apart from two additional analyses to examine concurrent changes to extraction height and pillar width.

These limitations are to some extent acknowledged by SCT who state within the EIS:

- “Numerical modelling is site specific and, in itself, cannot generate subsidence predictions across the entire mining area”.
- “The use of a low friction angle and adoption of yield pillar design.... does not account for all potential long-term moisture impacts”.
- “In the unlikely event that evidence of non-yielding was to emerge, additional modelling and impact assessment would be carried out and appropriate remediation measures put in place”.

7.4. Chain Pillar Performance

Based on geological evidence and geometric considerations MSEC considers the following site specific factors to be significant with respect to subsidence prediction:

- The variation and magnitude of the depth of cover.
- The height of extraction.
- The variation in strength of the units bounding the target seam.

Individually the seam height and variation in depth of cover do not present significant challenges in terms of subsidence prediction. However the variation in strength in combination with these factors does present some potential issues.

The design philosophy as presented by MSEC, SCT and the EIS generally is an expectation that the chain pillars will fail increasing overlying subsidence and presumably locally reducing associated tilts and strains.

This assumption is based on:

- The interpreted strengths within boreholes as documented in the Geology Report (Figures 10.1 and 10.2 of Appendix C).
- Estimation of pillar strength using the empirical Mark-Bieniawski (1995) method.
- An assumed reduction in pillar area due to an expectation of yield, stress fracturing and caving in the vicinity of the pillar.
- An assumed pyramid shaped stress distribution around the yielded pillar.
- Modifications to the SCT 2D model to capture 3D behaviour due to “cut throughs” through pillars.

These assumptions are generally referred to ‘worst case’ conditions and have been used to set mine plan geometry such that all pillars would be expected to ‘fail’ sometime after one, two and three longwalls have been extracted, depending on location. Failure was confirmed in all three SCT site specific numerical predictions and the MSEC IPM was subsequently calibrated to mimic this response in terms of the magnitude of additional subsidence over pillars and the timing with respect to number of longwalls extracted.

The current subsidence prediction, therefore, is reliant upon pillar collapse which may or may not represent 'worst-case' conditions in terms of tilt and strain. In fact pillar failure may not occur in many areas due to better than 'worst case' conditions as evidenced by:

- Predicted variation in roof conditions ranging from an expectation of "compressive failure in both primary and secondary roof" to "no compressive failure" as shown in the Geological Report Figure 10.1 (Appendix C).
- Predicted variation in floor conditions ranging from a UCS of less than 15MPa to greater than 40 MPa, as shown in Geological Report Figure 10.2 (Appendix C).

The approach taken has, in effect, used an empirical predictive tool (the IPM) to extrapolate the results from three theoretical idealised profiles across the entire site. Given that the SCT model has been shown to be sensitive to many of input parameters and that these parameters have been estimated, the lack of information concerning the sensitivity of this approach is therefore of significant concern.

It is noted that concern over the likely impacts should the chain pillars not collapse is raised by both the PAC (Reference 3) and Dr Bruce Hebblewhite.

7.5. Management Strategy

The current management strategy is understood to encompass an "adaptive management plan" comprising:

- Undertake an initial stage of mining where a limited (one or two) number of longwalls are extracted in the north-east of the site in the first instance.
- Conduct a variety of survey and monitoring exercises to collect relevant and sufficient data to enable the IPM and SCT models to be verified.
- Consider changes to the mine plan to mitigate any issues arising from survey or model verification.

There are several potential issues associated with this approach, namely:

- The type and extent of survey must be sufficient to clearly measure the extent and nature of mining induced impacts including pillar stability changes in permeability, rate of subsidence development and height and extent of fracturing.
- The first longwalls may or may not be a reliable indicator of future longwall performance as they with lower extraction height and therefore may not initiate pillar yield as predicted. This would make model calibration difficult as the conditions under where pillar yield will occur may remain unknown.
- Some monitoring elements, such as groundwater wells, may be subject to external influences (such as abstraction) making interpretation of mining influence difficult to substantiate.

7.6. Findings

The predicted impacts due to W2CP are, in general terms:

- Subsidence up to 2.6m with less subsidence predicted in residential areas to the east and more subsidence within forested areas to the west, Figure 5.
- Tilts up to 15mm/m concentrated above the edges of the panels and over forested areas, Figure 6.
- Tensile strains up to 4mm/m concentrated near the edge of panels, Figure 7. About 99% of these strains are expected to be less than 2.5 mm/m, Figure 7.
- Compressive strains up to 5.5 m/m concentrated about 50m inside the panel edges, Figure 8. About 99% expected to be less than 3.3 mm/m.
- Far field movements up to ~60 mm horizontally at a distance of around 1km from mining diminishing to less than 25 mm at a distance of 2 km.
- The expected number and severity of impacts across the 245 properties within the area affected by the predicted subsidence are:
 - 83% of properties being unaffected;
 - 12% requiring very minor to minor repair;
 - 5% requiring substantial to extensive repair, and
 - <0.5% requiring a complete rebuild (ie. about 1 property)

In summary we conclude that:

- Based on our discussions with W2CP, we understand that something like 4 to 5 panels would need to be extracted before a full model calibration exercise could be undertaken.
- The reliability and accuracy of the SCT method is unknown as:
 - There is a reliance on extrapolated inputs to which the method has been shown to be sensitive.
 - The model is calibrated to site-specific data and not to a small number of measurements from other sites.
 - The sensitivity to most input parameters is not presented.
- Due to the empirical nature of the method the IPM is only as reliable as the data to which is it calibrated, in this case the SCT model results. Therefore the reliability and accuracy of the IPM is in doubt.

This is to some extent recognised by MSEC who in the EIS state:

“A thorough calibration...will only be achieved after subsidence monitoring data is obtained and analysed”.

- The use of one predictive model to calibrate another is generally unwise and not widely regarded as best practice.

- The IPM is stated as being conservative and likely to over predict impacts. The evidence for this conservatism and the expected magnitude with respect to W2CP are not provided. Indeed all indications are that the model development is centred around matching expected conditions and not exceeding or over-predicting them.
- There is a reliance on pillar compression after extraction resulting in a smoother subsidence profile. However, the basis for this assumption appears to conflict the Geological Report (Appendix C), where significant variation in both roof and floor conditions is expected across the site.
- The EIS acknowledges that pillar compression may not occur but does not quantify the impacts or changes in impact should this not occur.
- First longwall will prove that this pillar compression assumption is valid.
- At least 3 longwalls (L1N to L3N) and more likely 4 to 5 longwalls are required before pillar compression theory can be verified.

We accept that these predicted impacts are in agreement with expectations based on measured subsidence impacts elsewhere, and the Newcastle and Southern Coalfields in particular.

We are in general agreement that should the predicted level of subsidence occur, the type distribution and severity of impacts on houses, buildings and infrastructure is likely to be similar to that stated in the EIS.

We do not agree that the prediction represents a conservative estimate of subsidence impacts as all the evidence presented in the EIS suggests the prediction represents the most likely impacts. We consider that the model, calibration and application of the prediction does not provide sufficient guidance as to the sensitivity and reliability of the method and may, therefore, fail the Director General's "reasonable level of confidence" test.

In general we did not find any omissions or evidence to suggest that subsidence due to W2CP is likely to be significantly different to that predicted by the EIS. Our main concern is the lack of certainty around the predictive method and the likely variation in prediction based on observed variations that are already known and potentially those unknown.

8. GROUND & SURFACE WATER

8.1. Introduction

The potential impacts on groundwater and surface water resources arising from the proposed Wallarah 2 longwall coal mine are considered in this section of the report. The assessment is based substantially on material presented in Appendices of the Wallarah 2 EIS, these being:

- Appendix H: Groundwater Management Studies
- Appendix I: Surface Water Impact Assessment.

The assessment considers the methodology and inputs into the groundwater model undertaken by Mackie Environmental Research (MER) reported in Appendix H.

The prime outputs of the groundwater modelling pertain to the following:

1. The rate at which water flows into the mine, which the miners then have to deal with.
2. The impact of the mine on groundwater levels.

Point 2 above has particular relevance for the local area in regard to water levels in the Yarramalong and Dooralong Valleys and the availability of water in the Wyong River downstream of the proposed mine which is used as part of the water supply to the Wyong and Gosford Local Government Areas. The water intake point on the Wyong River is managed by the Central Coast Water Corporation (CCWC).

Further, activities in both of the valleys such as turf farming and equestrian properties rely on water supply from the local groundwater systems either by collecting the water in dam and/or pumping water from bores.

8.2. The critical importance of extreme events in relation to water resources

8.2.1. Overview

Firstly, we note that the assessments in the Wallarah 2 EIS in relation to groundwater impacts are made in relation to average rainfall conditions, and the same is true for some of the critical assessments in relation to surface waters. Such assessment in terms of averages warrants very careful consideration. This is particularly so given recent experience on the Central Coast where significant water restrictions were in force.

To that end, the groundwater assessment should consider the variation in inputs to the surface water supply to account for extended dry periods. This is particularly so given that if the EIS prediction of leakage from the alluvial lands is negligible given the recharge from runoff. To illustrate this, the following discussion on the Jilliby Jilliby Creek flows is presented.

8.2.2. The Mine and Jilliby Jilliby Creek Catchment

Figure 12 shows the catchment of Jilliby Jilliby Creek in the Dooralong Valley in relation to the mine footprint. It clearly shows that this catchment is the one most vulnerable to mine impacts.

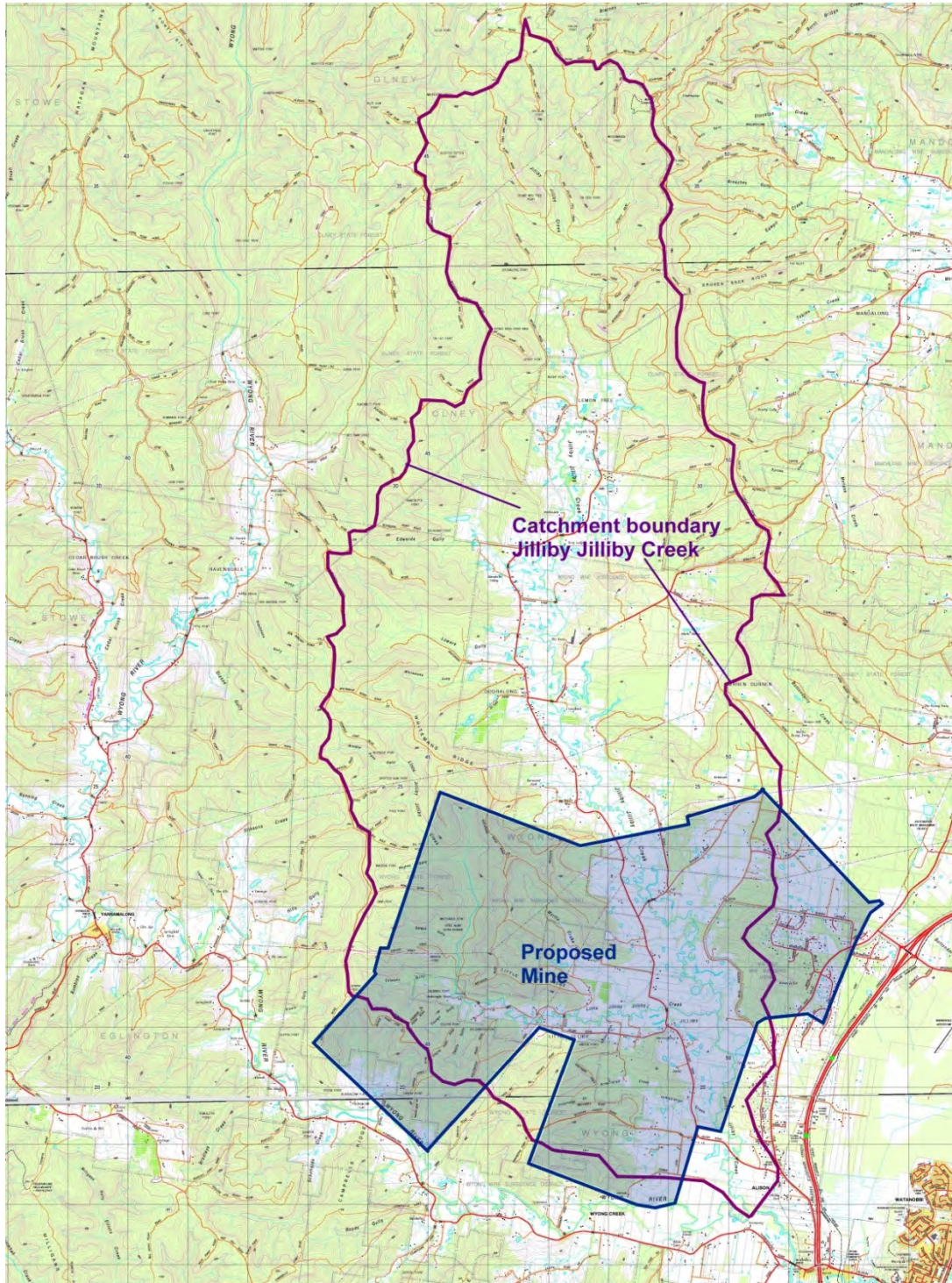


Figure 12: Jilliby Jilliby catchment complete

One of the facets of this catchment is that just downstream of where it joins the Wyong River is the main pump station from which water is pumped to either Mardi Dam or Mangrove Creek Dam (see Figure 13B). Pumping rates over the past few years are shown in Figure 13A.

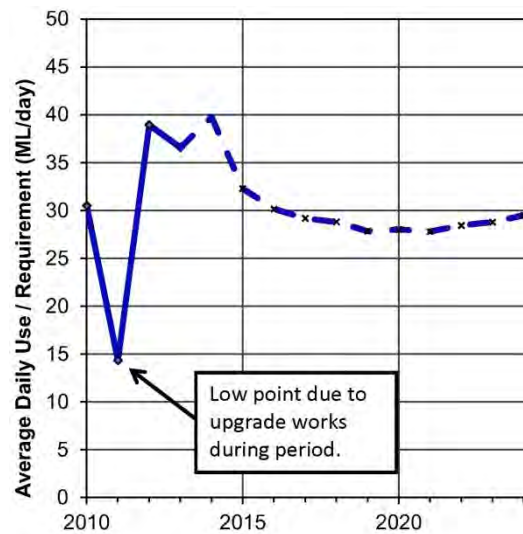


Figure 13A: Pumping rates from Wyong River since 2010 (and projected requirements)

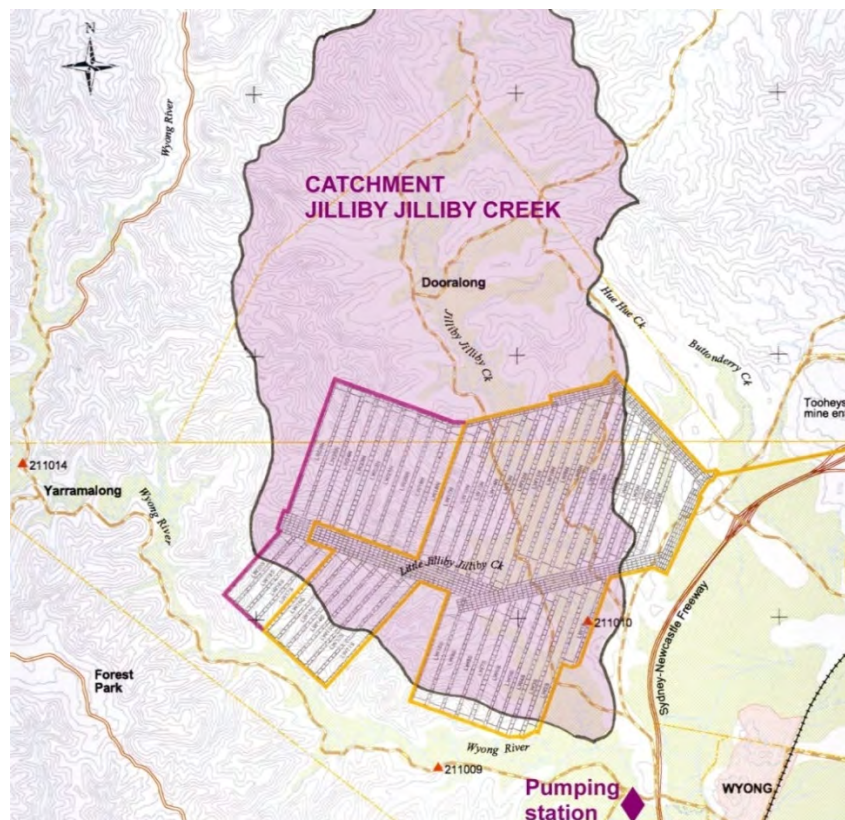


Figure 13B: Location of Wyong River pumping station downstream of confluence of Jilliby Jilliby Creek

8.2.3. Recent Creek Flows

Figure 14 gives the statistical analyses of the flows in Jilliby Jilliby Creek, upstream of the Wyong River, from records since 1972.

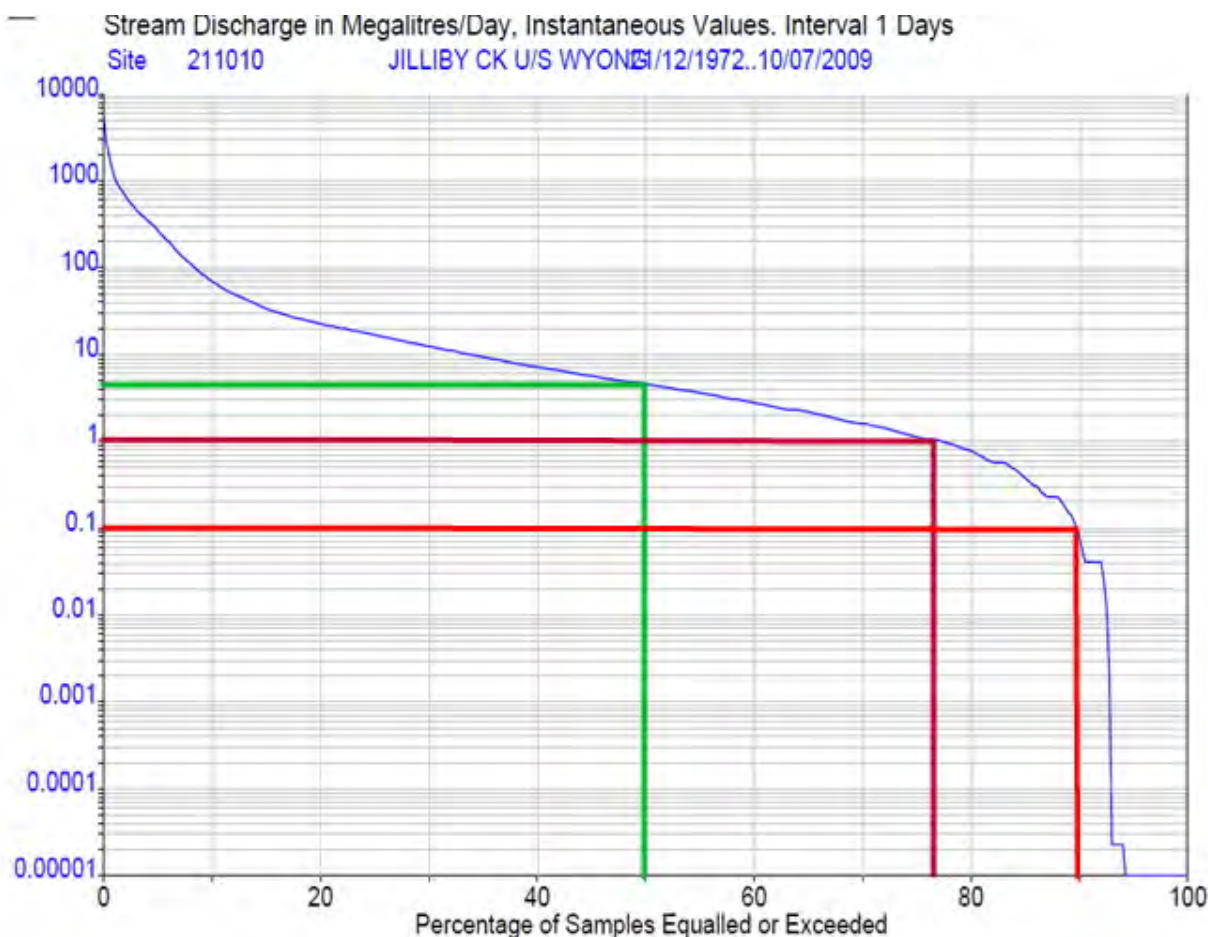


Figure 14: Statistics of flows in Jilliby Jilliby Creek, 1972 – 2013

From the plot above it can be seen that the median flow rate is about 4.5 Megalitres per day (ML/day). However, the flow is less than 1ML/day for 24% of the time of record, and less than 0.1 ML/day for 10% of time.

To put these flow rates into perspective, Figure 15 and Table 4 show that the five longest periods of consecutive days, since 1972, when flows were less than 1 ML/day and 2 ML/day since 1972. It can be seen that for a stretch of 190 days in 1980/81, flows were less than 2ML/day (less than half the average). Sustained periods of flows of less than 2ML/day also occurred for periods of 179, 168, 167 and 135 days. All of these occurred between 1991 and 2006.

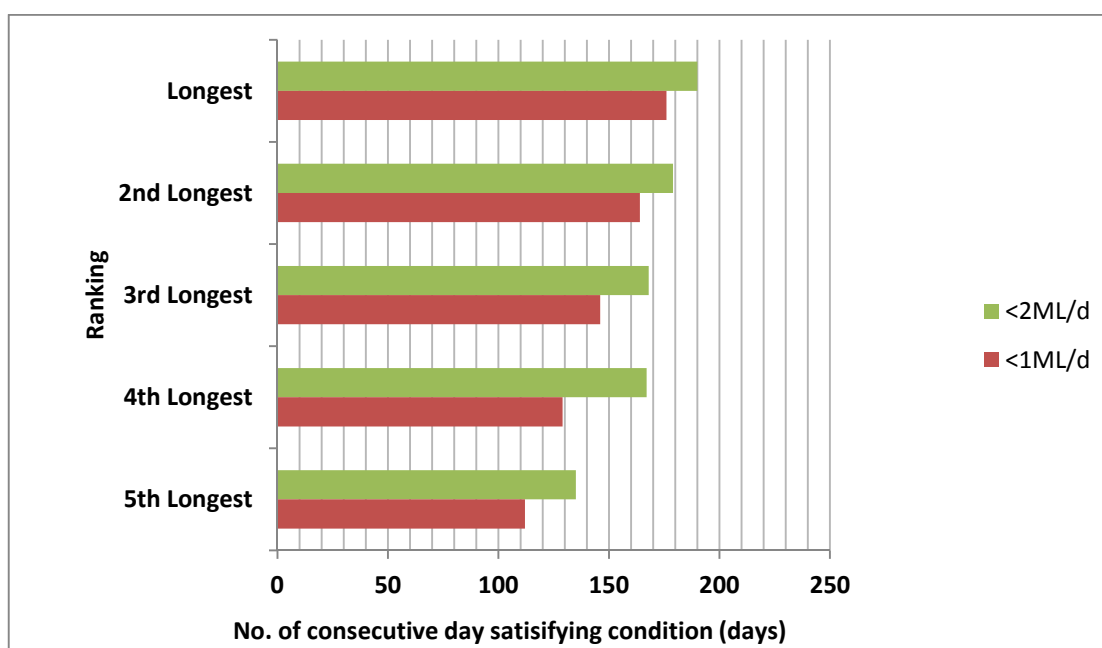


Figure 15: Consecutive days of flow in Jilliby Jilliby Creek less than either 1ML or 2ML per day

The particular periods that are plotted in Figure 15 are summarised in Table 4 below.

TABLE 4
CONSECUTIVE DAYS OF LOW FLOW

| RANK | FLOW CONDITION (ML/day) | DAYS | START DATE | END DATE |
|------|-------------------------|------|------------|------------|
| 1 | <2 | 190 | 31/07/1980 | 5/02/1981 |
| | <1 | 176 | 12/03/2006 | 3/09/2006 |
| 2 | <2 | 179 | 10/03/2006 | 4/09/2006 |
| | <1 | 164 | 19/10/1997 | 31/03/1998 |
| 3 | <2 | 168 | 17/04/2004 | 1/10/2004 |
| | <1 | 146 | 8/08/1980 | 31/12/1980 |
| 4 | <2 | 167 | 17/10/1997 | 1/04/1998 |
| | <1 | 129 | 30/01/1991 | 7/06/1991 |
| 5 | <2 | 135 | 25/01/1991 | 8/06/1991 |
| | <1 | 112 | 25/11/1982 | 16/03/1983 |

8.2.4. Climate

Following from the discussion above, the next important questions are:

- what were the climatic conditions at the time when these sustained periods of low flow occurred; and
- how representative of the full record of local experience area are they?

While the flow records for Jilliby Jilliby Creek from 1972 to now capture the Millennium Drought, they do not capture the more intense droughts of World War 2, and the time of Federation. Figure 16, taken from Appendix H of the EIS, clearly shows how much more severe was the drought of WW2. This means that Figure 16, in all likelihood, does not capture the largest periods for which low flows occurred in the creek. Further, it shows that even short, but intense dry periods such as 1979 to 1981 can significantly impact on the stream flow.

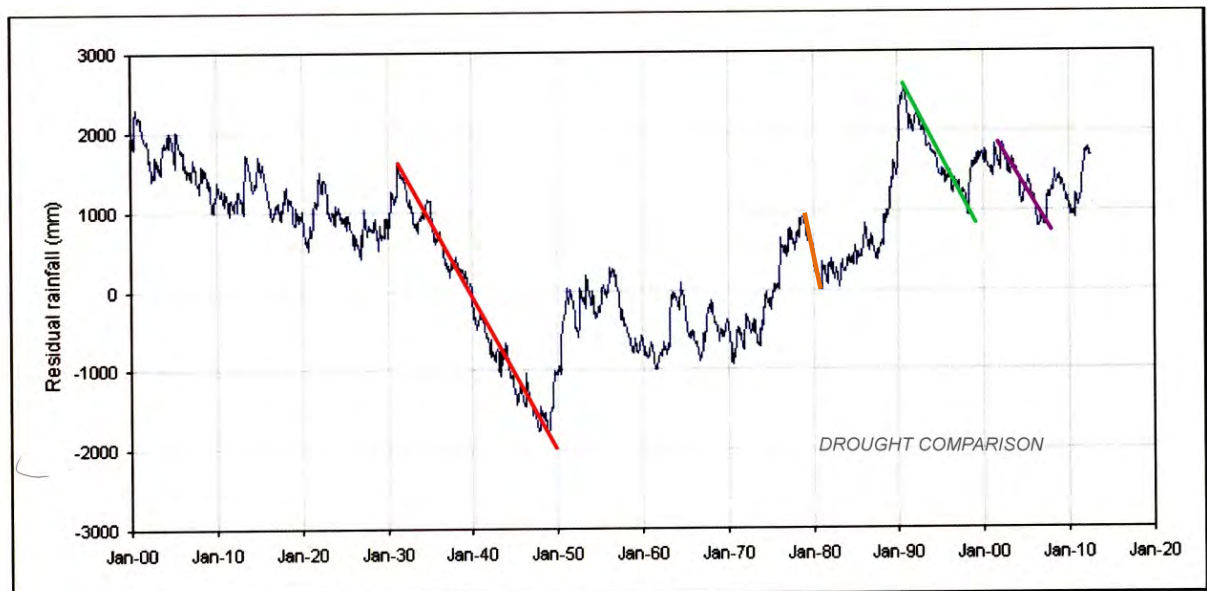


Figure A1: Rainfall residual mass plot for Wyee Gauge 061082 from 1900

Figure 16: Droughts in Wyong are shown by 113 years of rainfall records at Wyee. Downward slopes are periods of below average rain; the steeper the slope the more intense the drought; the longer the downward sloping period the longer the drought.

8.3. Computed Impacts in the EIS on Groundwater and Surface Water

8.3.1. Surface Water Impacts

Based on the 3D groundwater model, the EIS predicts mine inflows as given in Figure 17.

It can be seen that computed inflows reach about 1.5ML/day in Year 6 and are up to 2.5ML/day for 15 to 20 years after about Year 18. The EIS also notes that these calculations do not include flows from fracture zones which are estimated to potentially increase inflows by about 0.5ML/day.

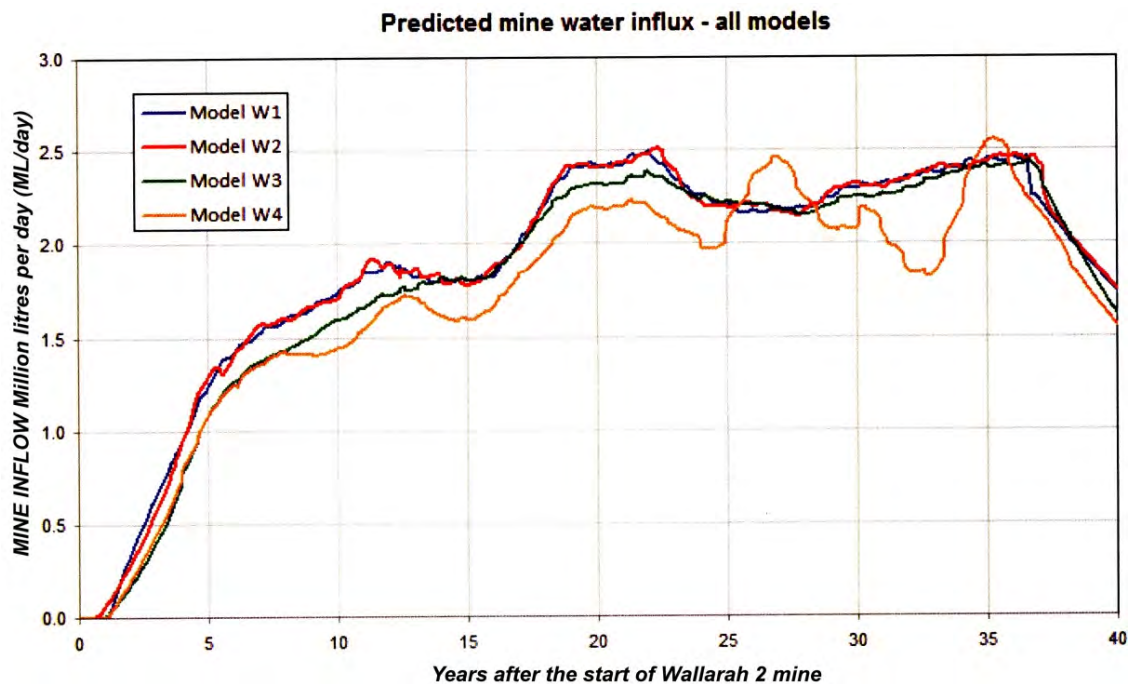


Figure 17: Computed mine inflows as given in the EIS

The EIS does not provide any attempt to reconcile where this water comes from. It implies that it would largely come from water stored in the ground, but this avoids the fact that water stored in the ground comes from somewhere, and is in equilibrium with natural recharge. A valid way to consider this matter is encapsulated in the following quotation from Dr Rick Evans, principal hydrogeologist of Sinclair Knight Merz, viz:

"There is no free lunch here. It's very simple – every litre of water your pump out of the ground reduces river flow by the same amount".

Australian Financial Review,
24 May 2007

While we cannot define precisely what portions of which rivers will be affected, by virtue of Figure 12, it is reasonable to conclude that Jilliby Jilliby Creek is likely to be the dominantly affected stream system. We also cannot say, with confidence, how many years it will take for the impact of underground extraction to reflect in surface flows.

However, it is not a question of if it will occur, it is only a question of how long will it take for the impact to occur. The rate of leakage may be slow if the EIS estimates of Patonga Claystone permeability are correct but much faster if, as discussed in Section 8.9, they are not.

It is valid to compare the data in Figure 16 with the flow records of Jilliby Jilliby Creek.

It is readily seen that 2.5ML/day of mine inflow is more than half the average flow of Jilliby Jilliby Creek and is greater than the flows recorded for 40% of the time since 1972. It is reasonable to assume that the periods of low flow in the creek (see Figure 14) may be longer in future under climatic conditions similar to those experienced since 1972.

This matter of overall water balance is incorrectly addressed in the EIS. On page 86 of Appendix I is the misleading statement that:

“It is possible that undermining of Jilliby Jilliby Creek may generate some additional groundwater storage which would be sourced from regional rainfall recharge, as well as surface runoff. The diverted water volume would represent less than 1% of the total licensed extraction volume for the area”.

The inference from this statement is that the flow loss in Jilliby Jilliby Creek is of no consequence. But page (iii) of the same Appendix states that the flow loss may be 0.74 ML/day¹.

For 20% of the time since 1972, the flows in Jilliby Jilliby Creek have been less than 0.74ML/day and that a loss of this magnitude will substantially change the low flow characteristics of Jilliby Jilliby Creek. As discussed below, this will be associated with a substantial change to the groundwater system in Dooralong Valley.

A similar level of baseflow loss was also reported in Section 5.4 of the PAC report (Reference 3) when some cognisance was given to the sensitivity of the modelling to variation in the permeability of the rock mass. In this case a value of 1ML/day was found which represents 24% of the flow record since 1972.

¹ The document states 270ML per year, which is 0.74ML/day.

8.3.2. Groundwater Impacts

Figure E17 of Appendix H of the EIS gives calculations of the groundwater pressure regime around the mine under natural conditions, at the end of mining (Year 38). In this form the plots do not provide guidance on near surface flow lines that illustrate the flow path. The discussion and figures below set out to present the data from the EIS in a practical form to illustrate the impact of creating a groundwater sink in the form of the underground mine.

Figure 18 is an annotated version of part of the EIS plot of natural groundwater conditions above the mining area. To interpret the plot 'equipotential lines' have been annotated onto the EIS data. Equipotential lines indicate the level the water in a well will rise to which on the Figures below is benchmarked against the height above sea level (AHD). So in the case below the equipotential lines show the level water would rise to in a well open only at the bottom, whose bottom is placed on that equipotential line.

Three imaginary wells have also been annotated onto the two figures below, Wells A, B and C. These have been selected to illustrate the results of the MER modelling on the level of water that would appear in a very deep, a mid-range and a shallow bores in the Dooralong Valley.

The water level in the well is shown by the blue column for each well. It can be seen that the two wells (B and C) on the 20m equipotential line rise to the same level, namely RL20 m.

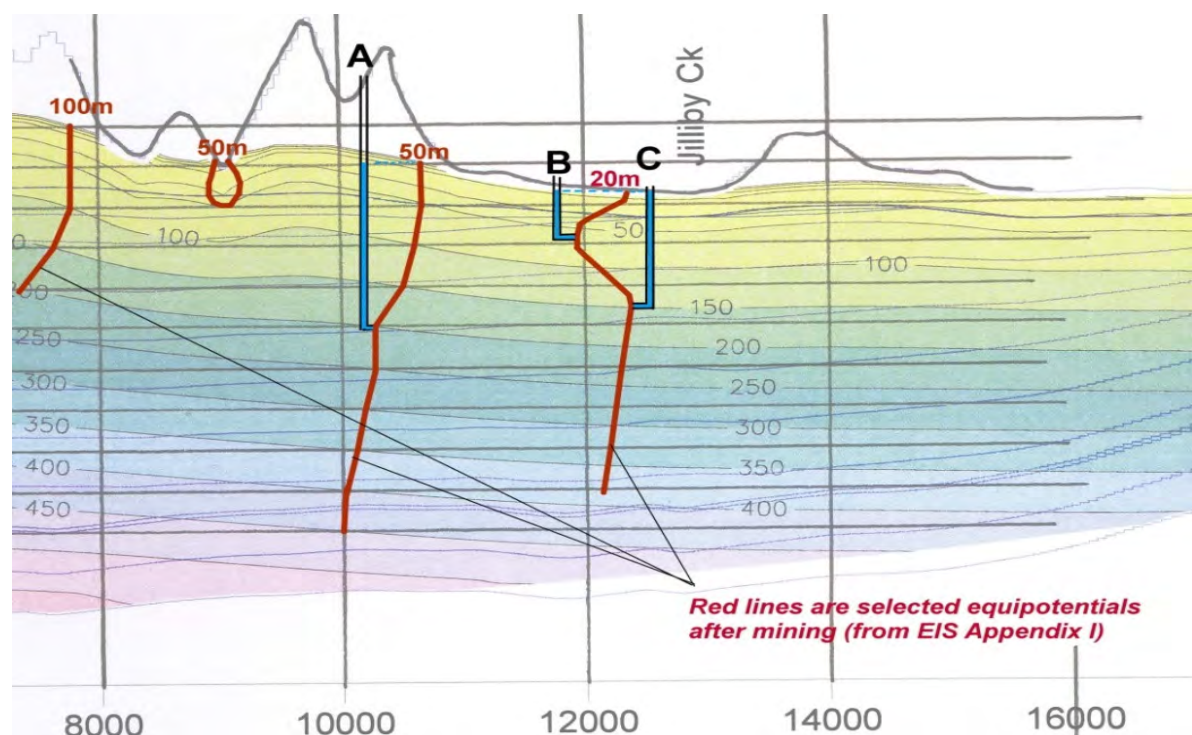


Figure 18: Pre-mining groundwater regime from Figure E17 of Appendix H of the EIS

Figure 19 is the prediction in the EIS of the groundwater regime at completion of mining. Again, selected equipotential lines and the three imaginary wells are annotated onto the figure. The water levels in these wells predicted at the end of mining are again shown by the blue columns. The drop in level for each well is shown by the orange column and as written on the figure. It can be seen that:

- the water level in Well A drops 48m;
- the water level in Well C drops 100m; and
- the water level in the mid-range, 70m deep, Well B drops 12m.

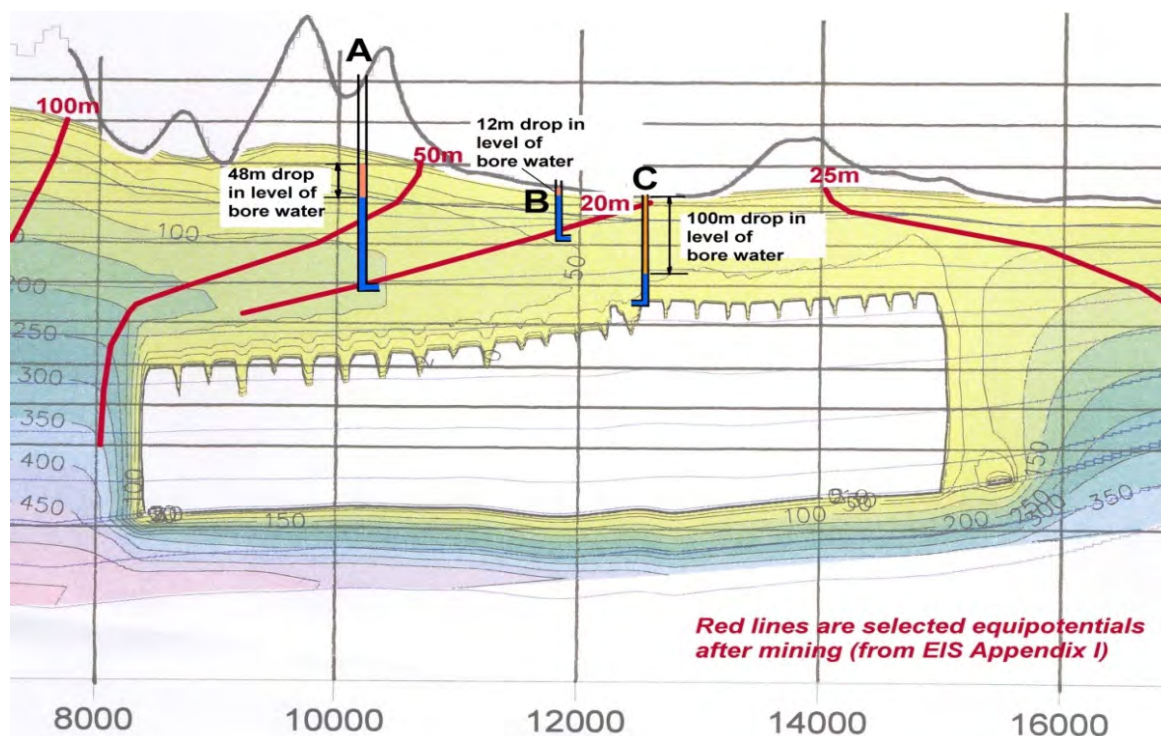


Figure 19: Prediction in the EIS of the groundwater regime at completion of mining

Water level drops in the wells annotated above are substantial and indicate significant changes to the groundwater regime. These pressure drops within the rock must reflect in pressure decreases within the shallow alluvium within the Dooralong Valley, and these decreases, in turn, cause the decrease in base flows to Jilliby Jilliby Creek that are discussed earlier.

It is therefore clear from the modelling results presented in the EIS that there will be very substantial changes to the groundwater regime above the area of the proposed mine.

8.4. Comments on the Groundwater Modelling in the EIS

8.4.1. The Accuracy of Groundwater Models

The validity of any hydrogeological model, notwithstanding its extent, sophistication and cost, depends entirely on:

1. The accuracy of the permeability and storativity parameters for the ground strata.
2. The boundary conditions, including recharge from the surface and around the perimeter of the model.
3. Whether the model properly simulates three dimensional behaviour.

Numerical models always contain a significant degree of uncertainty because of uncertainties in respect of items 1 and 2 listed above, and inherent limitations of the methods of analysis within item 3 above.

In the case of the model run by MER for the W2CP (Appendix H) project, the findings are almost completely dictated by two input parameters, namely:

- (a) the assumed permeabilities for the natural strata prior to mine extraction, and in the Confined Zone that is deemed not affected by mining, and
- (b) the thickness of the two zones whose permeabilities are increased by mining, namely, the zone directly above extraction (220m assumed by MER) and the Surface Zone (Forster 1995 Figure 1) where there is increased vertical permeability².

These facets are discussed in further detail below. However, given the dependence on these key parameters the groundwater model for Wallarah 2 should have been run for a range of assumptions for the assumed permeabilities (point (a) above) and extent of fracturing above the longwall (point (b) above), thereby giving ranges of:

- mine inflows,
- change of flow directions above the area of mining,
- downward loss of water from the alluvium of Dooralong Valley,
- probable drops in bore levels within Dooralong Valley, and
- decrease in base flow to Jilliby Jilliby Creek.

However, only one set of figures covering the all of the factors above has been given in the EIS. This prevents an understanding of the probabilities of the mine impacts on groundwater and stream flows.

² This zone has been studied in some detail in the Southern Coalfields and was the cause for loss of water in the Cataract River and the Woronora Rivulet.

8.4.2. Specific matters in respect to the groundwater model

There have not been substantial changes to the assumptions that were adopted by MER in their work presented in the original EIS (2010), compared with those presented in Appendix H of the EIS (September 2012). This is confirmed by a statement in paragraph E4 of Appendix H, namely,

“The 2012 model is identified as model W3. This model is very similar to the previously reported model W1 (MER, 2010).”

The only significant change in respect to assumed permeability values (hydraulic conductivity) is a change for “the Terrigal Formation in hilly terrain”.

The following issues represent the uncertainties in the parameters adopted in the model. There are always such uncertainties and it is for this reason that a range of assumptions should have been presented in the EIS to allow proper evaluation of the risks to groundwater and surface waters.

8.4.2.1. Permeability (hydraulic conductivity) assumptions

Firstly, the hydraulic conductivity, or permeability is a measure of how quickly water will flow through a medium, in this case the distance water will flow through the rock in a given time (e.g. meters per second or meters per day). To assess this, MER took samples of solid rock from the exploration bores for the W2CP and considered how fast the water could flow through the rock itself.

In adopting these permeability values, MER makes the assumption that there are no fractures such as joints in the rocks of the Narrabeen Formation below the weathered near surface environment through which water may flow. .

The concept that groundwater flow through rock masses is normally dominated by fracture flow, and not substance (core) flow, is so well established in the civil engineering, building construction tunnelling and mining professions that it does not warrant any testimony. Consequently, MER to a large degree, have based their selection of rock permeabilities on laboratory tests on small (50mm diameter) intact core samples. All field permeability testing that has been done for dams, tunnels, basement excavations and coal mines in the Sydney Basin over the past 80 years was unnecessary if core permeability was the relevant measure.

The vast experience of groundwater flow in rock, down to depths of at least 500 m, demonstrates that it is fracture permeability that matters and not core permeability. There are many references to support this contention with many being cited in the following recent publication:

A method of estimating bulk potential permeability in fractured-rock aquifers using field-derived fracture data and type curves, Mandala, Mabey, Boutt and Cooke, Hydrogeology Journal, Volume 21, Number 2, March 2013.

The MER assumption as to the absence of fractures within the bulk of the Narrabeen sequence is also in contradiction to findings of a paper by Cook (2009):

“The bores intersected Terrigal Formation with a preserved thickness of up to 145m in the LGA. Extensive geological and geophysical bore logging delineated aquifers and enabled stratigraphic correlation within and between borefield..... Aggregate yields greater than 15 L/s were recorded from multi-layered aquifers in several bores.

Networks of nested multi-level hardrock and alluvial monitoring bores installed in the borefields revealed direct and indirect hydraulic connection between multi-layered hardrock aquifers with varying degrees of artificially induced vertical leakage from the overlying valley-fill systems during pumping.”

The permeability values adopted for the Wallarah 2 model are given in Table 5 (taken from Appendix G of the EIS).

**TABLE 5
NARRABEEN FORMATION (PRE-MINING) PERMEABILITY (HYDRAULIC CONDUCTIVITY) VALUES ADOPTED BY MER FOR THE WALLARAH 2 MODFLOW MODEL**

| UNIT | HORIZONTAL | | VERTICAL | |
|-----------------------|----------------------|-----------------------|----------------------|-----------------------|
| | m/day | m/sec | m/day | m/sec |
| Terrigal Formation | 2.1×10^{-5} | 2.4×10^{-10} | 3.6×10^{-6} | 4.2×10^{-11} |
| Patonga Claystone | 1.8×10^{-5} | 2.0×10^{-10} | 3.8×10^{-6} | 4.3×10^{-11} |
| Tuggerah Formation | 3.1×10^{-5} | 3.5×10^{-10} | 1.5×10^{-6} | 1.7×10^{-11} |
| Munmorah Conglomerate | 3.4×10^{-5} | 3.9×10^{-10} | 2.3×10^{-6} | 2.6×10^{-11} |
| Dooralong Shale | 2.0×10^{-5} | 2.3×10^{-10} | 2.7×10^{-6} | 3.1×10^{-11} |
| LOG MEAN | | 2.7×10^{-10} | | 3.0×10^{-11} |

Now, if we compare an analysis of the field measurements from Coffey Partners International for the Wyong area and the Pacific Power at Dooralong with the MER work for the Ulan Mine the following log mean values for the Narrabeen Formation are found.

| | |
|------------------------------|-----------------------------|
| Wyong and Dooralong (Coffey) | 3.37×10^{-9} m/sec |
| Ulan (MER) | 4.69×10^{-7} m/sec |

It can be seen from the above data that on average the vertical permeability values adopted by MER for the Wallarah 2 model are 100 times lower than values suggested by the Coffey field testing.

The values adopted by MER apply to ground that has not been disturbed by subsidence effects and are used by MER in the so-called Constrained Zone that is considered to exist from 220m above the extraction level to the weathered portion of the Narrabeen Formation. Therefore, in essence, MER assumes that there will remain a 150m to 300m thick layer of rock with a very low vertical permeability even after mining is completed.

The input of permeability values and assumption on the constrained zone dictate the findings of the model.

This assumption that there will be a Constrained Zone of unaffected permeability more than 220m above the level of extraction is not supported by experience within the Southern Coalfields and at Ulan. However, the EIS has placed a reliance on the behaviour of the Southern Coalfield to provide a model of subsidence at W2CP. The experience and calculated impact of subsidence on permeability presented in the EIS is discussed further in Section 8.4.2.2 below.

8.4.2.2. Contradictions within the EIS

The assumptions regarding permeability in the MER 3D model are contradicted by calculations given in the MSEC/SCT report in Appendix F to the EIS. The calculations show some disruption of the strata throughout the 350m profile above the level of extraction.

Furthermore, Figures 2.28, 2.34 and 2.48 of Appendix F give the post-mining vertical permeability profiles for:

- the Hue Hue 4 mining thickness case,
- the 'valley' case, and
- the 'forest' case.

These permeability profiles are very different from those adopted in the MER model, upon which groundwater impacts are assessed.

To demonstrate the large differences between what the EIS states as being appropriate permeability ranges, and what has actually been used in the EIS to assess impacts on the groundwater regime, we have plotted, in Figure 20, the parameters used by MER (3D model) against the 'valley' case permeability ranges given in Appendix F.

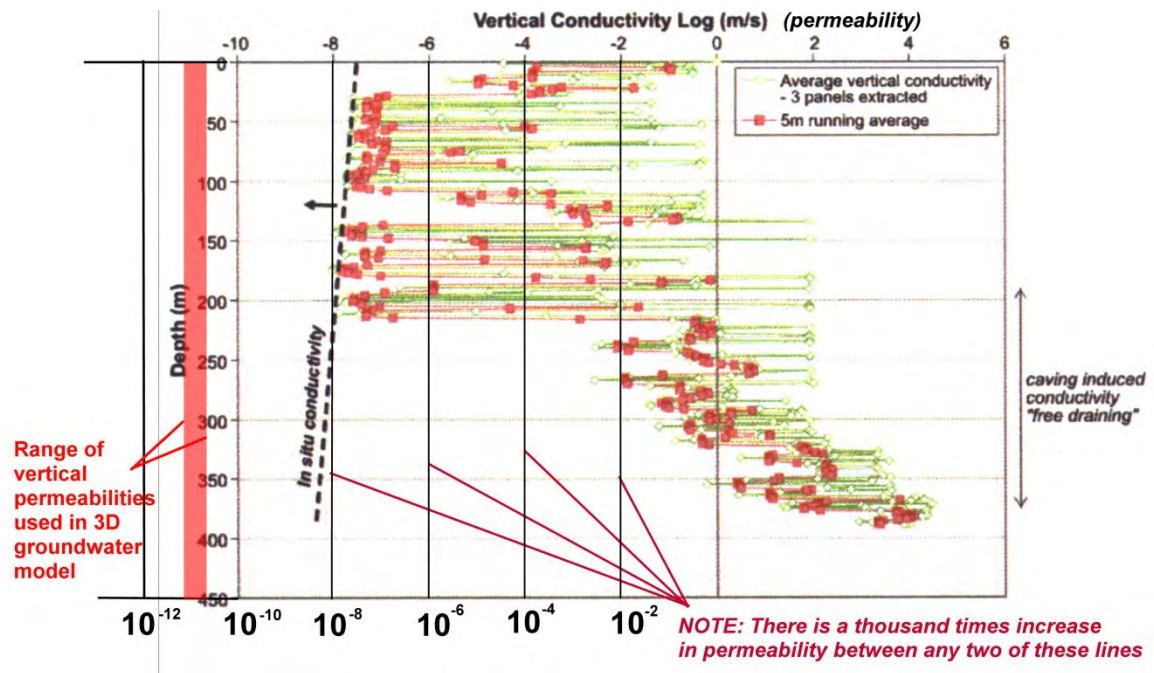


Figure 20 Vertical Permeability values from Appendix F of the EIS versus values used in groundwater impact assessment in Appendix G (After Figure 2.35 Valley Case)

Figure 20 indicates that the hydraulic conductivity values adopted in the MER W2CP model are substantially on the low side of any realistic range of possibilities which have been identified within the EIS itself. If the values provided in Figure 20 were adopted the computed mine inflows, and the rate at which depressurisation progresses through the strata would be substantially higher.

Indirectly MER appear to agree with this assessment. Figure E27a from Appendix I repeated below as Figure 21, shows a distribution plot of vertical (k_v) and horizontal (k_h) conductivity for the Constrained Zone from a synthetically generated randomised distribution.

Interpretation of the data presented in Figure 21 shows that at about 50% of the realisations of vertical permeability have a value equal to, or less permeable than those modelled by MER (about 10^{-11} m/sec or 10^{-6} m/day). However, this indicates that 50% of the potential realisations of permeability are more permeable than those modelled. While it must be acknowledged that the plot below is a probabilistic one, it does show another view that permeability could be higher. The order of increased permeability values shown are:

- 20% of values have a value of k_v up to 10 times greater than those modelled
- 15% of values have a value of k_v up to 100 times greater than those modelled
- 10% of values have a value of k_v up to 1000 times greater than those modelled

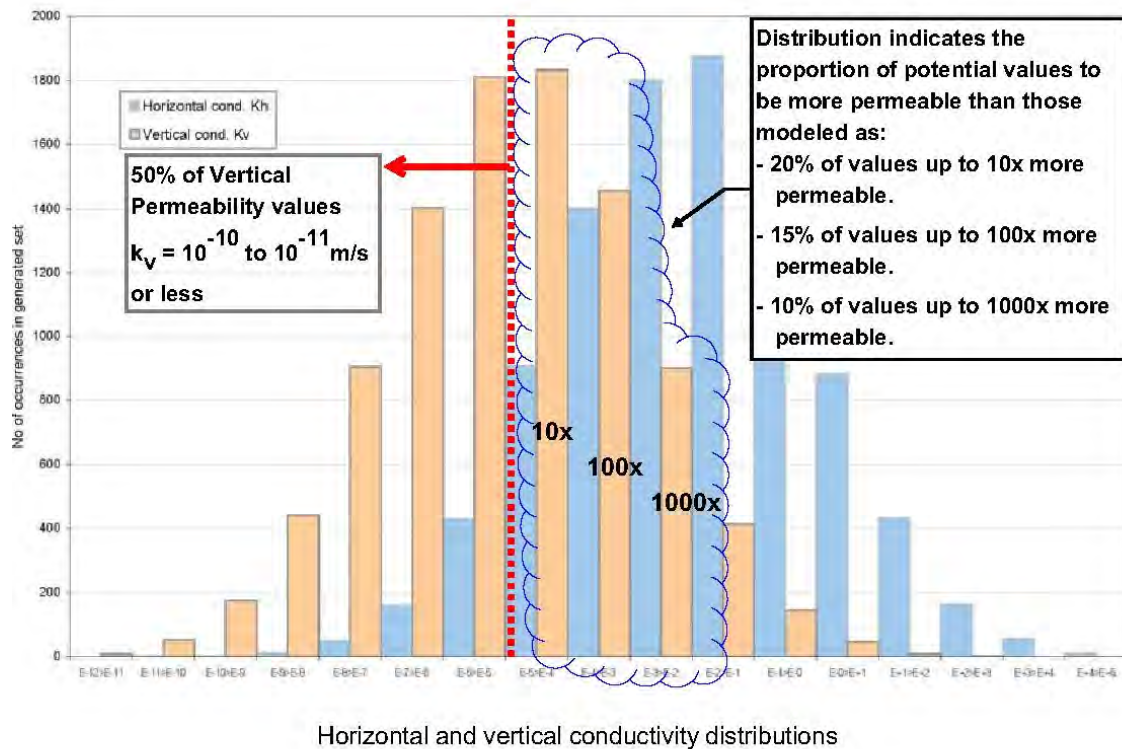


Figure E27a

Figure 21 Distribution of synthetically generated permeability values in the constrained zone by MER – Figure 27a in Appendix H of the EIS

Figure 22 summarises the progression of depressurisation through the strata from the MER model, a process still continuing after 38 years. If MER had adopted the parameters recommended in the previous chapter in same EIS then depressurisation would have been calculated as occurring much faster and to a much greater extent.

Therefore, the flow quantities and extents of depressurisation discussed in Section 8.2, above, must be viewed in the context that they are non-conservative in respect to impacts on groundwater and surface waters. Therefore, the significant impacts actually shown by the MER model, as outlined in Section 8.2, could readily be more adverse, and at the very least warrant assessment with regard to sensitivity and risk.

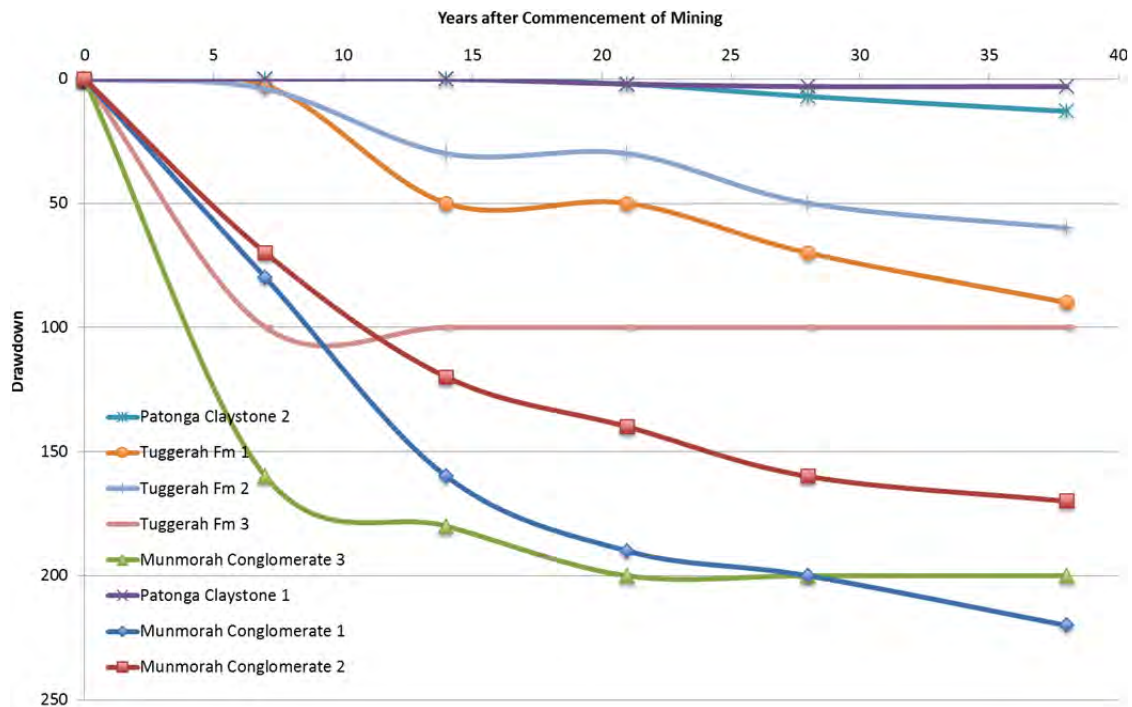


Figure 22 Depressurisation curves extracted from the plots of the MER W2CP model given in Appendix G of the EIS

8.4.2.3. Sampling Methodology

One aspect of the project that has an impact on specialist studies pertains to the makeup of the rock mass that lies between the shallow, alluvial water table and the proposed mine. Studies such as the groundwater modelling rely on the interpretation that the presence of the Patonga Claystone below the alluvium “prevents” water loss from the alluvial layers and the creeks. This is based on the view that no vertical connection occurs to the deeper and apparently more fractured materials in the Tuggerah Formation, the Munmorah Conglomerate and the Dooralong Shale.

The first point to note is that the fracture system in the sedimentary rocks in the Sydney Basin is dominated by sub-horizontal bedding planes and a network of sub-vertical joints. The absence of vertical joints as stated in the EIS is likely to be more of a reflection on the exploration drilling program which exclusively used vertical boreholes, which, by their geometry, are unlikely to intersect such features. Indeed, Mackie notes that:

There is potential for groundwater exchange between strata via fractures and micro cracks which introduce secondary permeability if they are connected. However it is extremely difficult to establish the occurrence, frequency and connectivity of these fractures since they are mostly vertical or sub vertical and consequently are less likely to be intersected by exploration boreholes than fractures that occur at shallow angles.

While we agree that direct connection between the surface alluvial aquifer and the mine is likely to be '*rare*' (in terms of the risk assessment rating in Table 1B), the potential for water to travel via a '*tortuous*' path of vertical joints and bedding planes, albeit ones that are often tight and/or infilled with materials like sand, silt and clay, the likelihood that the tortuous path is present cannot be discounted based on the factual geological information provided and the sampling method of vertical boreholes.

We note that it is not typical for a deep coal mine to undertake a programme of angled cored boreholes, particularly in the initial investigation stages due to the prime interest being at depth with regard to coal quality and stability of the longwalls and main headings. While we understand that W2CP have an extensive database of information on fractures over the project area, the EIS does not indicate how this relates to the near surface rock formations, and in particular the assumed aquatard characteristics of the Patonga Claystone strata.

This oversight goes to the heart of the concern raised by the Director General of Planning about uncertainty and recommendations are made at the Conclusion of this report with this in mind.

8.4.2.4. Sensitivity Checks – Model W4

A single model, W4 has been run by MER to consider sensitivity with regard to permeability. However, inspection of the "scaling" used by MER with regard to vertical and horizontal permeability values, particularly in relation to the layers that actually matter in regard to near surface impacts (Table E3 or Appendix H) again do not appear to reflect the subsidence modelling (SCT 1999 & 2011 as referred to by MER). The factors used to scale the permeability values in the MER "sensitivity model – W4" are repeated in Table 6.

A key parameter in our discussion on groundwater above is the vertical permeability of the Patonga Claystone. Table 6 shows that the sensitivity of this parameter has not been tested.

TABLE 6
PERMEABILITY SCALING FACTORS – MER SENSITIVITY MODEL W4

| LITHOLOGY | SCALING FACTOR USED BY MER | |
|-----------------------|-------------------------------------|---------------------------------------|
| | VERTICAL PERMEABILITY (x K_v) | HORIZONTAL PERMEABILITY (x K_h) |
| Terrigal Formation | 1 | 1 |
| Patonga Claystone | 1 | 10 & 20 |
| Tuggerah Formation | 1.1, 2 & 10 | 60, 100 & 600 |
| Munmorah Conglomerate | 100 & 1000 | 1000 & 6000 |
| Dooralong Shale | 90000 | 148000 |

8.4.2.5. Absence of critical parameters

MER has properly used the version of MODFLOW that addresses the impact of desaturation in the strata on reducing permeability values. This reduction in permeability has a very important impact on the computed mine inflows and the rate of depressurisation.

There is no information in the EIS, and in particular in Appendix G, that sets out what assumptions have been made in the model in respect to permeability reduction in the desaturated zone in the goaf. Therefore, it is impossible for a measured review to be made of the model results.

In addition to presenting the material parameter assumptions, it would have been proper for the assumptions to be validated against field data from Mandalong Colliery, where there has been substantial depressurisation above the extracted longwalls, viz:

Mining of the longwall panels has however resulted in depressurization of the deeper overburden.

Whereas at some depths this may be a temporary depressurization due to bedding parting, at deeper levels the bedrock has probably been permanently depressurized/dewatered when mining intersected a fault and/or goafing provided hydraulic connection with the mine. The alluvium and shallow overburden has however not been impacted with the exception of site BH22, as stated.

The data also indicates that the Great Northern Seam to the south of the Mandalong Mine may have been depressurized as a result of mining in the area, but that the deeper Fassifern Seam has not been impacted.

*End of Panel Report
Longwall 12
Mandalong Mine
August 2012*

8.5. Borefields

Borefields have been developed for use by the W2CP as a drought contingency measure and we understand there is only limited data on the historical operation and medium to long term yields of these resources.

Borefields are located at:

- Woy Woy
- Somersby
- Mangrove Creek
- Ourimbah
- Mardi.

The yield from these borefields is reported as being:

- Woy Woy - 3.8ML/day
- Ourimbah (Narara) - 1.2ML/day
- Other (remaining) - 3.0ML/day

Notwithstanding the relatively small volume of water reported above, we consider that only the Mardi groundwater bores have any potential to be impacted by the W2CP as they are within about 3km of the southern extent of the mine. The remaining fields are considered too distant to be affected (>6km).

With regard to the Mardi borefield, it actually only comprises one functioning bore, BH15 located at the Mardi Water Treatment Plant site. A second bore, BH16 at Mardi Dam (near Woodbury Park) is understood to no longer be operational. Bore BH15 is understood to extend to a depth of 150m, which is expected to locate the base of the bore in rocks of the Tuggerah Formation, or possibly in the top of the Munmorah Conglomerate. The WGN seam is at about -400mRL to -450mRL in this area (Figure 5 Appendix I) indicating a depth of about 450m to 500m.

Based on predicted piezometric drawdown levels in the EIS (Figures E23 and E26, Appendix I), the location of bore BH15 will not be affected during the period of mine operations. However, some drawdown of up to 5m may occur, based on the EIS after a long period of time (modelling was based on 500 years after mining).

CCWC would need to assess this prediction with regard to the known operation of the bore.

8.6. Findings

The conclusions reached by MER are primarily the result of the input parameters adopted for their numerical modelling. These input parameters are neither consistent with available data from field testing nor the subsidence calibration modelling and do not consider the impact of extended periods of drought conditions on the surface recharge assumed in the modelling. The level of uncertainty is considered to be high and without sufficient sensitivity assessment of the impacts of inputs to the model.

On this basis, the findings from the MER study should be considered as a limited and very likely, unconservative view of potential impacts. This means that, at present, it is not known with an acceptable level confidence what the impacts of the Wallarah 2 longwalls will be on likely groundwater resources, and on groundwater that feeds into the streams of the Dooralong and Yarramalong Valleys.

9. FLOODING

9.1. Introduction

The assessment of flooding impacts of the W2CP is based on material presented in Appendix K by G Herman and Associates (Herman), although this work relies upon information provided in other Appendices in the EIS, viz:

- Appendix G: Subsidence Modelling
- Appendix J: Surface Water Impact Assessment.

As described in Reference 2, the Yarramalong and Dooralong Valleys are well defined and comprise steep valley sides with flat floodplains. As a result, increases in flood levels cause relatively small increases in the overall extent of floods.

The previous EA included assessment of the affect the W2CP on the extent and depth of flood events was undertaken by Environmental Resources Management (ERM) and was included as Appendix C to the 2010 EA. The new assessment presented in the EIS states that the previous flooding assessments were *“fundamental in the development of the current final mine plan assessed in this report”*.

However, the flood study by Herman utilised more advanced methods of assessment utilising the TUFLOW software package to allow 2D modelling as compared to the 1D/pseudo 2D modelling undertaken in the earlier studies. This was in line with suggestions from the review panel in 2009.

Herman only assesses flooding for design storms with a 1% and 20% Annual Exceedance Probability (AEP). A 1% AEP implies there is a 1% chance that the design flood will occur, or on average the design flood can be expected to occur once every 100 years.

The 1% AEP flood maps are included in Annex I to Appendix K and are included in the following sections.

The flood maps for the 20% AEP assessment are not present within the EIS document, this being the design flood which is expected, on average to occur every five years.

9.2. Study and Modelling

The study area for the flood assessment includes the areas immediately below the W2CP in the Yarramalong and Dooralong Valleys and in the Hue Hue Creek area and obviously considers flooding due to rainfall across the full catchment areas upstream of the proposed mine. The extent of the study area is shown in Figure 23 and comprises:

- Wyong River upstream of the F3 for a distance of 25.9km.
- Jilliby Jilliby Creek upstream of its confluence with Wyong River for a distance of 20.05km.
- Little Jilliby Jilliby Creek.
- Hue Hue Creek upstream of the F3 for a distance of 5.48km.

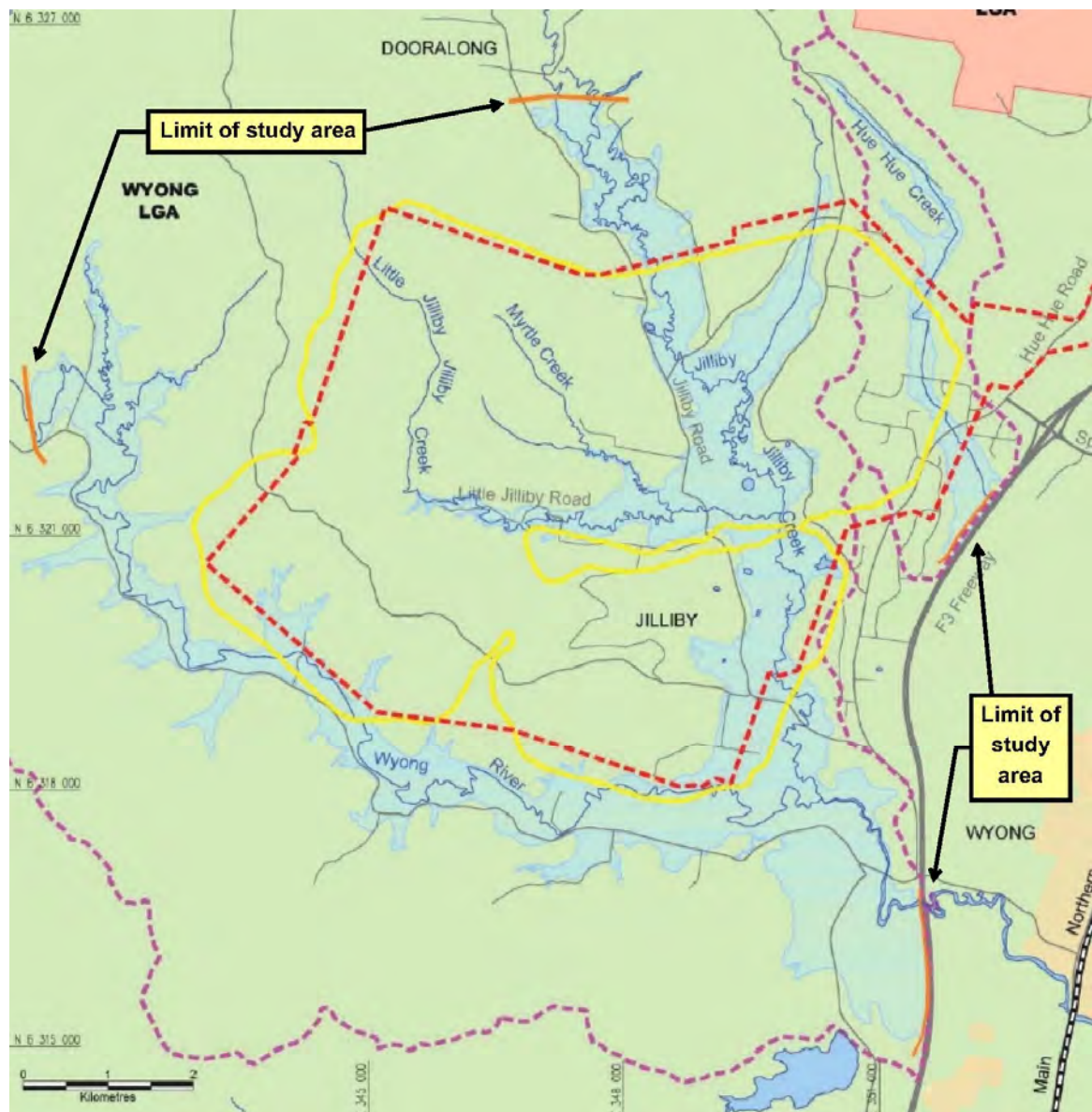


Figure 23: Study Area

As indicated above, the 2D TUFLOW software is able to model secondary flow effects which often occur at stream confluences or the influence of tidal or backwater flows due to high water levels downstream of the study area, such as may occur due to climate change effects. The programme is also able to model the transition between supercritical and subcritical flows. This ability is considered important with subsidence quite possibly producing conditions (i.e. a sharp increase in elevation) that could cause a change in the flow regime. However, it should be noted that TUFLOW cannot model hydraulic jumps.

A further advantage of the TUFLOW model is that it is far more flexible than the modelling software utilised earlier and can be re-calibrated either during the initial work or later such as over the lifetime of the mine if different impacts of flooding are observed to those found from modelling.

A summary of the work conducted in the flood impact assessment is presented below:

- A TUFLOW model was developed to simulate the pre and post mining subsidence flood differences for a 1% AEP flood.
- The assessment considered points of stream construction such as bridges and undertook a process of calibration to ensure the pre mining modelling reflected historical and community records of past flooding.
- Assessed the extent of flooding and level differences due to the project.
- Allowed recommendations on dwellings, access roads and flood hazard risk impacts due to the flooding differences caused by the W2CP.
- Assessed the sensitivity of the results to reasonable changes in the input parameters, in particular Manning roughness coefficients, and due to climate change effects by:
 - Increased storm input to the model by 20% to simulate increased wet periods in the future, and
 - Application of a high tailwater level of 1.1m at the F3 boundary to simulate high lake and/or river water levels.

Further to the above, the following points are noted.

- Sensitivity checks for climate change are described by Herman as simplistic and very conservative. The approach is not considered current best practice (for example a different method will be applied in the upcoming Australian Rainfall and Runoff (AR&R) update). However, the approach is very closely modelled on the NSW legislation requirements, which are conservative. Whilst the modelled climate change results are expected to 'over-engineer' the result there are no adverse effects except possibly higher costs to the project if any pre-emptive works are dictated such as bridge or road access points.
- In general, the model has a low sensitivity to antecedent conditions and downstream boundary condition tail water level and a slightly higher sensitivity to Mannings n and the degree of subsidence.
- Changes to material properties (e.g. Mannings 'n') resulted in slightly reduced peak flows, but increased the peak flood levels by up to 0.15m.

- Changes in the downstream boundary condition tail water level caused virtually no flooding differences beyond 600m upstream of the downstream boundary condition.
- Calibration of the model has been done using the historical stream flow results from within the catchments. However, due to the limited stream flow data in the catchments the model may not be calibrated properly for floods < 2%AEP, due to the absence of records with an AEP less than 0.02. The calibration process was to calibrate the initial/continuing losses, calibrate Mannings 'n' and then recalibrate the initial/continuing losses.
- The DTM's (Digital Terrain Models) used as for input to TUFLOW are from 1996 or more recently. The calibration floods are all from prior to 1996. It is possible with the creek/river being subject to dynamic geomorphological changes (see Appendix J to the EIS) that the DTM in the model used could be different in the stream/creek locations for the calibration years, which would be more critical if there was significant curvature/alignment differences between the calibration years and post 1996.
- Whilst it seems logical to select maximum parameters from the AR&R for the IFD calculations as a conservative assumption, this may not be the case, as discussed below.
 - The BOM online service has been used to provide an IFD curve for the project location. When compared with results from Annex B there are up to 10mm/h differences in the 100yr ARI results. The differences are maximum at shorter durations and a minimum at a 72hr duration (0.08mm/h), with, as expected, the results in Annex B always the greater of the two.
 - The 30hr and 12hour durations give the critical floods for the Dooralong/Yarralong and Hue Hue models respectively.
 - The calibration cannot be confirmed for storms with an ARI greater than 50yrs due to the available historic stream flow data.
 - The Mannings 'n' values considered had to be increased over the whole catchment in the calibration process. It is possible that this could be a result of 'overestimating' the input rainfall, which would cause the roughness to have to be increased in calibration to give the calibration results. This when combined with the fact that all calibration is done on <50yr ARI storms and that modelling is done for 100yr ARI storms means that the overall catchment roughness may be overestimated (as a portion of the flood plain covered in an 100yr ARI flood is unlikely to have been covered in the <50yr ARI calibration storms), which would attenuate and translate the peak of the hydrograph (potentially underestimating the peak).

Overall, the calibration is considered acceptable and likely to be relatively insensitive to the technical points made above.

Aspects considered beyond the scope for the work presented in Appendix K are:

- Fluvial geomorphology
- Low flow hydrology and river hydraulics
- Sediment transport and deposition.

9.3. Impact of Mining on Flooding

9.3.1. Overview

Results of the flood modelling for the 1% AEP flood event indicate that subsidence from the current W2CP mine plan is likely to result in only minor increases in the depth and extent of flooding compared to current, pre-mining estimates.

A summary of the changes in flood extents and depths as a result of mining subsidence is presented in Tables 8 and 9 below. The reader will also note the introduction of the Flood Impact Category rating in Table 7. A description of what each Impact Category comprises is included in Table 9.

Further to the dwellings described in Table 8, a total of 14 dwellings have no significant change in flood impacts while a total of 49 properties will see a reduction in flood impacts. Most falls in flood level are predicted to be negligible (less than 50 mm fall in flood level). We note that dwelling (D0226) listed as Flood Impact Category E1 is incorrectly assessed, it should be Category E2 based on the values presented in Table 6.2 of Appendix K of the EIS.

Other impacts of the subsidence on flooding such as flood peak flows are anticipated to be slightly reduced with a minor increase in the duration of the peak, although the EIS notes these as being insignificant.

Further, key access roads and some bridges within the Dooralong and Hue Hue valleys will become inaccessible for longer periods as a result of the subsidence.

The reader should note that changes noted are in relation to the 1% AEP event and that the impacts described would only fully come into effect after mining has been completed. Also note that there are minor discrepancies in Appendix K where slightly higher impacts are reported in the executive summary compared to the main body of the report.

TABLE 7
CHANGES TO EXTENT OF FLOODING

| AREA | AREA OF ADDITIONAL FLOODING IMPACTS | AREA NO LONGER AFFECTED BY FLOODING |
|--------------------|--|--|
| Yarramalong Valley | 5.2 Ha | Nil |
| Dooralong Valley | 28.3 Ha | 5 Ha |
| Hue Hue Creek | 1.9 Ha | 0.8 Ha |
| Total Areas | 35.4 Ha | 5.8 Ha |

The changes to flooding extents will have an adverse effect on up to 10 properties. The impact is assessed to be up to 5% of additional land area inundated (4 Properties) and up to 20% of additional land area for the remaining 6 properties.

TABLE 8
ADVERSE IMPACTS TO DWELLINGS

| DETAIL (IMPACT CATEGORY) | CHANGES TO FLOOD IMPACT | |
|--|---|-------------------------------|
| | YARRAMALONG & DOORALONG VALLEYS | HUE HUE CREEK |
| Dwellings not currently affected by flooding become flood prone ^A (MAJOR – A1) | 4 in Total 3 between 4 & 14cm 1 up to 1.27m | 1, up to 7cm |
| Increased Inundation ^A (MAJOR – A2) | 1, up to 41cm | None |
| Increased Inundation ^A (MODERATE – B1 & B2) | 7 in Total Increase flood levels by between 6 & 17cm | 1, up to 3cm |
| Reduced Freeboard ^B (MODERATE – B3) | 2 in Total Freeboard Levels of between 26 & 28cm | 1, Freeboard remaining of 4cm |
| Increased Inundation ^A (MINOR – C2) | 4 in Total Increase flood levels by between 1 & 4cm | None |
| Reduced Freeboard ^B (MINOR – C1 & C3) | 6 in Total Freeboard Levels of between 8 & 48cm | None |
| ^A Flooding depth above floorboard level. | | |
| ^B Remaining amount of freeboard between predicted flood level and floorboard level. | | |

9.3.2. Flood Maps, Dwellings and Property Impacts

A detailed description of the flood study findings can be found in Sections 6.4 to 6.6 of Appendix K. The results are presented in two formats, namely flood maps and tabular format indicating the following:

- Detail on flood levels and freeboard associated with each dwelling for the 1% AEP and 20% AEP are presented in Tables 6.1, 6.2 and 6.3 of Appendix K, although no key is provided as to street addresses associated with the Dwelling ID's.
- Tables 6.4 and 6.5 present a summary of the Impact Category for the changes in the flood status of Dwellings and properties respectively that are a result of the W2CP.

For this report, we have provided a summary of the information from both the flood maps for the 1% AEP. Figure 24 shows an overview of the increased extent of flood water post mining for a 1% AEP flood. Figures 24 and 25 show a detailed view of the Dooralong and Yarramalong Valleys respectively.

Tables 6.4 and 6.5 in Appendix K have been reproduced here as Tables 10 and 11 respectively. The latter two tables described in the second bullet point above are also included as it is useful in outlining the extent of the change at each dwelling and categorise how the detrimental impacts of flooding due to mine subsidence is likely to be treated by WACJV.

Figure 24: Overview of Increased Extent of Flooding (1% AEP) shaded red and areas of reduced flooding shaded green along the fringes of the Dooralong Valley.

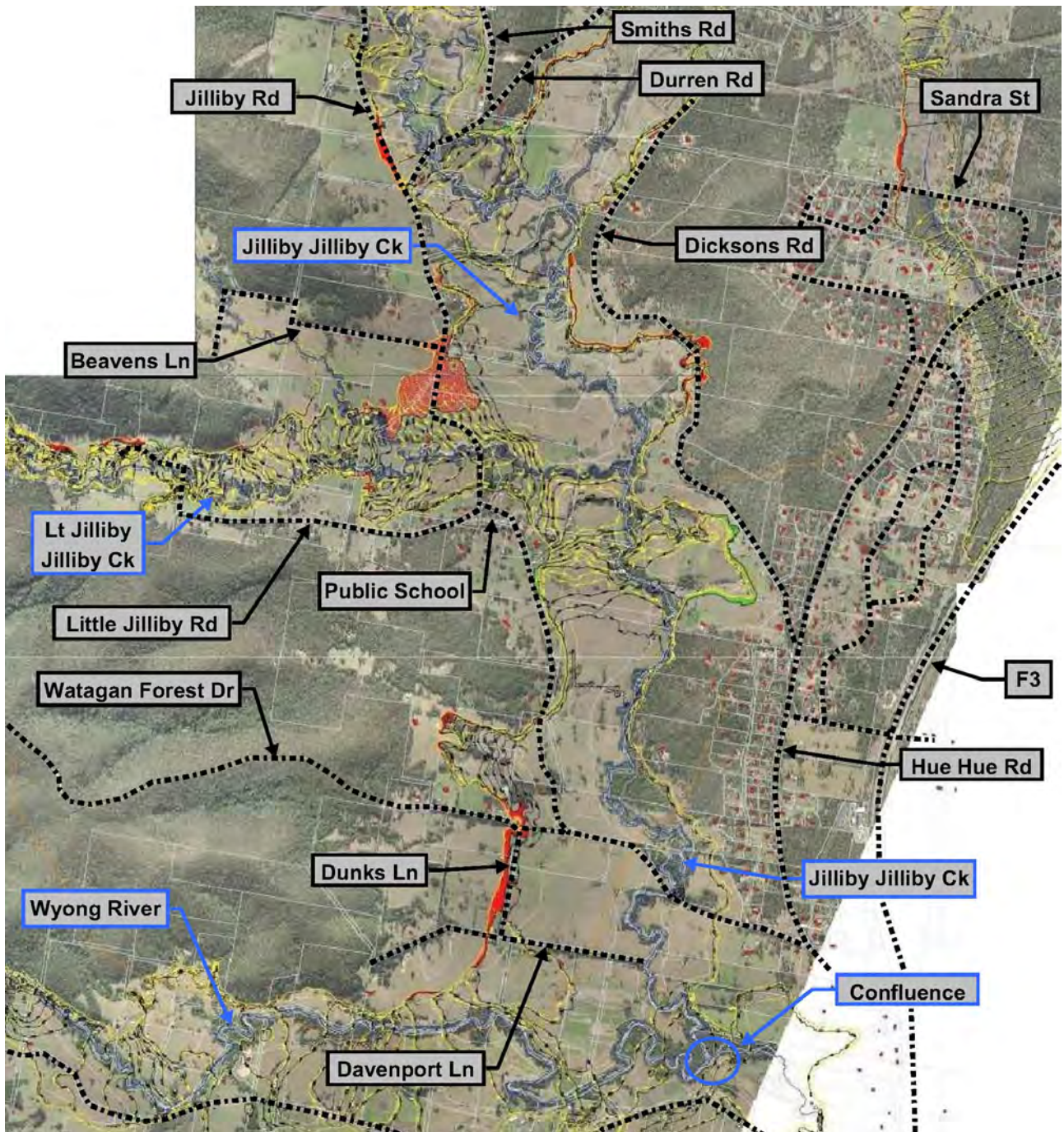


Figure 25: Main Areas of Increased 1% AEP Flooding – Dooralong Valley

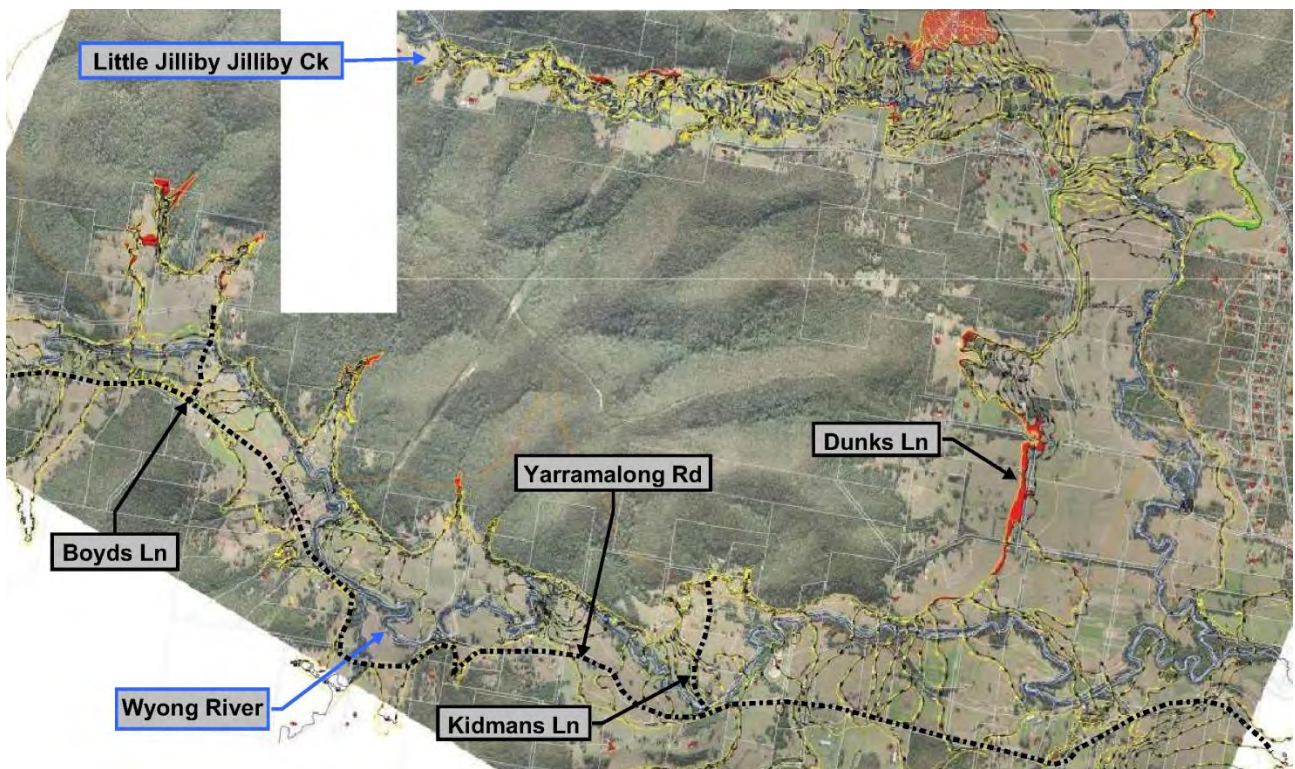


Figure 26: Main areas of increased 1% AEP Flooding – Yarramalong Valley

A minor, but significant point from the aspect of EIS review is that of presentation. It is difficult to interpret with any confidence what the flood levels are on the 1%AEP flood maps included in Annex I to Appendix K nor from the various Figures throughout the text of the EIS. Indeed, the only clearly defined data is that presented in Tables 6.1 to 6.5 of Appendix K with the limitation as to no actual identification of dwelling.

A sample of the current 1% AEP mapping available to Council (from the 2012 Wyong River Flood Catchment Study by BMT WBM) is given as Figure 27 and clearly shows flood levels and depth of flooding.

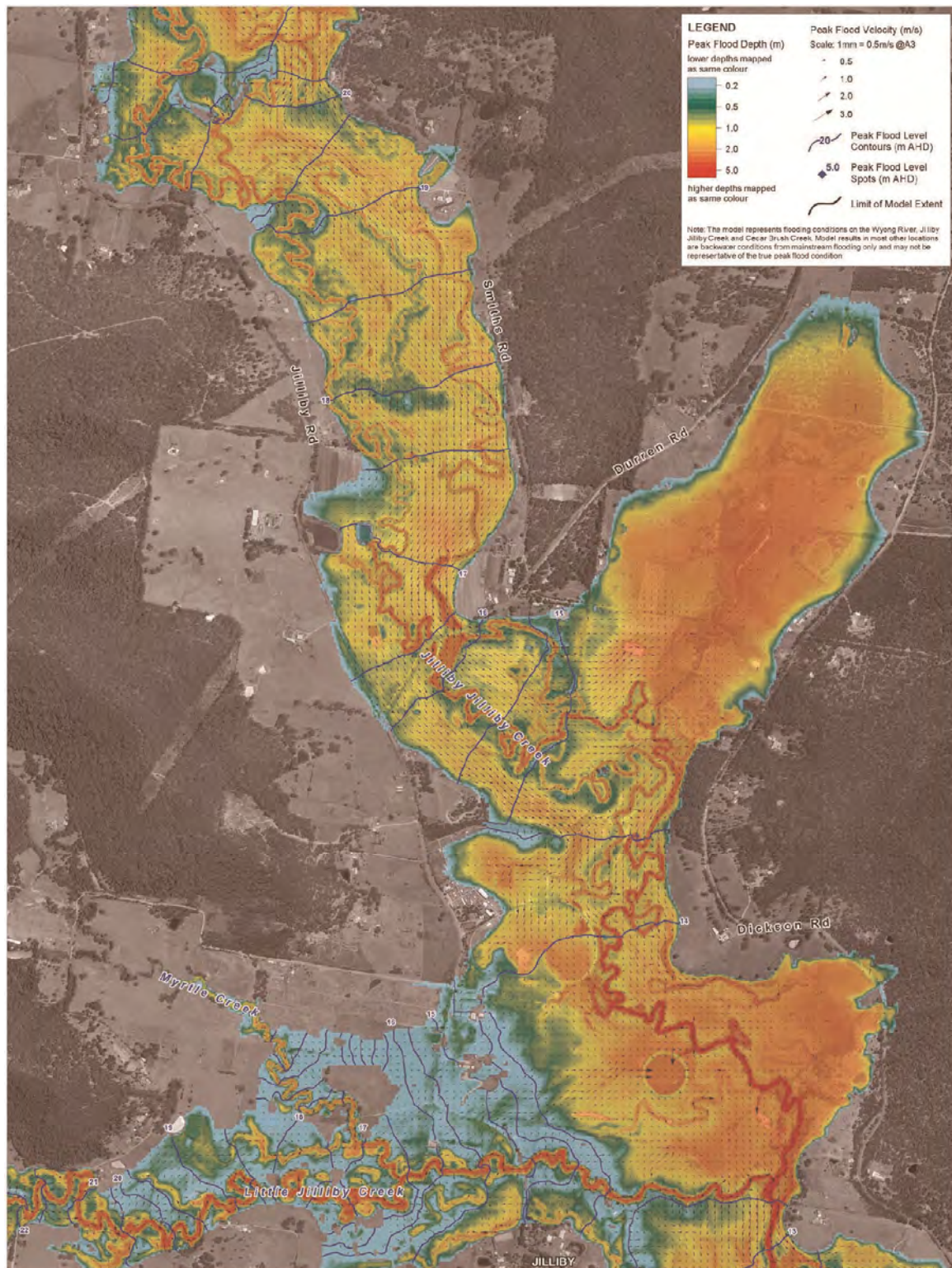


Figure 27: Sample of 1% AEP Mapping for confluence of Jilliby Jilliby and Little Jilliby Jilliby Creeks (2012 Flood Study by BMT WBM).

TABLE 9
FLOOD IMPACT CATEGORIES - DWELLINGS

TABLE 9
FLOOD IMPACT CATEGORIES - DWELLINGS (Continued)

TABLE 9
FLOOD IMPACT CATEGORIES – DWELLINGS (Continued)

| Category | Description | Number Affected | Houses Affected | Impacts |
|----------|---|-----------------|--|--------------------------------------|
| E3 | Negligible (<0.05 m) reduction in flood levels and/or freeboard after mining for all floods | 46 | (see Tables 6.2 & 6.3) | No impacts and no significant change |
| U | Unchanged | | | |
| U | No change in flood depths after mining but minor change in ground levels | 14 | D0006, D0009, D0048, D0106, D0108, D0115, D0170, D0201, D0377, D0384, D0712, D0869, and sheds S0048, S0842 | No impacts |

TABLE 10
FLOOD IMPACT CATEGORIES – PROPERTIES

| Category | Description | Number Affected | Land / Properties Affected | Impacts |
|----------|--|-----------------|---|-----------------------------------|
| L1 | Reduction in Flood Extent of 1:100 yr flood (1%) by more than 5% of individual property area after mining. | 2 | Generally grazing land near property boundary. | Moderate Beneficial Impact. |
| L2 | Reduction in Flood Extent of 1:100 yr flood (1%) by less than 5% of individual property area after mining. | 3 | Generally grazing land near property boundary. | Minor Beneficial Impact. |
| | | | | |
| L3 | Increase in Flood Extent of 1:100 yr flood (1%) by more than 5% but less than 20% of individual property area after mining. | 4 | Mostly grazing land plus some areas of non-agricultural and uncleared land. | Minor to Moderate Adverse Impact. |
| L4 | Increase in Flood Extent of 1:100 yr flood (1%) by more than 20% of individual property area (or other major effect) after mining. | 6 | Agricultural land plus one cattle property. | Moderate to Major Adverse Impact. |

9.3.3. Access and Low points

Low points on access routes were assessed based on the pre and post mining flood levels considering the NSW Floodplain Development manual (2005) for safe depths for vehicles at specified flow velocities.

A total of thirty low points were identified by Herman. Figure 28 indicates the location of key low points on both primary and secondary access routes. Table 11 summarises the details of the key low points on primary access routes.



Figure 28: Low points and flood affected roadways (both primary and secondary access routes)

TABLE 11
KEY LOW POINTS – PRIMARY ACCESS ROUTES

| Key Low Point ID | Maximum Existing Trafficable RL (m AHD) | Maximum Subsided Trafficable RL (m AHD) | Existing Inundation Duration (hours) | | Post-mining Inundation Duration (hours) | | Increase in Inundation Duration (hours) | |
|------------------|---|---|--------------------------------------|---------|---|---------|---|---------|
| | | | 1% AEP | 20% AEP | 1% AEP | 20% AEP | 1% AEP | 20% AEP |
| D20 | 20.0 | 20.0 | 19 | 9 | 19 | 9 | Nil | Nil |
| D30 | 19.3 | 19.3 | 5 | 0 | 5 | 0 | Nil | Nil |
| D40 | 18.35 | 18.35 | 19 | 11 | 19 | 11 | Nil | Nil |
| D41 (Bridge C) | 15.40 | 14.21 | 24 | 24 | 22 | 21 | Nil | Nil |
| D50 | 10.0 | 8.7 | 6 | 0 | 33 | 31 | 27 | 31 |
| D60 (Bridge A) | 7.9 | 7.9 | 24 | 21 | 24 | 22 | Nil | 1 |
| D70 | 12.45 | 11.24 | 15 | 12 | 28 | 25 | 13 | 14 |
| D80 (Bridge B) | 14.9 | 13.7 | 10 | 0 | 15 | 11 | 5 | 11 |
| D81 | 14.7 | 13.4 | 11 | 4 | 17 | 10 | 6 | 6 |
| Y80 | 12.6 | 12.4 | 71 | 68 | 73 | 69 | 2 | 1 |
| Y90 (Bridge 7) | 13.06 | 12.95 | 62 | 54 | 63 | 55 | 1 | 1 |
| Y170 (Bridge 3) | 9.84 | 9.84 | 50 | 50 | 50 | 49 | Nil | Nil |
| Y180 (Bridge 2) | 9.20 | 9.20 | 51 | 50 | 51 | 50 | Nil | Nil |
| Y190 | 9.25 | 9.25 | 33 | 32 | 33 | 32 | Nil | Nil |
| Y230 | 7.85 | 7.85 | 10 | 0 | 10 | 0 | Nil | Nil |

As can be seen from the table above, six locations are expected to be inundated for longer periods as a result of the W2CP subsidence (1% AEP), the increased period over which access will not be possible varies from 1 hour up to a maximum of 27 hours at D50 toward the southern end of Jilliby Road, just north of the intersection with Watagan Forest Drive.

Of the secondary access routes, the maximum reported increase in inundation due to mining is 13 hours at point D70 on Dickson Road.

9.4. Mitigation

9.4.1. Property

As reported above, Herman presents a range of categories against which the impact of flooding induced by mining subsidence may be assessed. Similar to remarks made by ERM in 2009, Herman suggest that it

“would be reasonable to expect that mitigation works will be required for dwellings in Category A (Major Impacts) and Category B (Moderate Impacts). However, dwellings in other categories are unlikely to require mitigation works.”

There are a total of 6 dwellings identified as Category A (2 less than the 2010 assessment) and 11 dwellings as Category B.

Mitigating options are discussed in relation to the management measures outlined in the NSW Floodplain management manual (2005) and comprise works that comprise either:

1. Property modification – either of the property itself such as by raising or flood proofing, new controls on the property and infrastructure such as bunds, or outright purchase.
2. Response modification of the population at risk through measures such as evacuation plans.
3. Flood modification measures such as retarding dams, levees, bypass floodways or channel improvements.

Herman has spent some time considering the options above and has made some preliminary suggestions:

- i. Minor channel improvements can be made to a short reach of Jilliby Creek below the confluence with Little Jilliby Creek but this would be to address localised ponding issue and would have little impact on flood levels,
- ii. Raise Sandra Street to increase the retarding storage upstream. However, the single dwelling immediately upstream at this location would be further impacted but may limit the requirements for purchase / relocation of properties in the Hue Hue precinct.
- iii. Raising or relocating of three timber framed dwellings (ID - D0060 by 0.63m, D0061 by 0.86m & D0237 by 2.02m)
- iv. Possible new construction of dwellings of equivalent or superior size, quality and amenity – this option is suggested for all the dwellings identified in the Flood study as being adversely affected by flood changes due to subsidence.
- v. Construct grassed earthen levee(s) around dwellings to provide a minimum freeboard of 0.3m. Possible dwellings that this method may suit are D0017, D0058, D0737, D0063 and D0430.

Herman notes that with regard to the voluntary purchase of properties, while a viable option, the mechanism and form of compensation is beyond the scope of their report.

Lastly, Herman notes that WACJV is not responsible for any works pertaining to existing impacts of flooding.

9.4.2. Access

The six, primary access route low points adversely affected by subsidence related flooding can be raised after subsidence has occurred to mitigate the adverse effect. In some instances, the works may require new culvert works to facilitate passage of flood waters past the obstacles.

The impact of “raised” roads does not appear to have been considered as a sensitivity scenario for the flooding assessment and would need to be undertaken if any of these works is to be considered.

9.5. Findings

The results of the flood assessment appear reasonable given the limits of the prediction of subsidence and can be considered as “best practice”. However, changes to mine plans can and almost invariably do occur prior to final approval with the associated changes to subsidence. The predicted movement may well be less but could equally be more than currently stated and so the impacts of flooding within the mined areas are also likely to vary.

The discussion on potential flood mitigation measures remain at a feasibility level but are considered appropriate and to constitute “best practice” for this level of appraisal. Detailed assessment will be required if planning approval is given and this must ensure all the Director General’s requirements are met.

Notwithstanding the above an ongoing programme of review of subsidence and its impacts on flooding is essential to ensuring flood impacts are correctly assessed and remedial measures undertaken to mitigate flooding.

10. NORMAL STREAM FLOWS

10.1. General

The impact of mining on stream flows in “normal” conditions has been considered by the W2CP and is reported in Appendix J of the EIS. The assessment was undertaken by WRM Water and Environment (WRM) in 2013.

Assessments are driven by a consideration of subsidence along existing creek alignments for the Wyong River, Jilliby Jilliby Creek and Little Jilliby Jilliby Creek. Figures 29 and 30 present the profile along Jilliby Jilliby Creek and Little Jilliby Jilliby Creek respectively. A similar plot for Wyong River has not been produced due to the maximum predicted subsidence being only 150 mm at some locations.

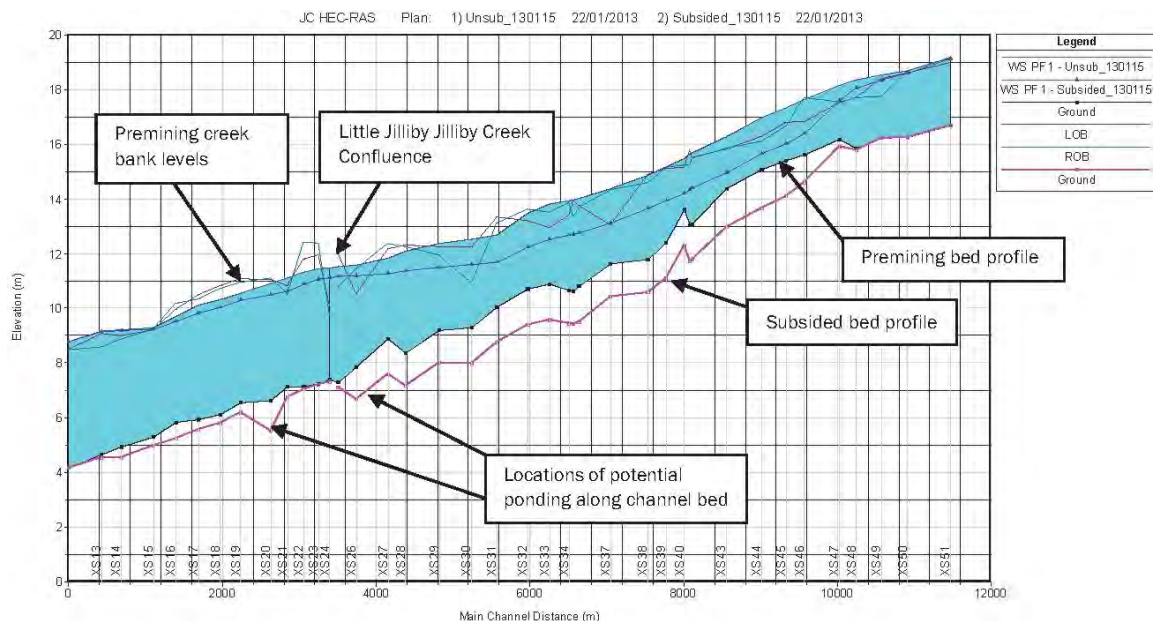


Figure 29: Pre and post mining profiles along Jilliby Jilliby Creek

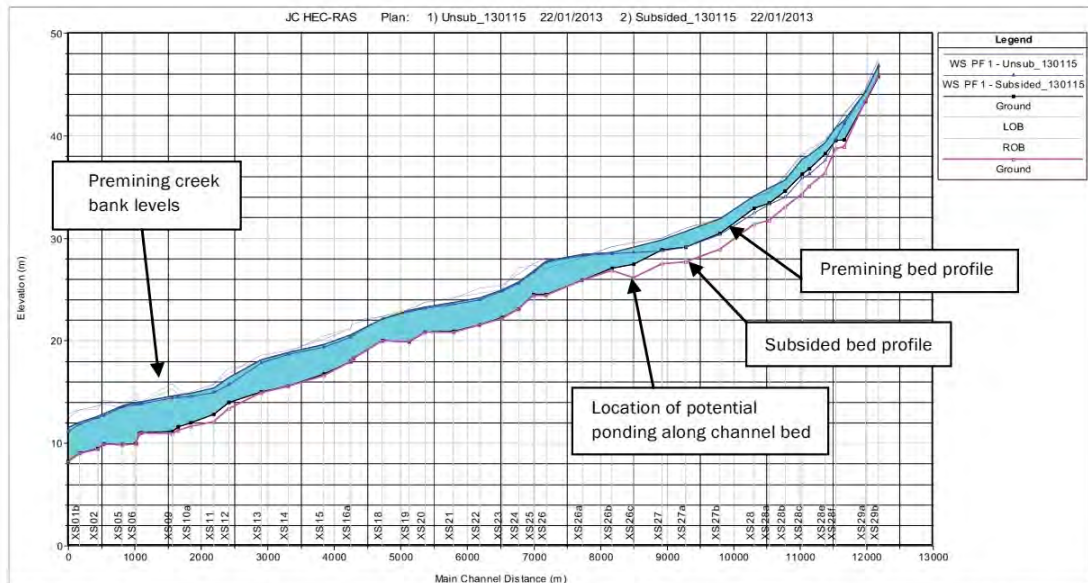


Figure 4.15 Longitudinal Section of Little Jilliby Jilliby Creek Upstream and Downstream of Jilliby Jilliby Creek Confluence, Bed and Water Levels, Pre and Post Subsidence, Bankfull Flow Conditions

Figure 30: Pre and post mining profiles along Little Jilliby Jilliby Creek

Figures 31 and 32 also present the changes in creek flow velocity as a result of subsidence for the Jilliby Jilliby and Little Jilliby Jilliby Creeks respectively. As can be seen, the maximum predicted increase in flow velocity is up to 0.2m/sec in the Jilliby Jilliby Creek and less than 0.1m/sec in the Little Jilliby Jilliby Creek.

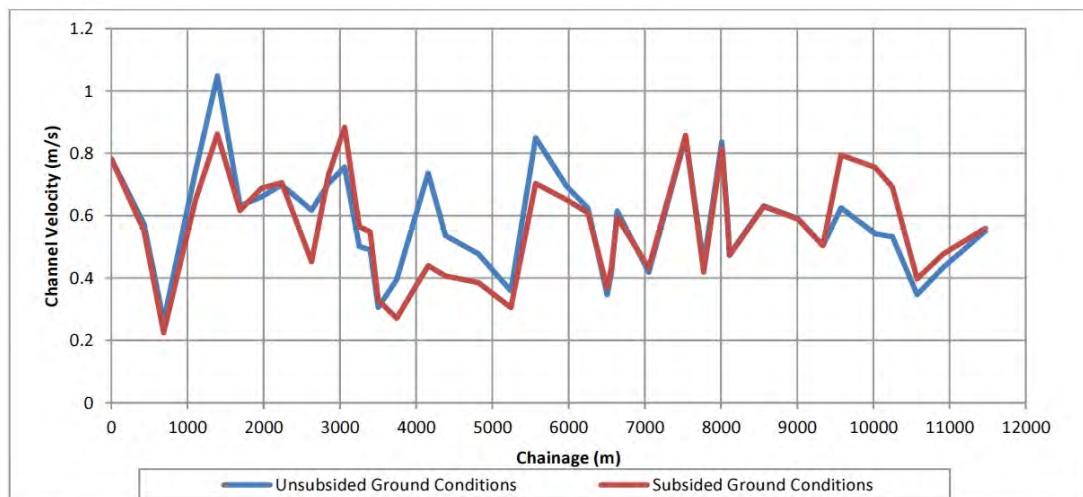


Figure 4.13 Longitudinal Section of Jilliby Jilliby Creek, Velocities, Pre and Post Subsidence, Bankfull Flow Conditions

Figure 31: Pre and post mining normal stream flow velocity along Jilliby Jilliby Creek

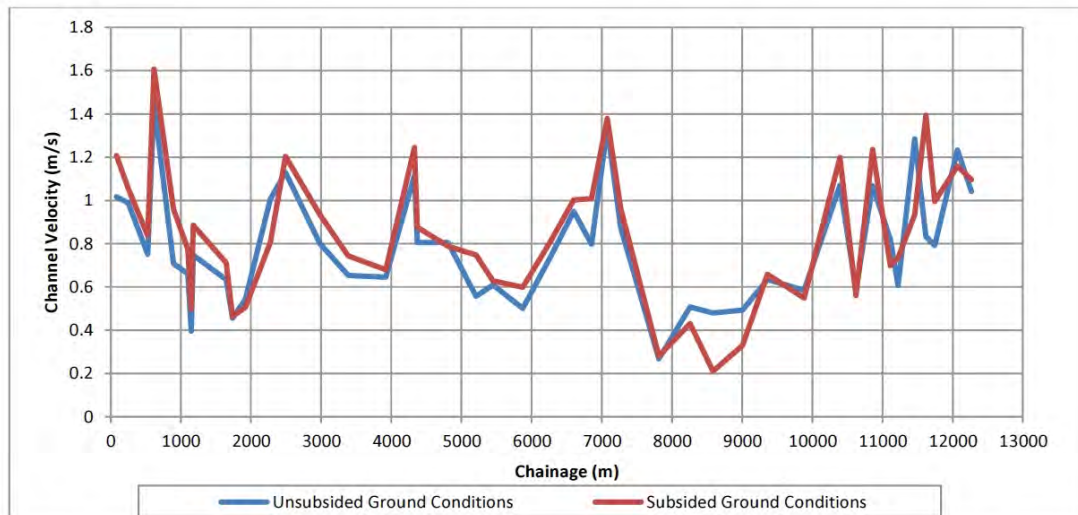


Figure 4.16 Longitudinal Section of Little Jilliby Jilliby Creek, Velocities, Pre and Post Subsidence, Bankfull Flow Conditions

Figure 32: Pre and post mining normal stream flow velocity along Little Jilliby Jilliby Creek

The impact of subsidence is considered by the EIS in the following areas.

- a. stream levels and localised changes to the level of ponded water
- b. flow velocities and impacts on erosion
- c. localised widening and narrowing of streams
- d. flora and fauna
- e. downstream wetlands
- f. water quality.

Items a. to c. are discussed in the sections below. The other items are considered outside PSM's area of expertise.

10.2. Loss of Surface Water

Loss of water into the near surface zone is critical to stream flows and the ecology of the streams. The issue of loss of surface water is discussed in Section 8.2 of this report. The reader should note that the assessment of this issue by WRM is governed by the fact that the loss to groundwater reported by MER is taken as the basis for the assessment, ie. *"It was assumed that impacts to baseflow were negligible (MER 2013)"*.

10.3. Stream Flows and Ponds

In general terms, subsided areas can result in increased areas or "bowls" where additional water storage can occur along streams. Increased storage capacity can result in deprivation of water flows into areas downstream of the "bowl". Where base flows are low or ephemeral this can lead to longer and/or more frequent periods of drying downstream of the pond.

Impacts upstream of any such “bowl” are difficult to interpret off the plots presented in the Figures showing the current and predicted creek longsections above. However, it is likely to be limited to less than say 500m, and in all likelihood less than say 100m.

Based on the creek long section profiles presented in the Figures above and on the EIS, “bowls” where ponding may be predicted to occur are:

1. Negligible along the Wyong River.
2. Up to about 1m depth at two locations along Jilliby Jilliby Creek, one just upstream and the other just downstream of the confluence with Little Jilliby Jilliby Creek.
3. Between about 0.5m and 1m depth along the Little Jilliby Jilliby Creek in the upland forested region toward the head of the creek).
4. Unknown along the Hue Hue Creek.

Following the points above, the potential for dry conditions, solely as a result of upstream ponding to adversely impact native flora and fauna will be minimal but could impact stream edge environments for some short distance downstream of the ponded water. However, WRM make the comment that;

“Inspection of the waterway (Jilliby Jilliby Ck) indicates that the creek is experiencing active bank erosion under existing conditions”,

And that

“the main channel drainage system and sediment transport dynamics are unlikely to experience significant adverse impacts due to the project”

Based on these statements, WRM indicate that the stream beds should readily re-level themselves, via erosion to re-establish a continuous stream bed.

This statement is expected to be correct where the ponds occur in the more silty and sandy alluvial soils along the creeklines, but may be much more limited or restricted if the ponds occur in areas of heavy clay. The timeframe for these changes depends on the soil types and also the flow velocity and frequency where the stream is ephemeral.

If ponds occur in areas underlain by rock, such as may occur in some of the forested areas, these are unlikely to be able to re-establish a continual stream bed and flows will not occur until the pond is overtopped.

Any impacts due to subsidence related ponding should be able to be effectively managed with suitable monitoring and timely response in mitigating any adverse effects. The timing of any inspections and/or testing needs to consider the fact that as subsidence effects travel across the ground surface, the “edge” of the settlement bowl results in localised deformation referred to as either tilt or sometimes travelling strain.

Where the tilt/travelling strain occurs along stream beds/banks, instability due to erosion from increased stream flows can occur. In general, the risk of mining causing an increase in erosion is most likely to occur during “normal” stream flows and smaller, albeit more frequent flood events.

The ability of the mine, locals, Council, or other authority to say what is adverse and what would or could have been expected to occur pre-mining will be high on impossible to ascertain and so the question what should be done in terms of mitigation or preventative works. This also impacts on who is responsible for undertaking the works.

10.4. Environmental Flows

The issue of environmental flows is beyond the expertise of PSM and comment on suitable flow volumes and/or frequency is not made.

However, while it is possible that a suitable volume of suitable quality water could be provided to the creek systems for the purpose of environmental flows, say by the W2CP in the form of treated water from that they collect from the underground mine, the benefit of any re-supply to the local waterways will be limited to the immediate stream ecology. The ability for re-supply water to the streams to fully compensate all the alluvium areas and any bores is doubtful, as discussed in Sections 9.2 and 9.3 of this report.

10.5. Mitigation and Management

WRM note that the impacts of the project on surface water resources can be mitigated through implementation of:

- Property Flood Management Plans a water quality monitoring programme for streams in the W2CP area; and
- A stream stability monitoring and management programme.

WRM suggest that the surface water monitoring in streams comprise measurement of pH, EC and TSS and be undertaken on a monthly basis, with an annual “comprehensive” suite of tests. Broadly, this level of testing is likely to be suitable but the detail on what constitutes “comprehensive” is not clear.

With regard to the management of the stream stability and remedial works, WRM propose that works comprise:

- A baseline ground survey of nominated creek cross-sections in areas of expected subsidence prior to undermining as part of the Subsidence Management Plan process.
- Development of specific measurable trigger levels (in consultation with NOW and local landholders) to enable subsidence monitoring to identify any possible unforeseen impacts to the stream system.
- Ongoing monitoring of the stream system prior to, during and after mining beneath the sections of the creek.
- A walkover assessment of key areas, particularly around the confluence of Jilliby Jilliby Creek and Little Jilliby Creek, identifying areas of water ponding, active bed and/or bank erosion and qualitative assessment of the condition of riparian and floodplain vegetation.
- Collection of photographs of creek channel and floodplain conditions.

- Preparation of a report documenting the results of each assessment with recommendations for any mitigation works that may be required. This report will specifically require a Trigger Action Response Plan (TARP) to be prepared to set aside a process for management of any unforeseen impacts to the system.

WRM suggest the field assessment be undertaken quarterly and following any significant flow event. They also note that the frequency may be reduced once an area is considered stable in terms of subsidence. Broadly this set of works is appropriate.

However, it is not clear whether this approach is entirely “reactive” or will endeavour to be “pro-active” in nature. We recommend that the WACJV should act to prevent erosion rather than repair it, as this would be best practice.

10.6. Findings

The proposed approach of undertaking detailed baseline studies of the streams in the W2CP area as well as the water quality and ongoing inspection and assessment of the impacts on stream stability and flows is considered appropriate and best practice, provided the approach incorporates a pro-active approach to issues such as stream stability wherever these are identified prior to mining impacts occurring.

If the mine is approved, the issue of assessment of what is adverse, the means of measurement and assessment and mitigation must be carefully and fully detailed to prevent long and potentially futile arguments occurring. To this end, specific and measurable/quantifiable targets must be agreed and established so all parties understand where they stand.

The issue of baseflow loss was presented earlier in this report under Section 8.

11. ADAPTIVE MANAGEMENT AND MONITORING

In recent years a trend has developed for adopting, so-called, Adaptive Management to deal with uncertainties in respect to future impacts on groundwater and surface water systems from mining operations. This developed to the point that adaptive management involved changing the targets that were established in environmental impact statements in response to what actually occurred in the field. This was done in conjunction with the establishment of groundwater monitoring systems and the visual and flow monitoring in creeks and rivers.³

The fallacy of this approach was determined by the Land and Environment Court in a recent case (2013) in regard to the proposed expansion of Berrima Colliery. The judges found as follows with respect to Adaptive Management:

Adaptive management regime

The intention of the Water Management Plan is to provide an adaptive management regime, under which management actions would be modified in response to the results of the monitoring program. Preston CJ held that,

“in adaptive management, the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.”

It follows that it is necessary for there to be precise limits imposed on the cumulative operations of the colliery.

The judges went on to quote Judge Preston in a previous case in relation to the need for implementation of the precautionary principle when there is uncertainty in respect to future environmental impacts. They stated:

Preston CJ held in *Telstra* at [150], the following, in regard to the precautionary principle and the shifting of the evidentiary burden of proof:

‘If each of the two conditions precedent or thresholds are satisfied – that is, there is a threat of serious or irreversible environmental damage and there is the requisite degree of scientific uncertainty – the precautionary principle will be activated. At this point, there is a shifting of an evidentiary burden of proof. A decision-maker must assume that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that this threat does not in fact exist or is negligible effectively reverts to the proponent of the economic or other development plan, programme or project.’

We are satisfied that the precautionary principle is activated as the risk of significant environmental harm currently remains uncertain,.....

³ For example: responses to cracking of Cataract Creek and Waratah Rivulet in the Southern Coalfields; draining of swamps at Springvale Colliery in the Lithgow area, complete depressurisation of the groundwater systems at Berrima Colliery and Ulan Colliery, and major cliff collapse at Dumbarton Colliery, Nattai North Colliery, Katoomba, Newnes and Baal Bone Colliery

The judges determined that the proposed expansion of Berrima Colliery should not proceed on the basis of Adaptive Management as was proposed by the colliery owners.

We consider that the legal findings summarised above should be taken into account in respect to the proposed Wallarah 2 project, because future impacts on groundwater and surface waters are likely to be substantial to both town water supplies in drought periods, and to agriculture and flora and fauna under even average climatic conditions. Furthermore, there are substantial uncertainties in respect to these impacts, making it possible, and even probable that the impacts will be greater than assessed by the EIS.

12. CONCLUSIONS

12.1. Subsidence

The predicted impacts due to W2CP are, in general terms:

- Subsidence up to 2.6m with less subsidence predicted in residential areas to the east and more subsidence within forested areas to the west.
- Tilts up to 15mm/m concentrated above the edges of the panels and over forested areas.
- Tensile strains up to 4mm/m concentrated near the edge of panels. About 99% of these strains are expected to be less than 2.5 mm/m.
- Compressive strains up to 5.5 m/m concentrated about 50m inside the panel edges. About 99% expected to be less than 3.3 mm/m.
- Far field movements up to ~60 mm horizontally at a distance of around 1km from mining diminishing to less than 25 mm at a distance of 2 km.
- The expected number and severity of impacts across the 245 properties within the area affected by the predicted subsidence are:
 - 83% of properties being unaffected;
 - 12% requiring very minor to minor repair;
 - 5% requiring substantial to extensive repair, and
 - <0.5% requiring a complete rebuild (ie. about 1 property)

In summary we conclude that:

- Based on our discussions with W2CP, we understand that something like 4 to 5 panels would need to be extracted before a full model calibration exercise could be undertaken.
- The reliability and accuracy of the SCT method is unknown as:
 - There is a reliance on extrapolated inputs to which the method has been shown to be sensitive.
 - The model is calibrated to site-specific data, and not to a small number of measurements from other sites.
 - The sensitivity to most input parameters is not presented.
- Due to the empirical nature of the method the Incremental Profile Method (IPM) is only as reliable as the data to which is it calibrated, in this case the SCT model results. Therefore the reliability and accuracy of the IPM is in doubt.

This is to some extent recognised by MSEC who in the EIS state:

“A thorough calibration...will only be achieved after subsidence monitoring data is obtained and analysed”.

- The use of one predictive model to calibrate another is generally unwise and not widely regarded as best practice.

- The IPM is stated as being conservative and likely to over predict impacts. The evidence for this conservatism and the expected magnitude with respect to W2CP are not provided. Indeed all indications are that the model development is centred around matching expected conditions and not exceeding or over-predicting them.
- There is a reliance on pillar compression after extraction resulting in a smoother subsidence profile. However, the basis for this assumption appears to conflict the Geological Report (Appendix C), where significant variation in both roof and floor conditions is expected across the site.
- The EIS acknowledges that pillar compression may not occur but does not quantify the impacts or changes in impact should this not occur.
- First longwall will prove that this pillar compression assumption is valid.
- At least 3 longwalls (L1N to L3N) and more likely 4 to 5 longwalls are required before pillar compression theory can be verified.

We accept that these predicted impacts are in agreement with expectations based on measured subsidence impacts elsewhere, and the Newcastle and Southern Coalfields in particular.

We are in general agreement that should the predicted level of subsidence occur, the type distribution and severity of impacts on houses, buildings and infrastructure is likely to be similar to that stated in the EIS.

We do not agree that the prediction represents a conservative estimate of subsidence impacts as all the evidence presented in the EIS suggests the prediction represents the most likely impacts. We consider that the model, calibration and application of the prediction does not provide sufficient guidance as to the sensitivity and reliability of the method and may, therefore, fail the Director General's "reasonable level of confidence" test.

In general we did not find any omissions or evidence to suggest that subsidence due to W2CP is likely to be significantly different to that predicted by the EIS. Our main concern is the lack of certainty around the predictive method and the likely variation in prediction based on observed variations that are already known and potentially those unknown.

12.2. Groundwater

The conclusions reached by EIS are primarily the result of the input parameters adopted for their numerical modelling. These input parameters are primarily driven by the unsuitable method by which the makeup of the rock and its defects have been sampled and are not consistent with available data or modelling within the EIS. Further, modelling assumes recharge of the water system based on average climatic conditions.

The EIS implies that water inflow to the mine, of up to 2.5ML/day would largely come from water stored in the ground. However, it avoids the fact that water stored in the ground comes from somewhere, and is currently in equilibrium with natural recharge. A valid way to consider this matter is encapsulated in the following quotation from Dr Rick Evans, principal hydrogeologist of Sinclair Knight Merz, viz:

“There is no free lunch here. It’s very simple – every litre of water your pump out of the ground reduces river flow by the same amount”.

Australian Financial Review,
24 May 2007

Other points to note are:

- We cannot define precisely what portions of which rivers will be affected by leakage losses from the near surface alluvial lands into the deeper rock mass;
- We cannot say, with confidence, how many years it will take for the impact of underground extraction to reflect in surface flows; and
- The EIS states that the mine will not fully recover groundwater pressures for over 500 years.

These points, combined with the uncertainty on the input parameters to the groundwater modelling there is a high probability that leakage losses from the alluvial lands will impact the surface water. Given the high likelihood or even near certainty that climate impacts would be sufficiently severe at some point implies that it may affect visible flows for long periods.

On balance, the findings from the EIS are at the least a limited and probably unconservative view of potential impacts. This means that, at present, it is not known with an acceptable level confidence what the likely impacts of the Wallarah 2 longwalls will be on groundwater resources, and on groundwater that feeds into the streams of the Dooralong and Yarramalong Valleys.

12.3. Surface Water

Flooding

The results of the flood assessment appear reasonable given the limits of the prediction of subsidence and can be considered as “best practice”.

The discussion on the impacts of the W2CP on flooding are made in relation to the 1% AEP event (1 in 100 year) and would only fully come into effect after mining has been completed. It is important to note that the assessment of flooding is dependent on the

expected subsidence and so any change to mine plans, or the prediction of subsidence through any validation process will result in changes to the extent and impact of flooding.

Results of the flood modelling for the 1% AEP flood event indicate that subsidence from the current W2CP mine plan is likely to result in only relatively minor increases in the depth and extent of flooding compared to current, pre-mining estimates with a total of about 35Ha of additional land becoming affected across the whole W2CP area.

The changes to flooding extents will have an adverse effect on up to 10 properties. The impact is assessed to be up to 5% of additional land area inundated for 4 of these Properties and up to 20% of additional land area for the remaining 6 properties.

In terms of impacts on residential dwellings, a total of 5 properties that were not previously impacted by the 1 in 100 year flood level are now impacted by flood water depths of between 4cm and 1.27m above floor level. These are assessed as being Major impacts in the system of Flood Impact Categories adopted for the W2CP. In addition to these dwellings, a further one dwelling is Categorised as being subject to a Major Impact, in this case the expected 1 in 100 year flood level increase by up to 41cm above current, pre-mining predictions.

In the moderate flood impact category, a total of 8 dwellings will see a rise in the currently predicted inundation levels due to the 1%AEP event by between 3cm and 17cm. A further 3 dwellings will have the level of clearance, or freeboard between the predicted flood level and dwelling floor level reduced to values of between 4cm and 28cm.

Minor impacts are expected to occur to a total of 10 dwellings and comprise increased levels of flooding above floor level by between 1cm and 4cm and reduced levels of freeboard above flood levels.

Further to the dwellings described above, a total of 14 dwellings are expected to have no significant change in flood impacts while a total of 49 properties will see a slight reduction in flood impacts.

Other impacts of the subsidence on flooding are flood peak flows are anticipated to be slightly reduced with a minor increase in the duration of the peak, although the EIS notes these as being insignificant.

Flooding will impact a total of 30 primary and secondary access roads in the project area. Of these, only 6 primary access route low points will be adversely impacted by the mine. Adverse impacts comprise increased duration of flooding of between 1hour and up to 27 hours. The latter time pertains to the crossing (D50) located toward the southern end of Jilliby Road just north of the intersection with Watagan Forest Drive.

Mitigation of the impacts of flooding can readily be undertaken by the WACJV. Detailed plans for each location and/or dwelling are not provided at this stage of the process and are only required after approval has been given.

At this time, the only indication of the extent of potential mitigation is in relation to the Major and Moderate Impact Categories.

Preliminary descriptions of possible mitigation works presented in the EIS comprise:

- Raising or relocating dwellings;
- Raising Sandra Street to increase the upstream flood retarding storage;
- Construction of grassed earthen levees around dwellings to provide a minimum freeboard of 0.3m; and
- Construction of new replacement dwellings.

The purchase of dwellings is mentioned as an option, but is not linked to any dwellings in the EIS, nor is any mechanism or process for such an option canvassed.

In terms of primary access points, the six adversely affected locations can be raised after subsidence has occurred to mitigate the adverse effect. In some instances, the works may require new culvert works to facilitate passage of flood waters past the obstacles. Council must be conscious of the longer term maintenance requirements of any mitigation measures.

The discussion on potential flood mitigation measures remain at a feasibility level but are considered appropriate and to constitute “best practice” for this level of appraisal. Detailed assessment will be required if planning approval is given and this must ensure all the Director General’s requirements are met.

Loss of Surface Water

Loss of surface water from streams in either the Yarramalong and/or the Dooralong Valley will have a direct impact on the availability of water in the Wyong River downstream of the proposed mine which is used as part of the water supply to the Wyong and Gosford Local Government Areas. Further, loss of surface water will also affect businesses such as turf farming and supply of water to local bores.

The assessment of loss of surface water is entirely dependent on the inputs to groundwater modelling and the impacts on groundwater flow by the mine. The EIS concludes that there will be very little impact on leakage from the near surface alluvial lands due to the very low permeability of the rock below the alluvial lands and, that what loss does occur will be readily compensated for by surface recharged.

These statements are based on two assumptions. Firstly, that average climactic conditions prevail and secondly, a favourable view of the permeability of the rock below the alluvial lands. The latter point is discussed above under the topic of groundwater modelling, but suffice to say there is considered to be a high level of uncertainty and a lack of factual evidence to confirm the parameters used.

With regard to the first point above, for the EIS to be relevant, it must also consider the variation in inputs to the surface water supply in extended dry periods. The review in this report considers the flow in Jilliby Jilliby Creek between 1972 and 2013 to illustrate the sensitivity of the stream flow to climate and to small variations in flow volumes, viz:

- The median flow rate in the creek is about 4.5 ML/day.
- Flows of less than 1ML/day occurred for 24% of the time
- Flows of less than 0.1 ML/day for 10% of time.

The predicted water inflow to the mine of up to 2.5ML/day represents more than half of the average flow for Jilliby Jilliby Creek and is greater than the flows recorded for 40% of the time since 1972.

These flows are put into perspective when records of consecutive days, since 1972, where low flows considered. The five longest periods of consecutive days when flow was less than 1 ML/day and 2 ML/day range from 112 up to 190 days. This shows that when dry periods occur, the flow in the creeks can be expected to be at a level that may be readily affected by leakage losses from the alluvial lands.

Further, a review of the climate during this period reveals that while some periods of drought did occur such as the Millennium Drought, it does not include the experience of the more intense droughts of World War 2, and the time of Federation.

Ponding

Current predictions of subsidence indicates three locations where increased bowls of storage in ponds along Jilliby Jilliby Creek (2 No.) and Little Jilliby Jilliby Creek (1 No.) are expected to result in longer and/or more frequent periods of drying downstream and similarly of wetting upstream of the newly created pond.

The expected extent to which the stream and adjacent lands may be impacted upstream and downstream of the pond is difficult to predict, but is not expected to be more than 500m and in all likelihood would be less than say 100m. Given the generally cleared/settled nature of the floodplain areas, the potential for drying conditions to adversely impact native flora and fauna is minimal. Any impacts should be able to be effectively managed with suitable monitoring and timely response in mitigating any adverse effects.

These conditions are expected to prevail until such time as the streams re-establish a continuous stream bed. This is highly likely to occur where the ponds occur in the more silty and sandy alluvial soils along the creeklines, but may be much restricted if the ponds occur in areas of heavy clay. The timeframe for these changes depends on the soil types and also the flow velocity and frequency where the stream is ephemeral.

The potential for ponding in Wyong River is considered negligible under the anticipated subsidence.

Subsidence profiles along the Hue Hue Creek have not been provided and so assessment of impacts of mining have not been made.

Erosion and Environmental Impact

The EIS notes that there is active erosion occurring along the banks of the Jilliby Jilliby Creek, but also that the impacts of the project on surface water resources can be mitigated through implementation of:

- Property Flood Management Plans a water quality monitoring programme for streams in the W2CP area; and
- A stream stability monitoring and management programme.

As with the subsidence and flooding, the W2CP is not required to prepare detailed management plans at this stage of the process but has included some indication on the approach and works within the specialist reports. Broadly the set of works and frequency suggested is considered appropriate but requires a significant amount of detail to allow any worthwhile appraisal to be undertaken of its likely effectiveness. However, it is not clear whether the approach is to be entirely “reactive” in nature, or whether it will include some form of “pro-active” works.

We recommend that the WACJV should endeavour act to prevent erosion rather than repair it where appropriate, as this would be best practice.

The ability of the mine, locals, Council, or other authority to say what is adverse and what would or could have been expected to occur pre-mining will be virtually impossible to ascertain and so the question is what should be done in terms of mitigation or preventative works. This also impacts on who is responsible for undertaking the works. In order to prevent this, and other similar issues from resulting in futile and circular arguments that result in nothing being achieved or done, specific and measurable/quantifiable targets must be agreed and established so all parties understand where they stand if the mine is approved.

12.4. Borefields

Borefields have been developed at Woy Woy, Somersby, Mangrove Creek, Ourimbah and Mardi for use by the CCWC as a drought contingency measure. Of these, only the single, 150m deep bore at Mardi is potentially going to be impacted by the W2CP. This bore is about 3km from the southern extent of the mine.

The Mardi bore is thought to extend into the rock of the Tuggerah Formation, or possibly to the top of the Munmorah Conglomerate. The main coal seam in this location is at a depth of about 450m to 500m.

The EIS predicts piezometric drawdown levels in the location of bore will not occur during the period of mine operations. However, drawdown of up to 5m may occur after a long period of time (500 years after mining).

These predictions appear to assume that nearly all of the water inflow to the mine is from that stored in the ground. Hence the predicted drawdown is expected to represent a worst case. If, as we consider likely, a portion of the water flowing into the mine comes from the alluvial lands above the mine, then the impacts at locations such as the Mardi bore will be less than predicted by the EIS.

12.5. Risk Assessment and Adaptive Management

In terms of groundwater impacts and to a lesser extent surface subsidence, the EIS presents an abridged assessment of the potential impacts and hazards posed by the W2CP. This situation arises as the EIS only considers risks that have been modelled by the specialist consultants and is thereby limited by the specialist assumptions and either lack of or limited sensitivity assessments. This is not considered appropriate at this stage of the assessment where transparency as to the entire gamut of potential impacts should be canvassed.

Further, the consequence rankings at the high end of assessment have been combined and limit the risk assessment process by requiring that severe, long term and/or potentially irreversible impacts must also be wide spread to warrant a high ranking.

In order to begin to allow the impacts of the project to be managed via adaptive management, the understanding of the impacts and risks must be robust and comprehensive, and quantitative in nature, not qualitative as is the case here.

The risk assessment should consider the level of risk associated with all aspects of the W2CP, and in particular those that:

- a. Are associated with a high level of severity in terms of consequence,
- b. Have a high degree of uncertainty surrounding the assessment/modelling,
- c. Have consequences that either may not/cannot be able to be remediated, mitigated or managed once they are observed, or
- d. Represent a significant degree of community concern.

The results of a rigorous, qualitative risk assessment could then be considered with respect to acceptable levels of risk, and/or a cost/benefit assessment. The latter of which may, or course result in high consequence impacts with a low risk and/or cost impact being disregarded in the final assessment of the project. However, as stated above, they all need to be considered and presented so an informed judgement/decision can be made.

In terms of the aspects of the project covered in this report, we would recommend the following be subject to a detailed risk assessment process.

1. Ground Water Impacts – test the sensitivity of the baseflow water losses with respect to hydraulic conductivity, level of subsidence induced by mining and environmental factors such as drought.
2. Subsidence Impacts – test the magnitude and location of subsidence effects with respect to items such as variability of the roof conditions of the mine and strength of pillars.

If the impacts of the mine are to be managed via adaptive management then a risk assessment is essential in order for the process to be:

- i. Correctly focused; and
- ii. Establish realistic and measurable targets.

Following this, and possibly with the assistance of a cost/benefit assessment, for an adaptive management plan to be effective it must be based on targets for monitoring and assessment that are:

- specific;
- measurable; and
- agreed between all parties.

Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process.

Agreed responses may be as minor as “continue to monitor / watch” to potentially leaving coal below the alluvial areas unmined or even as strong as “cease mining”.

13. MANAGEMENT PLAN DEVELOPMENT/APPROVAL CONDITIONS

Measures to mitigate and/or remediate the impacts of subsidence, increased flooding of dwellings and erosion are discussed in the EIS. However, the discussions are relatively general in nature and can only be considered appropriate for the feasibility stage of the project.

The EIS and Regulatory requirements are such that detailed Subsidence Management Plans (SMPs) need only be developed in consultation with landowners, Council and other stakeholders for adversely affected properties and streams after any approval has been granted. This would be expected to invoke the “Adaptive Management” approach for the project, for which there are very significant concerns given the level of uncertainty and lack of a comprehensive risk assessment for the all the possible project impacts.

The following table sets guidance on matters such as monitoring, validation and further assessment requirements, particularly in areas where information is unclear or uncertainty on data and/or impacts is high. The guidance provided below is intended for consideration by approving authorities in the assessment of the EIS and, if applicable the setting of conditions for the approval of the W2CP.

It is possible that approval could be given subject to the satisfaction of conditions prior to commencing mining. In such a scenario it would be expected that the decision of when to assess the conditions or undertake further studies would typically at the discretion of the W2CP as the risk of not meeting any conditions is theirs to evaluate.

TABLE 12
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|--|-----------------------------------|---|
| Subsidence | High | <p>Accurate measurement of surface subsidence is expected to be undertaken by the mine if and when mining occurs. This must be calibrated against an accurate map of conditions prior to mining.</p> <p>The record must also include detailed survey of all properties, infrastructure and structures that may be affected by subsidence along with comprehensive dilapidation assessments. Agreement with all stakeholders and landowners must be gained as to the extent and infrastructure to be assessed for impact due to subsidence.</p> |
| Subsidence Model | High | <p>A hold point after an agreed number (possibly 5) of longwalls have been extracted and the SCT and MSEC models validated and recalibrated as necessary.</p> |
| Subsidence – potential variability in modelling results. | Medium | <p>The influence of UCS – Sonic correlation UCS – modulus correlation and stress regime on the prediction of subsidence must be validated – as is proposed by the EIS.</p> |
| Subsidence – impact of pillar yielding on subsidence and the ability to validate predictions | Medium | <p>A comparison of impacts with and without the influence of pillar yielding. A program of pillar performance measurement including convergence measurements and extensometer readings.</p> |
| Mine Plan | Medium | <p>It is likely, or even inevitable that the Mine Plan and layout of longwall panels will change during the life of the mine. This is particularly so after the process of validation of the subsidence modelling has been completed following initial mining of the first longwall panels (minimum of 4).</p> <p>Modification to the Mine Plan and longwall panel layout will alter the extent and location of subsidence and the location of impacts on flooding, access routes and stream flows.</p> <p>A clear process must be setout for the assessment and approval of revised mine plans and must include Council. Assessments of the impacts of Mine Plan change include subsidence magnitude and extent, potential impact on groundwater modelling, impact on flooding and stream flows/ponding.</p> |

TABLE 12
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING (Cntd)

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|--|-----------------------------------|---|
| Sampling of rock mass – impacts on groundwater modelling | High | <p>In order to confirm the EIS assumption and reduce uncertainty on the extent and connectivity (tortuous) of the defect system within the “aquatard” which is relied upon in the modelling factual data should be provided. If this data is not available then within the existing mine database, or other sources additional exploration cored boreholes drilled at an angle to the horizontal plane of say 60° should be implemented. Drilling would need to be undertaken in the Dooralong Valley and in the lower reaches of the Yarramalong Valley to target rocks below the alluvial soils. Drill holes to extend to at least the base of the “constrained zone” from subsidence modelling. The location and number of such holes is not recommended here, but should be of sufficient number to provide confidence in the result when used in conjunction with other available data.</p> <p>These angled holes could also be used to undertake further in-situ permeability testing by means such as Packer or Constant Head testing.</p> |
| Permeability of Patonga Claystone – impacts on groundwater modelling | High | <p>Specific testing of the permeability of the rock mass below the alluvial soils in the valleys be undertaken to confirm EIS assumptions, or otherwise. The assumptions, and hence impacts of the EIS groundwater modelling must be confirmed prior to mining below any alluvial areas.</p> <p>Testing to be in inclined, cored boreholes. Holes must be logged to allow permeability testing to be carefully targeted to allow assessment of vertical and horizontal defects. Possible methods to test the rock mass permeability comprise;</p> <ul style="list-style-type: none"> • Packer testing. • In-situ Constant Head testing. • Full scale in-situ pump testing targeting the impacts of dewatering below the Patonga Claystone formation. We acknowledged that these tests are expensive and time consuming and alternate methods may be appropriate. We recommend the former two methods be employed as a first phase of testing. <p>Testing should comprise a suitable number of locations and successful tests to be meaningful. The final number is likely to be subject to the results of the works at the time. A minimum of 6 test holes is suggested.</p> |

TABLE 12
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING (Cntd)

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|------------------------------|-----------------------------------|---|
| Impact on Groundwater Levels | High | <p>Should the mine be approved a comprehensive system and regime of groundwater level monitoring must be implemented.</p> <p>This will require a robust system of new and existing monitoring wells and/or piezometers that are able to survive the predicted subsidence impacts.</p> <p>Monitoring points must be read on a frequent basis and compiled into a central database which is not only open for access by Council, but the data must be reviewed and assessed for its 'meaning' on a regular basis.</p> <p>This system should be augmented by measurement of levels and yields from water bores in the valleys.</p> |
| Impact on Stream Flows | High | <p>Monitoring of streamflow and inputs that influence alluvial lands water table recharge must be ascertained to allow assessment of the impact of groundwater leakage/loss. Aspects that must be monitored include:</p> <ul style="list-style-type: none"> • Rainfall and runoff across the catchment area for Wyong River and Jilliby Jilliby Creek, • Stream Flows – measured at multiple points along the various streams. As a minimum this must comprise <ul style="list-style-type: none"> ○ Jilliby Jilliby Creek upstream of the mine area, upstream and downstream of the confluence with Little Jilliby Jilliby Creek and just upstream of the confluence with Wyong River. ○ Wyong River upstream of the mine area - say at Duffy's Point, just upstream and downstream of the volcanic intrusion along the southern edge of the mine – say about 500m upstream of Chandlers Creek and about 700/800m upstream of Kidmans Lane, just upstream and downstream of the confluence with Jilliby Jilliby Ck. ○ Little Jilliby Jilliby Creek just upstream of the confluence with Jilliby Jilliby Creek and say just as the creek enters the upper forested area. <p>These points could also be used to monitor water quality as necessary.</p> |

TABLE 12
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING (Cntd)

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|-----------------------------------|-----------------------------------|---|
| Flood Remediation to Access Roads | Medium | <p>The impact of potential remedial works to access roadways must be understood prior to undertaking such works with regard to the impacts on future flood levels. Models for the 1%AEP and 20% AEP must be developed, assessed and agreed.</p> <p>Further, the method and design of remedial works and the maintenance implications for the future must be understood and agreed with Council.</p> |
| Stream Stability (and ecology) | Medium | <p>Specific and measurable/quantifiable targets must be agreed and established concerning stream stability and the impacts on erosion (as well as flora and fauna) so all parties understand where they stand if the mine is approved.</p> <p>This is particularly so given the very difficult nature of assessment of what is adverse and what is not as a result of the mine.</p> |
| Risk Assessment | High | <p>A detailed and comprehensive risk assessment must be undertaken to provide a framework against which reasonable adaptive management programmes can be developed, and assessed.</p> |
| Adaptive Management | High | <p><u>Specific, measurable and agreed</u> targets or levels from monitoring MUST be established prior to any underground works to allow all stakeholders certainty about what the aims of any adaptive management programme are. These should be based on the results of a comprehensive quantitative risk assessment and possibly cost/benefit assessment.</p> <p>Targets may include loss of stream flows, lowering of water levels/pressures in monitoring bores and levels of subsidence.</p> <p>Further, the targets must be accompanied by agreed responses otherwise the management system would be reduced to an impotent and disingenuous process. Agreed responses may be as minor as “continue to monitor / watch” to as strong as “cease mining” or to quarantine sensitive areas from mining.</p> <p>It may be considered that it is not possible to sufficiently confirm through monitoring the level of streamflow loss. In that case it may be that a proportion of the mine inflow water is deemed to be from streams and an agreed method and distribution of this proportion of mine water is treated and repatriated to streams, users/residents and areas of significant flora.</p> |

TABLE 12
GUIDANCE FOR FURTHER ASSESSMENT / VALIDATION AND MONITORING (Cntd)

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|---|-----------------------------------|--|
| Independent Impact Monitoring Authority | Medium | <p>An independent body be established to install, monitor and maintain all the groundwater, surface water and surface level impacts of the mine both during and after operation – this is particularly so given the EIS stated length of impact on groundwater and uncertainty on the speed with which pillar yield may impact subsidence.</p> <p>This body <u>must</u> be guaranteed funding to not only establish the monitoring system, but to maintain it as the impacts of subsidence and the long mine life will require significant repairs and timely replacement of equipment and monitoring points/instruments. Indeed, replacement of instrument/monitoring points should not take longer than say 2 months to maintain continuity of measurements.</p> <p>It is also recommend the monitoring authority be given either a direct, or at the least oversight role in the assessment of impacts and on the assessment of compensation for damage/loss or the development of remedial works/measures to control/limit the impacts of the mine – judged against the specific targets of the Adaptive Management Plan – and as such must be able to undertake, or direct the mine to undertake additional investigations and/or assessments with regard to subsidence, groundwater and surface water.</p> <p>The records and recommendations of the authority should be available on the public record.</p> |

For and on behalf of
 PELLIS SULLIVAN MEYNINK



DEREK ANDERSON

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Wallarrah 2 Coal Project

Wyong, NSW, Australia

Review of 2013 EIS

Prepared for



By



EARTH SYSTEMS
Environment | Water | Sustainability

June 2013



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Executive Summary

Earth Systems has undertaken a detailed review of the 2013 Wallarah 2 Environmental Impact Statement (EIS) for the Wyong Shire Council (WSC).

The Wyong Areas Coal Joint Venture (WACJV) proposes to develop an underground coal mine known as the Wallarah 2 Coal Project. This Project would extract coal using longwall mining techniques from under the Dooralong and Yarramalong Valleys in Wyong Shire, New South Wales.

In 2010, WACJV submitted an EIS which was refused by the NSW Government for the following reasons.

“The reasons for refusal of the project application are as follows:

- Uncertainty around the subsidence predictions for the project, particularly in the western portion of the site under Jilliby Conservation Area and the Wyong State Forest;*
- The project does not adequately address potential surface water quality impacts, resulting in uncertainty around the ability of the project to meet acceptable water quality outcomes;*
- Uncertainty around the ecological impacts of the project, particularly in the western portion of the site, as a result of a lack of ecological survey effort combined with uncertainty as to subsidence predictions in this area.*
- Uncertainty around the heritage impacts of the project, particularly in the western portion of the site, as a result of a lack of heritage survey effort combined with uncertainty as to subsidence predictions in this area.*
- In light of the above, the project is not considered consistent with the principles of ecologically sustainable development, including the precautionary principle, and as a consequence is not considered to be in the public interest.”*

A revised EIS was submitted by the proponent in 2013.

As a key stakeholder, WSC has a role to ensure that all relevant impacts and risks associated with the Project are professionally investigated and assessed to protect the interests of the Shire’s residents and the environment. WSC engaged Earth Systems to independently review and evaluate the revised EIS and provide expert advice on the potential environmental and planning issues related to the Project. Earth Systems has been instructed to review all aspects of the EIS apart from subsidence, ground and surface water hydrology, and flooding which are being reviewed for WSC by another technical group.

The EIS documents have been reviewed for accuracy, technical competence, statutory compliance and conformance with Australian standards and guidelines and international best practice within the mining industry. A number of technical specialists and environmental impact assessment (EIA) experts from Earth Systems have contributed to the review.

Environmental Impact Assessment should be a thorough and consultative process involving specialist and multi-disciplinary inputs. Although many aspects and components of the Wallarah EIS appear to have been conducted competently, and are improved from the 2010 EIS, there are still some significant uncertainty and gaps in the EIS.

In general the EIS reaches the conclusion that there will be few significant adverse impacts (apart from subsidence and some flooding) as a result of Project development. This appears overly optimistic

considering the sensitivity of the project setting close to a significant population centre and in a catchment that supplies water to the Central Coast population.

Management, monitoring and risk mitigation measures are often poorly articulated. In particular, the assessment of water quality impacts and air quality impacts appears to be flawed or inadequate in some key areas.

The EIS details very few clear commitments regarding management, monitoring and risk mitigation providing key stakeholders with little confidence that their assets and values will be protected by the Project should it proceed.

Further specific findings of the EIS review are as follows:

Structure and Approach

1. The EIS should fully consider and assess the different phases of the mine. The EIS does not adequately assess construction impacts, focusing primarily on operations. Impacts and issues associated with air quality, water quality and transport are likely to be significantly different during construction. The EIS does not adequately consider closure planning and no assessment of potential closure impacts has been undertaken. The EIS does not demonstrate that the Project would be closed in a manner that safeguards the environment and community assets.
2. The Proponent's risk assessment and cost benefit analysis is based on the results of the EIS. The risks, benefits and costs associated with the Project need to be re-rated based on the knowledge gaps and uncertainties that remain and the findings of further recommended studies.
3. An Environmental Management System has not been developed for the Project, nor is there a commitment to develop such a system.
4. The project proponent has not committed to regular independent environmental audits throughout the project life cycle. However, the project proponent has committed to developing an Annual Review Report to systematically assess performance and identify areas for improvement.

Stakeholder Engagement

5. The Proponent has still failed to adequately engage with the community during the environmental assessment process and consequently limited consultation has been conducted. The EIS does not provide sufficient information on the concerns raised by the community during consultation.

Water

6. The EIS does not assess impacts on surface water quality associated with the construction phase of the Project, nor does it provide management and mitigation measures for any potential impacts. There is no contingency for the Project if development does impact on water quality or hydrology.
7. The mined materials and wallrock of the deposit have not been assessed in terms of their ability to leach acid and metalliferous drainage (AMD). This is a significant oversight as AMD / saline drainage can be one of the most long-lived environmental impacts from coal mining.
8. The surface water monitoring program does not include a sampling point immediately downstream of the proposed Wallarah Creek tributary discharge site
9. The EIS does not provide contingency for overflow of untreated mine water from the Mine Operations Dam (MOD) in the event that overflow may occur.
10. The baseline assessment for groundwater quality appears to have included measurement of only pH and TDS, neglecting other key analytical parameters and therefore not providing a suitable baseline.

11. Mitigation measures for groundwater impacts are limited to repairing damaged bores from subsidence and replacing water supply if groundwater drawdown exceeds expectations. Mitigation for groundwater quality is not directly articulated.
12. The EPBC Act 'Water Trigger' Amendment (2013) has not been considered.

Air Quality

13. The methodology for air quality impact assessment does not appear to have been undertaken in a manner consistent with applicable legislation (DECC, 2005). Some modelling appears to include only Project emissions rather than Project emissions with baseline conditions. This provides a misleading assessment of likely dust levels that will be experienced by surrounding communities. Construction impacts and impacts associated with certain climatic conditions are not clearly outlined.
14. Predicted Project-related emission concentrations from dispersion modelling assume Project implementation of best practices. These estimates are only relevant provided these controls are implemented. It is unclear whether the EIS commits the Project to these management and mitigation measures.

Greenhouse Gas

15. Greenhouse gas emission mitigation strategies are very brief and do not demonstrate a sufficient level of commitment by the Proponent to reduce emissions. As such the Greenhouse Assessment does not adequately address the terms listed in the Director-General's Environmental Assessment Requirements and the Supplementary Director-General's Requirements.

Noise and Vibration

16. It is unclear whether the control measures identified in the Noise and Vibration specialist study are Project commitments or recommended best practices. The results of noise modelling are only valid if the recommended attenuation measures are committed to and implemented.
17. While noise modelling indicates that construction and operational noise will not be a major issue for the Project, modelling predicted that there may be some exceedences of Project Specific Noise Criteria (PSNC). Additional mitigation measures are not identified to prevent these exceedences.

Ecology

18. In general, an adequate ecological baseline (terrestrial and aquatic) has been provided, however, it lacks detail in regard to threatened species population distribution and abundance estimates. Ecological surveys should have been conducted over a broader survey area to reflect impacts associated with all project components.
19. Offsets required under the EPBC Act threatened species identified within the Project Boundary were not calculated using the new EPBC Act Policy Guidelines of 2012.

Traffic and Transport

20. A Rail Study has been conducted as part of the 2013 EIS to address the gaps in information regarding transport impacts identified in the 2010 EIS. This is a more comprehensive assessment of the transport route of the coal.

Visual Amenity

21. The visual assessment conducted for the Project provides a good site analysis and identification of key viewpoints, assessment of potential visual impacts and recommendations for mitigation measures to minimise impacts of the Project.

Archaeology and Cultural Heritage

22. In general, a comprehensive survey and report of the Aboriginal cultural and historic heritage of the areas surveyed within the Project Boundary has been prepared apart from some areas with accessibility restrictions.

Community Health and Safety

23. Uncertainties and knowledge gaps identified in this report including air and water quality impacts indicate that the assessment of community health and safety impacts and risks and their necessary management and mitigation measures are unlikely to be sufficiently comprehensive.

Impacts beyond DGRs

24. Contingency plans for potential disasters, whether naturally occurring or human induced, have not been included in the EIS. This is an oversight.
25. The Buttonderry Waste Management Facility is mentioned in the EIS in respect to visual amenity, however, the potential environmental risks (gas and leachate leakage) associated with the proximity of this facility to the project are not discussed.

Management and Monitoring

26. The EIS is not accompanied by management and monitoring plans. It is understood that these have not yet been prepared. Good industry international practice and / or best practice requires an Environmental Management and Monitoring Plan to be prepared as part of the EIS process. Ideally this should be accompanied by a budget indicating that the Project is sufficiently resourced to undertake this work. It is not possible to fully assess the impacts of the Project without an adequately articulated management and monitoring plan.

Recommendations based on these key findings follow.

Recommendations

It is recommended that the EIS is revised to address the gaps and deficiencies identified by this Review.

Should the EIS be approved then the consent should be conditional on the following conditions:

Air Quality

- Air quality impacts are assessed utilising relevant methodologies to ensure that detailed impact assessments of project phases are conducted effectively.

Greenhouse Gas

- A more realistic assessment of greenhouse gas (GHG) impacts is provided by including Scope 2 and 3 emissions sources in the analysis of the GHG impacts and updating impacts of the Project on anthropogenic global warming.

Water Quality

- Surface water quality is investigated further to ensure that all sources of contaminants are identified and that water sources are effectively monitored for changes associated with the Project.
- A geochemical assessment for potential AMD / salinity is conducted, including development of contingency plans for the management and treatment of the Mine Operations Dam.

EPBC 'Water Trigger' Amendment (2013)

- The EPBC Act Water Trigger Amendment (2013) is considered by the Proponent.

Ecology

- Further detailed surveys for biodiversity are conducted, including extended flora survey to establish a robust flora baseline for the Subsidence Impact Limit.
- The Biodiversity Offset Strategy for threatened species is revised to ensure it addresses the current Policy and that currently proposed offsets for fauna habitats are reviewed for suitability.

Mine Design and Layout

- Internal haulage routes are confirmed to allow assessment of potential impacts of heavy vehicle movement.

Stakeholder Engagement

- A robust Stakeholder Engagement Plan is developed that is inclusive of commitments to ongoing consultation and a structured grievance procedure.

Rehabilitation and Closure

- A comprehensive Rehabilitation and Closure Plan is prepared.

Risk Assessment and Cost Benefit Analysis

- The Risk Assessment and Cost Benefit Analysis are reviewed and revised based on detailed findings of further recommended work.

Disaster Risk Management

- A Disaster Risk Management Plan is developed to cover natural and human-induced emergencies associated with the Project. This Plan should be inclusive of specific Contingency

Plans to manage particular events, including the management / treatment of the Mine Operations Dam (MOD) and spontaneous combustion.

Community Health and Safety

- The Community Health and Safety assessment is reviewed and revised based on the findings of the further work recommended.
- Potential impacts upon the Buttonderry Waste Management Facility associated with the development of the Project are fully considered.

Management, Monitoring and Reporting

- Management and Monitoring Plans are prepared for each aspect of assessment prior to commencement of the Construction phase to clearly outline how impacts will be mitigated and managed.
- An independent expert is commissioned by the Proponent to conduct Environmental Audits of the project on a regular basis throughout the project life cycle.
- An Environmental Management System based on ISO14001:2004 'Environmental management systems -- Requirements with guidance for use' is developed and implemented for the Project.

Additional specific recommendations are provided throughout the text.

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1 Introduction

1.1 Background

Earth Systems was commissioned in May 2013 by the Wyong Shire Council (WSC) to conduct an independent review of the Wallarah 2 Coal Project EIS (excluding ground and surface water hydrology, Flooding and Subsidence Impacts). The review is being conducted as part of the WSC's reviewing of the 2013 EIS.

The Wyong Areas Coal Joint Venture (WACJV) proposes to develop an underground coal mine known as the Wallarah 2 Coal Project (W2CP) (herein referred to as the Project), which would extract coal from beneath the Dooralong and Yarralong Valleys in Wyong Shire, New South Wales using longwall mining techniques.

WACJV (the Proponent) prepared an Environmental Assessment (EA) for the Project in 2010 (referred to as the 2010 EIS), which was submitted to the Director-General of the NSW Department of Planning (DoP) for assessment and approval under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). As part of the assessment process, the EA was placed on public exhibition from 31 March to 2 June 2010. During the public exhibition period any person (including a public authority) may make a written submission to the Director-General concerning the Project.

The development application for the Project was refused on March 3rd, 2011 by the Minister for Planning. In November 2011, Wyong Areas Coal Joint Ventures lodged a new application for development consent of a mining lease.

In January 2012 the NSW Government issued new Director General's Requirements (DGRs) for the Project (referred to herein as the 'New DGRs') that outline key issues requiring comprehensive evaluation during the environmental assessment for Project approval. The New DGRs are supplementary requirements and do not rescind obligations set for in the original DGRs for the Project, (provided 10 August 2009).

An additional supplement to the DGRs was issued by the NSW Government on 11 July 2012 (Supplementary DGRs). The Supplementary DGRs focus on the assessment of potential Project-related impacts on biodiversity, reinforcing Project obligations under the Environmental Protection and Biodiversity Conservation Act 1999 and the Environmental Protection and Biodiversity Conservation Regulations 2000. These include provisions that are summarised as follows:

- Descriptions of the controlled action;
- Descriptions of the existing environment;
- Descriptions of relevant impacts of the controlled action;
- Proposed safeguards and mitigation measures;
- Offsets; and
- Other approvals and conditions.

The Project Proponent has prepared a second Draft EIS, completed in April 2013 (herein the 2013 EIS). This report was prepared to meet the regulatory and legislative requirements of EIS in NSW, address the issues identified in the 2010 EIS refusal and to meet the original and supplementary Director General Requirements.

WSC has engaged Earth Systems to independently review and evaluate the 2013 EIS and to provide recommendations to assist the Council in ensuring Project fulfilment of environmental and planning obligations. The findings of this report will be forwarded to the Director-General as part of WSC's overall submission to the EIS.

1.2 Objectives and Scope

1.2.1 Purpose

This Report intends to provide an independent and objective review of the 2013 EIS to identify whether the relevant environmental, mining and planning issues have been appropriately investigated and assessed; whether all of the Director General Requirements have been met; and whether the shortcomings of the 2010 EIS, identified by the Minister for Planning, have been adequately addressed.

1.2.2 Aims and Objectives

The aims and objectives of the Report are to:

- Determine if the EIS achieves statutory compliance with all relevant legislation, policies and plans;
- Confirm that the EIS adequately addresses the Director-General's Environmental Assessment Requirements;
- Confirm that the EIS adequately addresses key issues identified by the Minister for Planning in the Project Refusal dated March 3rd 2011.
- Determine if the EIS has been prepared in a manner consistent with Australian and International standards and best practice guidelines.
- Confirm whether the EIS provides a comprehensive and technically robust assessment of potential impacts from the Project;
- Identify any potential important aspects or issues that have not been fully and adequately investigated and assessed; and
- Identify areas of uncertainty and further investigations and assessments required prior to Project determination and/or during the construction, operation and closure stages of the Project.

1.3 Project Overview

1.3.1 Project Location

The Project is located approximately 9 km to the northwest of Wyong township in New South Wales (refer to Figure 1-1). The proposed mining area is located wholly within the declared Wyong Mine Subsidence District and the Hue Hue Mine Subsidence District which together extend west of the F3 (Sydney – Newcastle) Freeway.



Figure 1-1 Project Location (Source: Hansen Bailey, 2013)

Two primary surface facilities are proposed for the Project. The main coal handling and rail loading facility is referred to as the Tooheys Road Site and would be located adjacent the northeast corner of the F3 Freeway and the Motorway Link Road intersection. The Buttonderry Site would include ventilation shafts, office and employee facilities and be located to the south of the Buttonderry Waste Disposal Facility off Hue Hue Road. The majority of the underground extraction area lies beneath the Yarralong and Dooralong Valleys and Wyong State Forest.

1.3.2 Project Setting

Key land uses within the Project Application Area range from light industrial, commercial and housing developments to small townships and small farms. The western area features heavily timbered hills, most

of which are in State Forests. Agricultural land uses in the proposed subsidence area include horticultural activities concentrated in the floodplains such as turf farming, market gardens, nurseries and orchards on the foot slopes. Further up the valleys extensive grazing predominates in the narrowing floodplain.

The Tooheys Road Site is located between the F3 Freeway and an active clay quarry and tile factory. The Buttonderry Site is situated adjacent to the Wyong Employment Zone (WEZ) and the Buttonderry Waste Management Facility. The Warner Industrial Park and Warnervale Aerodrome are located southeast of the Buttonderry Site. The proposed Warnervale Town Centre (WTC) is located southeast of the Project sites. Blue Haven residential area is located approximately 3 km to the north east of the Tooheys Road Site. A sewage treatment plant is located approximately 2 km to the south east of the Tooheys Road Site. Figure 1-2 shows the two surface facilities and the surrounding land uses.

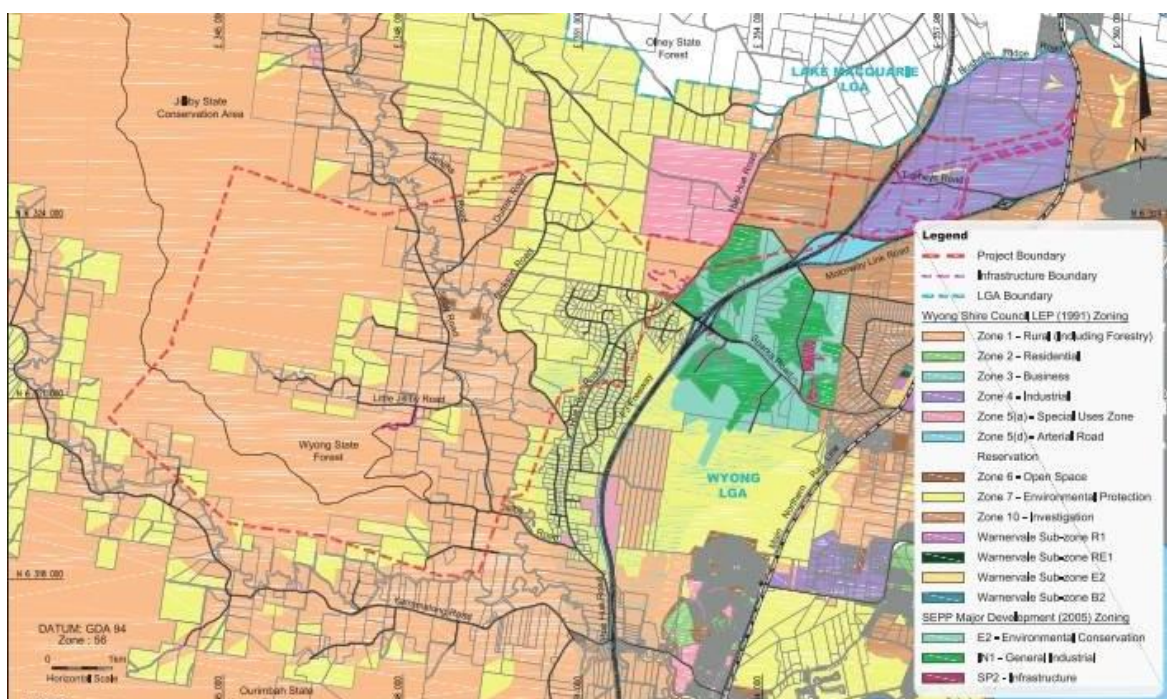


Figure 1-2 Surface Facilities and Surrounding Land Uses (Source: Hansen Bailey, 2013)

The Jilliby State Conservation Area and Wyong State Forest are located to the west of the Project area. Jilliby Creek flows south eastward to merge with the Wyong River which feeds Tuggerah Lake. Wallarah Creek flows through the Tooheys Road Site to Budgewoi Lake.

Major transport routes near the Project area include the F3 Freeway, Motorway Link Road and the Main Northern Railway Line.

1.3.3 Project Description

The Proponent proposes to extract of up to 5 million tonnes per annum of run-of-mine (ROM) coal from the Wallarah-Great Northern Coal Seam for a period of 42 years using longwall mining methods. The key components of the Project are summarised

Table 1.1 and depicted in Figure 1-3 and Figure 1-4. The Project is described in full in Chapter 3 of the EA.

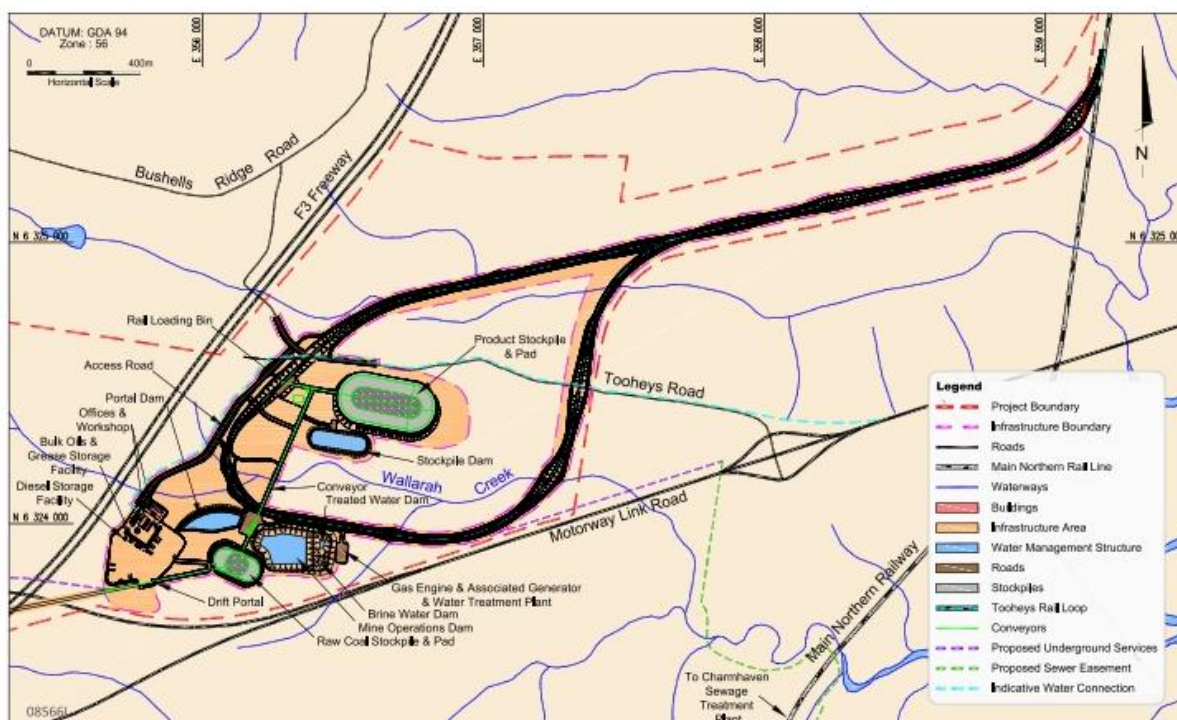


Figure 1-3 Tooheys Road Site (Source: Hansen Bailey, 2013)

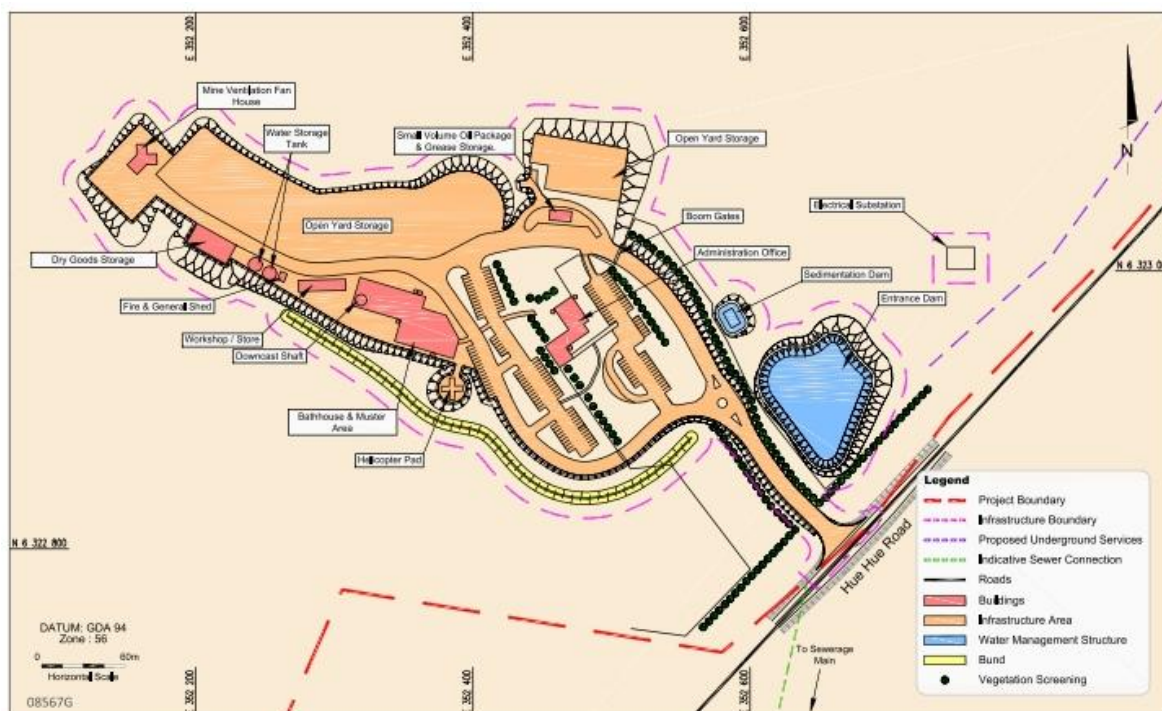


Figure 1-4 Buttonderry Site (Hansen Bailey, 2013)

Table 1.1 Key Components of the Project

| Aspect | Description |
|-------------------|--|
| Project Footprint | <p>Tooheys Road Site</p> <p>This site is on Proponent owned and leasehold land and would provide the main coal processing and handling facilities, coal stockpiling and</p> |

| | |
|---------------------|--|
| | <p>train loading facilities and include:</p> <ul style="list-style-type: none"> o A 6 km long rail spur and loop with two rail overbridges over Tooheys Road and coal loading infrastructure to transport coal from mine to Newcastle; o A coal handling plant (CHP) providing crushing, screening and storage facilities and coal stockpiles; o Mine access drift and portal; o Gas extraction and treatment plant; o Mine operations pre-treatment water storage dam and surface runoff settling ponds; o Mine water treatment plant (saline water to be treated by a reverse osmosis desalination plant); o Surface water management systems and sewage treatment facilities; o Environmental monitoring station; o Administration offices for up to 40 staff (only 20 staff required on average day); and o Car parking facilities. <p>Buttonderry Site</p> <p>This site is on Proponent owned land and would be the main site for mine employees and include:</p> <ul style="list-style-type: none"> o Ventilation and employee/materials access shafts; o Administration offices for 40 staff; o Bathhouse for 140 people; o Car parking facilities for 150 cars; o Surface water management systems and sewage treatment facilities; o Emergency services helicopter landing area; o Environmental monitoring station; o Electrical switchyard, hardstand and pollution control facilities. <p>A second western shaft site would be required by Mining Year 10 and would be located in Wyong State Forest.</p> |
| Mining and Reserves | <ul style="list-style-type: none"> o The Project is based on a coal reserve of approximately 151 million tonnes of ROM export quality thermal coal from the Wallarah-Great Northern Coal Seam. o The underground mining operations would use longwall mining methods at a depth of between approximately 345 m and 690 m below the surface. Longwall panel widths vary from 120 m to 250 m and extraction height ranges from 3.5 m to 4.5 m. |
| Coal Processing | <ul style="list-style-type: none"> o Coal would undergo minimal processing with no traditional coal preparation plant or washery required. The coal would be sized by a crusher and screened in the CHP. o Depending on the presence of minor faulting with the seam or other geological conditions that may be encountered, deshaling (a dry screening process) may be required to remove non-coal materials (waste rock). |
| Project Life | 42 years (initial planning approval sought for 28 years) |

| | |
|-------------------------|---|
| Hours of Operation | 24 hours per day 7 days per week. Shut downs may occur from time to time to allow for major equipment upgrades, repairs and maintenance. |
| Direct Employment | <ul style="list-style-type: none"> ○ Approximately 3,000 jobs would be created on Central Coast over the life of the Project's three year construction phase. ○ In first year of operation, the Project would generate approximately 250 jobs on the Central Coast, which would increase to 300 jobs at full production. |
| Access Roads | <ul style="list-style-type: none"> ○ Buttonderry site accessed from Hue Hue Road via a sealed internal road. ○ Tooheys Road site accessed from Tooheys Road, which would be slightly realigned and upgraded. |
| Product Coal Transport | <ul style="list-style-type: none"> ○ The majority of the thermal product coal would be railed via the Main Northern Railway to Newcastle Port for export. ○ At peak production, an average of five to six trains would be loaded every 24 hours. ○ From time to time, domestic coal trains would deliver coal to local power stations on the Central Coast. |
| Water Demand and Supply | <p>Water demand would vary at the two surface facility sites.</p> <p>Buttonderry Site</p> <ul style="list-style-type: none"> ○ A 10 ML Entrance Road Dam and local area site stormwater drainage system would be built to ensure sufficient water is available for use during construction. ○ Once operational, water self-sufficiency will be achieved during normal climatic conditions by harvesting clean storm water from the site for storage in the Entrance Road Dam, or directly collected from the roofs of buildings into Potable Water Storage Tanks. ○ An on-site water treatment plant would draw water from the dam and provide potable quality water for domestic consumption during drier periods when roof storm water harvesting is insufficient to meet demand. ○ During a drought period exceeding two months, it is expected that potable quality water will have to be imported. <p>Tooheys Road Site</p> <ul style="list-style-type: none"> ○ Three dams (120 ML Operations Dam, 3 ML Stockpile Dam, 3 ML Portal Dam) and site stormwater drainage system would be built to retain all dirty water runoff and ensure sufficient water is available for use during construction and eventually for mining production operations. ○ Once operational, an onsite water treatment plant would draw water from the Mine Operations Dam and provide potable quality water for domestic consumption, dust suppression and underground longwall operating requirements. ○ The site would be in water deficit during the first production year due to water demand for underground mining operations. Potable water and sewage treatment plant recycled water would be sourced from external suppliers. ○ This deficit would progressively reduce over the next five production years as mine seepage water make from underground increases as |

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| | <p>mining progresses.</p> |
| Coal Stockpiles | <ul style="list-style-type: none"> ○ Coal stockpiles would only be located at the Tooheys Road Site. ○ The main product coal stockpile would have a capacity of 250,000 t. The coal would be delivered by a 2,000 t/h overhead tripper conveyor. ○ The tunnel reclaim system under the product stockpile would feed a 4,500 t/h train loading system including a loading bin of approximately 250 tonnes. ○ Automated wind-activated watering systems for dust control. |
| Waste Products | <ul style="list-style-type: none"> ○ The Project has a zero coal rejects target. ○ Due to the absence of a washery, coal processing would not produce stony rejects or silty tailings; hence no tailings dams are required. ○ During the construction of the mine drift and shafts, approximately 180,000 m³ of excavated waste rock would be used at the two sites for perimeter bunding and landscaping. ○ Once operational, deshaling would produce approximately one truck load of waste rock per day which would be transported off site on an "as needs" basis to Buttonderry Waste Management Facility or another nearby licensed facility. |
| Gas Extraction and Utilisation | <ul style="list-style-type: none"> ○ Gas content is generally restricted to the coal seam and consists of greater than 95% methane. ○ Collected gas would be brought to the surface at the Tooheys Road Site for processing. ○ In the initial years of operation it is unlikely that sufficient quantities of gas would be produced to allow commercialisation of the resource. The collected gas would be flared during this time. ○ Future gas management and utilisation options would be evaluated in consultation with WSC and other stakeholders. One option could involve generating electricity on-site to power the desalinisation plant. |
| Site Rehabilitation and Vegetation Offsets | <ul style="list-style-type: none"> ○ Conceptual rehabilitation program outlines basic rehabilitation options and activities. ○ The primary objective of the rehabilitation program is to produce final stable landforms at each of the three Project infrastructure sites, consistent with surrounding topographic features and suitable for the proposed future land use: <ul style="list-style-type: none"> ○ The Tooheys Road Site would be rehabilitated to create a stable and non-polluting landform that is suitable for ongoing use as an industrial site. ○ The Buttonderry Site and Western Shaft Site would be rehabilitated to create a stable, non-polluting landform with self-sustaining vegetation to improve conservation values of the area. ○ Completion criteria for each stage of the rehabilitation program would be developed and refined through the Rehabilitation and Environmental Management Plan, which would be developed in consultation with key stakeholders after planning approval and a mining lease have been granted. ○ Rehabilitation activities to be undertaken in the mining area would be |

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| | limited to works required to repair any subsidence related damage. <ul style="list-style-type: none"> o Ecological offset strategy proposed involves planting 50 ha of native vegetation on Proponent owned land to compensate for loss of approximately 22 ha of native vegetation as a result of the Project. |
| Economic Benefits | <ul style="list-style-type: none"> o \$600 million total potential expenditure in the Central Coast economy from the three years of the mine's construction o Ongoing direct expenditure and flow-on effects to the local economy in the order of \$200 million per annum. o Over \$1 billion in total revenue to Government over life of Project. |
| Community Contributions | <ul style="list-style-type: none"> o The Project would implement a Community Enhancement Program (CEP) funded by the Proponent comprising contributions in cash and in-kind. o Specific works and actions to benefit the local community directly would cover four main elements: <ul style="list-style-type: none"> o Community Trust Projects o Local Environment and Biodiversity Management o Work-Ready and Training Development o Community Infrastructure |
| Capital Value | \$1.4 billion (over life of Project) |

1.3.4 Project Planning History

The Proponent has been exploring the Wyong Coal Development Areas under licence of the NSW Government since 1995. Exploration, mine planning, community consultation and environmental investigations have subsequently been ongoing for proposed Project development.

In November 2006, the Proponent lodged a Preliminary Assessment Report and Project Application with the Director-General of the Department of Planning (DoP). Accordingly, the DoP informed the Proponent of the Minister for Planning's confirmation that the Project is required to be assessed under Part 3A of the EP&A Act.

On 5 February 2007, prior to the issue of the Director-General's Environmental Assessment Requirements for the Project, the Minister for Planning announced an independent strategic inquiry into the *Impacts of Potential Underground Coal Mining in the Wyong Local Government Area* (referred to as the Wyong Inquiry). An Independent Expert Panel was appointed to conduct the inquiry which considered the issues related to potential coal mine developments in sensitive areas within the Wyong Local Government Area (LGA), including the Dooralong and Yarramalong Valleys.

Submissions were made to the Expert Panel from a host of potential stakeholders, including WSC and other Government agencies, interest groups and the coal mining industry. In addition, there were 66 individual submissions from the community and 237 form letters. The final report of the Inquiry was publicly released in December 2008.

An Independent Expert Panel was also appointed to conduct an independent *Strategic Inquiry into Underground Coal Mining in Southern Coalfield*. The final report of the Inquiry was publicly released in July 2008.

Following the two Inquiries, the Director-General issued the Environmental Assessment Requirements for the Project (DGRs) to the Proponent on 10 August 2009. The DGRs were prepared in accordance with the recommendations of the Inquiries; issues raised in public submissions and specific environmental

assessment requirements of relevant Government agencies, including WSC's requirements submitted to the DoP in June 2006. The Environmental Assessment Requirements only considered the findings from the Southern Coalfield Inquiry that were relevant to mining in the Wyong LGA.

The Proponent then prepared an EA (herein referred to as the 2010 EIS) and submitted it to the Director-General, who determined that the EIS adequately addressed the Environmental Assessment Requirements and made the submittal publicly available. Earth Systems was initially engaged to conduct an independent review of the 2010 EIS. The WSC subsequently provided written submission to the Director-General concerning the Project in the form of Earth Systems' 2010 Review of the EIS.

On the 3rd of March 2011, the Project application was refused by the Minister for Planning under Section 75J of the *Environmental Planning and Assessment Act 1979*. The Project Refusal provided the following reasoning:

"The reasons for refusal of the project application are as follows:

- Uncertainty around the subsidence predictions for the project, particularly in the western portion of the site under Jilliby Conservation Area and the Wyong State Forest;*
- The project does not adequately address potential surface water quality impacts, resulting in uncertainty around the ability of the project to meet acceptable water quality outcomes;*
- Uncertainty around the ecological impacts of the project, particularly in the western portion of the site, as a result of a lack of ecological survey effort combined with uncertainty as to subsidence predictions in this area.*
- Uncertainty around the heritage impacts of the project, particularly in the western portion of the site, as a result of a lack of heritage survey effort combined with uncertainty as to subsidence predictions in this area.*
- In light of the above, the project is not considered consistent with the principles of ecologically sustainable development, including the precautionary principle, and as a consequence is not considered to be in the public interest."*

2 Review Method

This Report was undertaken to review and evaluate the 2013 EIS and technical appendices for the proposed Wallarah 2 Coal Mining Project to determine whether the 2013 EIS fulfilled applicable regulatory and legislative requirements and to ascertain whether the Proponent had adequately addressed the shortcomings of the 2010 EIS. To ensure a comprehensive review, Earth Systems undertook the following steps:

1. Review of the 2013 EIS Main Report and Technical Appendices;
2. Review of the Project Refusal Document from the NSW Minister for Planning;
3. Review of 2013 EIS for compliance with each of the Director General Requirements (10 August, 2009), new DGR's (12 January, 2012) and supplementary DGRs (11 July, 2012);
4. Review of the EIS against *Department of Sustainability, Environment, Water, Population and Communities* (SEWPaC) requirements with consideration of relevant Australian standards and guidelines; and
5. Attend briefing meeting by the Proponent and WSC in June 2013.

2.1.1 Literature Review

The following key documents were reviewed during the preparation of this Report:

- *Walarah 2 Coal Project Environmental Assessment: Volumes 1 to 6 (2013)* and technical appendices;
- *Walarah 2 Coal Project Environmental Assessment: Volumes 1 to 4 (2010)* and technical appendices;
- *Director-General's Environmental Assessment Requirements (January 2012) and Supplement to the Director-General's Requirements (July 2012)* ;
- All relevant Federal and State legislation, policies and plans;
- Relevant environmental, sustainability and environmental impact assessment (EIA) standards and best practice guidelines; and
- Wyong Shire Council Brief and Correspondence.

2.1.2 Statutory Compliance

An important objective of this review is to ensure that the EIS clearly demonstrates that the Project complies with all relevant Federal and State legislative requirements with respect to mining, planning and environmental impact assessment. The review considers whether the EIS adequately addresses the relevant provisions of State, Regional and Local policies and plans and new or updated regulatory requirements that may now apply subsequent to the original submission of the EIS in 2010.

The review has been undertaken to confirm that the EIS adequately addresses the Director-General's Environmental Assessment Requirements, supplementary DGRs and SEWPaC environmental assessment requirements.

2.1.3 Australian Standards and Guidelines

The review assesses the EIS in accordance with current Australian environmental, sustainability and EIS standards and best practice guidelines. The review considers the methodologies, procedures and

requirements provided in *Coal Mines and Associated Infrastructure: EIS Guidelines* by NSW Department of Urban Affairs and Planning (DUAP, 2000).

The review of the EIS also considers the principles set out in *Enduring Value - the Australian Minerals Industry Framework for Sustainable Development* by the Mineral Council of Australia (MCA, 2005). The framework aligns with global industry initiatives and provides critical guidance on the International Council on Mining and Metals (ICMM) *Sustainable Development Framework Principles* and their progressive application and implementation at the operational level. It also builds on the Australian *Minerals Industry Code for Environmental Management* - the platform for industry's continual improvement in managing environmental issues following its introduction in 1996. The purpose of the framework is to assist the mining companies to operate in a manner that addresses expectations of the community and which seeks to maximise the long-term benefits to society that can be achieved through the effective management of Australia's natural resources.

Additional legislation or guidelines have been developed by NSW since the initial EIS submission to the Director General in 2010. As such the 2013 EIS is subject to the following additional State requirements:

- Nature Conservation Trust Amendment Act 2010
- Protection of the Environment Operations Amendment (Environmental Monitoring) Act 2010
- National Parks and Wildlife Amendment (Aboriginal Places and Aboriginal Objects) (2010)
- Threatened Species Conservation Amendment (Biodiversity Certification) Act 2010
- National Parks and Wildlife Amendment Regulation 2010
- Threatened Species Conservation Amendment Regulation 2010
- Protection of the Environment Operations (General) Amendment (Pollution Incident Response Management Plans) Regulation 2012
- NSW Guideline for the use of Cost Benefit Analysis in Mining and Coal Seam Gas Proposals (2012)

2.1.4 International Standards and Guidelines

The review also determines if the EIS has been conducted in a manner consistent with International environmental, sustainability and EIA standards and best practice guidelines. The aim of this aspect of the review is to establish whether the Project meets International standards and guidelines.

The review of the EIS considers the principles, findings and recommendations outlined in the following guidelines, among others:

- *Principles of Environmental Impact Assessment Best Practice* by International Association for Impact Assessment (IAIA) (1999);
- *Environmental Impact Assessment Regulations and Strategic Environmental Assessment Requirements: Practices and Lessons Learned in East and Southeast Asia* by World Bank (2006); and
- *Sustainable Development Framework Principles* by ICMM (2003).

3 EIS Structure and Approach

3.1 Environmental Planning and Assessment Regulations

This section addresses the following Director General Environmental Assessment Requirement:

The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

Clause 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* are provided in Appendix A.

Key findings of the review, with respect to the above requirement, are summarised below:

- The form and content requirements of the EIS are in general met with respect to Clause 6, with the requirements of each sub-clause being specifically referred to in the EIS Main Report.
- The four principles of ecologically sustainable development have been addressed in Section 9.7 of the EIS Main Report (Clause 7, Sub-Clause 4).
- Clause 6, Sub-Clause 1 requires a full description of the “*likely impact on the environment*” and the “*measures proposed to mitigate any adverse effects of the development*”. For some aspects of the EIS this sub-clause has been met, however, the level of detail and extent to which impacts are assessed and mitigation measures are developed in the EIS is not considered sufficient in many instances, particularly with respect to development of management and mitigation measures. Specific examples of these deficiencies are detailed in this report.

3.2 Project Description

This section addresses the following Director General Environmental Assessment Requirement:

The EIS must include a detailed description of the development including:

- Need for the proposed development.
- Justification of the proposed mine plan, including efficiency of coal resource recovery, mine safety, and environmental protection.
- Likely staging of development, including construction, operational and rehabilitation stages.
- Likely interactions between the development and existing, approved and proposed mining operations in the vicinity of the site.
- Plans of any proposed building works.

Key findings of the review, with respect to the above requirement, are summarised below:

- A description of the Project is provided Section 3 and justification for the project in Section 9 of the EIS Main Report.
- The justification of the proposed mine and the efficiency of coal resource recovery are articulated in the Section 9 and the alternatives analysis of Section 3.
- Section 3 of the EIS provides a framework for the timing of construction, which is proposed for approximately three years for facilities and infrastructure, with underground construction occurring throughout the operational life of the mine. The construction and operations phases of the Project would occur for an estimated 28 years.

The framework for rehabilitation and closure is summarised in Section 7.25. A preliminary closure plan has not been developed. Section 7.25 provides principles and rehabilitation objectives. Some conceptual rehabilitation strategies are also provided in Appendices O, G, H and X. However, at this stage, there are few commitments provided. Many of the impact assessments do not specify measures undertaken for closure (e.g. surface water quality and groundwater quality and air quality, amongst others).

3.3 Environmental Planning Instruments

This section addresses the following Director General Environmental Assessment Requirement:

The EIS must include consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments.

Environmental planning instruments include State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs) that regulate land use and development. For the purposes of this review, higher level federal and state regulatory requirements have also been considered.

Key findings of the review, with respect to the above requirement, are summarised below:

- In general, this aspect appears to be addressed reasonably well in the EIS Main Report Chapter 4.
- The following federal and state legislation relevant to the assessment and approval of mining projects have been referenced in the EIS:

Federal legislation

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, administered by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities)
- *Native Title Act 1993* (administered through the Commonwealth Native Title Act 1993).

NSW State legislation

- *Environmental Planning and Assessment Act 1979* (administered by the NSW Department of Planning & Infrastructure) – *The EP&A Act is the principal piece of legislation regulating the assessment, approval and operation of mining projects. If approval is granted by the Minister, it is the primary approval instrument with which most other approvals must be consistent.*
- *Environmental Planning and Assessment Amendment Act 2008 No 36.*

- *Mining Act 1992 (administered by the Department of Trade & Investment) – Mining leases are granted by DTIRIS under the Mining Act.*
- *Protection of the Environment Operations Act 1997 (administered by the NSW Office of Environment & Heritage) – The main objectives of the POEO Act are to protect, restore and enhance the quality of the environment in NSW through pollution prevention and cleaner production, the reduction of harmful discharges and wastes, the reduction in the use of materials and improved re-use, recovery and recycling of materials.*
- *Threatened Species Conservation Act 1995 (Administered by the NSW Office of Environment & Heritage).*
- *National Parks and Wildlife Act 1974 (Administered by the NSW Office of Environment & Heritage).*
- *Heritage Act 1977 (Administered by the NSW Department of Planning & Infrastructure).*
- *Water Management Act 2000 and Water Act 1912 (Administered by the NSW Office of Water).*
- *Dams Safety Act 1978 (Administered by the Dams Safety Committee).*
- *Coal Mine Health and Safety Act 2002 (Administered by the Department of Trade & Investment).*
- *Pipelines Act 1967 (Administered by the Department of Trade & Investment).*
- *Native Vegetation Act 2003 (Administered by the NSW Office of Environment & Heritage).*

NSW State Environmental Planning Policies (SEPPs)

- *State Environmental Planning Policy No 33—Hazardous and Offensive Development (1992-129).*
- *State Environmental Planning Policy No 44—Koala Habitat Protection (1995-5).*
- *State Environmental Planning Policy No 55—Remediation of Land (1998-520).*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (2007-65).*
- *State Environmental Planning Policy (State and Regional Development) 2011 (2011-511).*

Local Environmental Plans (LEPs)

- *Wyong Local Environmental Plan 1991 (Wyong LEP 1991)*
- *Draft Wyong Local Environmental Plan (LEP) 2012*

Other Relevant Policies

- *The Draft Aquifer Interference Policy (2012) – Stage 1 has also been released. This policy sets out the proposed regulation of aquifer interference activities, including those associated with coal and CSG mining and exploration.*
- While the main state and federal legislation involved in the regulation of mining project assessments is referred to in the EIS (as listed above) the following key documents were not cited or considered in the EIS:

EPBC Act 1999 - Environmental Offsets Policy

- *On 3rd October 2012 the Government released the national EPBC Act Environmental Offsets Policy, and this applies to any new referrals and variations to approval conditions*

from 2nd October 2012. It also applies to any projects currently under assessment for which a proposed decision has not yet been made.

- This is an important consideration for the Watermark Project, given the substantial offset areas expected to be required and significant changes introduced in the new policy (see Section 7).

EPBC Act Amendment Bill 2013 - 'Water Trigger' Amendment

- On 13 March 2013 this Bill was introduced into the House of Representatives to amend the EPBC Act 1999 to include 'water resources' as a new matter of national environmental significance (NES) for large coal mining and coal seam gas projects.
- The Bill passed the House of Representatives on 21st March 2013 and was referred (as of 15th April 2013) to the Senate Environment and Communications Legislative Committee. On the 19th June 2013, the Bill passed the Senate, meaning that the Commonwealth is now responsible for ensuring water systems are not impacted by major coal seam gas and coal mining projects. The Bill is awaiting assent by the Governor-General. The changes will commence the day after assent.
- Although the Amendment post-dates the Wallarah 2 Coal Project EIS submission, it would apply to any developments (such as this Project) that are currently referred for a decision that is in the approval process, where the Independent Expert Scientific Committee has not yet given advice.

Further information regarding this amendment is detailed in Section 4.1.4 of the Report.

Mining Regulation 2010 (under the Mining Act 1992)

- The amendments to the Mining Act 1992 and new Mining Regulation 2010 improve environmental regulation of the mining industry by:
 - Expanding the Government's powers to regulate mining activities, to ensure sound environmental and rehabilitation outcomes.
 - Introducing audit powers to promote compliance.
 - Requiring a rehabilitation cost estimate and disclosure of an applicant's environmental performance record in certain applications for authorisations.
 - Enabling consistency of approach with other environmental regulators.

Nature Conservation Trust Act 2001

- Nature Conservation Trust Amendment Act 2010.

Protection of the Environment Operations Act 1997

- Protection of the Environment Operations Amendment (Environmental Monitoring) Act 2010 No 85.
- Protection of the Environment Operations (General) Amendment (Pollution Incident Response Management Plans) Regulation 2012.
- A number of key regulatory requirements under the Exploration License EL 7223 were documented in Section 2.5.1 (Exploration) but omitted from Section 4 (Regulatory Framework). This includes a number of special conditions that were added to EL 7223 in January 2012. Of particular note is the requirement in EL 7223 that "any development approval sought by the licence holder within the initial term of the licence or during any extensions or renewals of the licence shall not include any of the following activities in the area covered by the licence: ... open

cut mining anywhere on the floodplain". The current Project design would involve open cut mining (Eastern Mining Area) on the Mooki River floodplain, as reported in the Surface Water Impact Assessment. Hence, this key requirement of EL 7223 has not been met.

3.4 Risk Assessment

3.4.1 2010 Risk Assessment

The Proponent commenced a risk assessment process for the Project in 1996, with the latest assessment conducted in October 2009 incorporating the Director-General's Environmental Assessment Requirements. The Director-General's requirements require a comprehensive risk assessment of the potential environmental impacts of the Project to be undertaken which identifies the key issues for further assessment.

A fair and reasonable risk assessment process identifies and prioritises potentially significant environmental risks and impacts to be addressed in the EIS. However, the Proponent's risk assessment appeared to be based on the results of the EIS and some important risks have been discounted in light of the findings of the EIS. The risk assessment fails to adequately consider some potential key failures and public risks commonly associated with longwall mining (e.g. water loss, water quality impacts, gas release and landslides).

The risks associated with the Project needed to be re-rated based on the knowledge gaps and uncertainties that remain and the findings of further assessments.

It was noted that the Proponent should continue the risk assessment process through the approvals phase, detailed design, construction, operation and ultimately closure of the mine.

3.4.2 2013 Risk Assessment

This section addresses the following Director General Environmental Assessment Requirement:

The EIS must include a risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment.

Key findings of the review, with respect to the above requirement, are summarised below:

- A Risk Assessment is summarised in Chapter 6 of the EIS Main Report, based on the assessment provided in Appendix of the EIS.
- The risk assessment provided in Appendix F is broadly consistent with Australian and International standards and guidelines on risk assessment and management, although several deficiencies in the risk assessment process have been identified.
- There was insufficient explanation of the method used to conduct the assessment, including the criteria used and assumptions made to assess each risk. This is a particular concern given the qualitative nature of the assessment.
- The risk assessment report has been condensed into a single page and is therefore inadequately covered (over-simplified) in the EIS Main Report, Section 6. For example, the risk summary tables in the EIS Main Report (Section 6) represent broad 'issues' but do not correlate with individual 'impacts' as assessed in Appendix F.

- The Preliminary Risk Assessment identified six 'high' risk issues (*Subsidence, Groundwater, Surface Water Management, Flooding, Ecology and Aboriginal Cultural Heritage*). All other preliminary risk issues were classified as "medium" or "low" risk.
- Following stakeholder engagement, a revision of the Preliminary Risk Assessment was undertaken to '*incorporate additional requirements*' (Chapter 6 – Risk Assessment) resulting in a Revised Risk Assessment. It is assumed from the Table in Appendix F that the Revised Risk Assessment also incorporates '*proposed management measures*'
- The '*proposed management measures*' in Table 1 in Appendix F to address specific impacts are not articulated clearly. In most cases the measures refer generally to recommendations made in the technical appendices (many of which were not committed to in the EIS Main Report) and/or to management plans that are yet to be developed.
- PDF errors in Table 1 of Appendix F render the table unclear; categories are undefined and are difficult to interpret.
- Key risks to community health and safety such as spontaneous combustion are not adequately addressed.

3.5 Commonwealth Government Requirements

This section addresses the following Director General Environmental Assessment Requirement as per the Supplementary Director General's Requirements of 11 July 2012:

The EIS must address the requirements of the Commonwealth Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC).

For reference, SEWPaC requirements are provided in Appendix B of this document.

Key findings of the review, with respect to the above requirement, are summarised below:

- SEWPaC requirements are itemised in the Supplementary Director General's Requirements (June 2012) with clear references to the most relevant EIS sections addressing each item. In many cases, however, the item is not adequately covered in the referenced section, and in some cases the item does not appear to have been considered at all. Specific examples are provided throughout this review.
- General information (SEWPaC Requirement 1):
 - This aspect appears to be adequately addressed in Chapter 1 and 3 of the EIS Main Report.
- Description of the controlled action (SEWPaC Requirement 2):
 - This aspect has been addressed in the EIS Main Report Chapter 3, with only minor limitations of data regarding some aspects of the project (i.e. internal haulage routes).
- Description of the existing environment (SEWPaC Requirement 3):
 - Some aspects of the ecological survey methods were consistent with this SEWPaC requirement, however, areas adjacent to the Project boundary have not been surveyed. These and other concerns relating to SEWPaC Requirement 3 are discussed in Section 7.3 of this report.
- Description of the relevant impacts of the controlled action (SEWPaC Requirements 4-6):

- The relevant impacts are discussed briefly in the EIS (and in more detail in Appendices O) however a number of concerns relating to the impact assessment have been identified as discussed in Section 7.3 of this report.
- Proposed safeguards and mitigation measures (SEWPaC Requirement 7):
 - The proposed safeguards and mitigation measures are discussed briefly in the EIS (and in more detail in Appendix O) however a number of concerns relating to the costing of these mitigation measures have been identified as discussed in Section 7.3 of this report.
- Offsets (SEWPaC Requirement 8):
 - Offset requirements have been assessed in the EIS however the assessment has not been undertaken in accordance with SEWPaC's new Environmental Offsets Policy (2012). This and other concerns relating to SEWPaC Requirement 8 are discussed in Section 7.3 of this report.
- Other approvals and conditions (SEWPaC Requirement 9):
 - This aspect appears to be adequately addressed in Table 14 in Chapter 4 of the EIS Main Report.
- Economic and social matters (SEWPaC Requirement 10):
 - These aspects have been addressed in the EIS Main Report Sections 7.17, and supporting document (Appendices V). A review of these aspects is provided in Section 6 of this report.
- Environmental record of person proposing to take the action (SEWPaC Requirements 11-12):
 - In Section 1.4 of the EIS Main Report, it is stated that "WACJV has not been the subject of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources".
 - Whilst not explicitly required by SEWPaC, a description of the environmental record of the Proponent in relation to their existing international mining operations would be more relevant for the purposes of this assessment.
- Information sources (SEWPaC Requirement 13):
 - Information sources generally appear to be adequately addressed throughout the EIS. However, there is very limited discussion of "uncertainties" in the environmental information provided throughout the EIS Main Report.
- Consultation (SEWPaC Requirement 14-15):
 - This aspect has been addressed in the EIS Main Report Chapter 5. A review of this aspect is provided in Chapter 5 of this report.

3.6 Plans and Documents

This section addresses the following Director General Environmental Assessment Requirement:

The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the Environmental Planning and Assessment Regulation 2000. These documents should be included as part of the EIS rather than as separate documents.

Key findings of the review, with respect to the above requirement, are summarised below:

- Detailed engineering design drawings of project infrastructure / buildings are provided in Appendix E.
- A number of key Project design, baseline and impact assessment figures have been produced for the technical appendices but omitted from the EIS Main Report.

3.7 Potential Impacts Beyond Director General Requirements

The following potential impacts, beyond the Director General requirements, were identified but not considered or fully addressed in the EIS:

Buttonderry Waste Management Facility

The Buttonderry Waste Management Facility is an essential service infrastructure for the Wyong Council; servicing the waste management needs of the Wyong Shire community. The Buttonderry facility is considered a strategic regional facility for future processing and disposal of waste.

The primary concern is that should subsidence occur, leachate and landfill gas (methane) management systems could be compromised, with potential to lead to environmental and economic impacts. This has not been addressed as a potential impact within the EIS no management or mitigation measures have been developed to minimise the risk and mitigate potential impacts.

Disaster Risk Management

Disaster risk management for naturally occurring or human- induced events have been overlooked in the EIS. These include environmental emergencies such as uncontrolled discharge during high rainfall events, water storage dam wall failure, and bushfires. Other disasters could include those associated with spontaneous combustion or blasting accidents.

It is recommended that a comprehensive disaster risk management plan is developed, inclusive of detailed contingency plans to manage specific events, such as the development of contingency plan for management / treatment of the Mine Operations Dam (MOD) water that would be required should MOD water levels approach potential uncontrolled discharge stages to prevent untreated water from reaching Wallarah Creek.

3.8 Coal Alternatives and Markets

Chapter 9 of the EIS (Project Justification) provides a discussion on coal alternatives and makes a statement relating to the current lack of viability of alternative energy sources to replace coal according to international expert agencies such as the International Energy Agency. Section 9.2.1 states ‘...an alternative source to replace carbon based fuel as the primary source of energy for base load electricity supply has not yet been and is considered not likely to be sufficiently developed in the near future (IEA, 2011)’.

It is suggested that the mine will produce export quality coal with potential markets in Japan, China and India. It is stated that the Project seeks to assist Australia in meeting international and local demand for coal over the mine life.

3.9 Project Design Alternatives

The EIS provides three Project Design Alternatives, inclusive of the current proposed Project.

Option 1: Do Nothing

Option 2: Underground Operation (Bord and Pillar)

The bord and pillar underground mining method as suggested by Option 2 generally results in a lower level of surface subsidence above the mine extraction area. However, this alternative was deemed unviable due to safety implications and economic considerations (higher initial capital cost and higher operating costs). It is suggested that the use of this method would have resulted in the Project not being developed and the resource being sterilised.

Option 3: The Project

The option of conducting an underground longwall mining operation has been selected as the most appropriate after assessing a number of mine designs. It is suggested in the EIS that this method will maximise social and economic benefits while minimising environmental impacts associated with surface water, water supply, ecology, aboriginal archaeology and soils. *This option was also considered the best alternative in terms of meeting the principles of ESD and Objects of the EP& A Act.*

The design remains consistent with that of the 2010 EIS, excluding the following changes:

Mine Plan Layout

- The long wall panel widths within the extraction area have been increased from the original 2010 mine plan layout. Within the Hue Hue Mine Subsidence District (MSD) Area the originally proposed 120 m and 150 m wide long wall blocks have been increased to 125 m and 175 m respectively.
- In 2010 it was specified that within the Valley Area the long wall panels would be 150 m, 170 m or 200 m depending on depth of cover. In 2013 these lengths have been increased to a range of between 175 m to 205 m wide long walls depending on the cover.
- Within the Forest area the long wall panels have been stated as being less than 255 m which is an increase from the 250 m proposal in 2010.

Western Ventilation Shaft:

- The western ventilation shaft dimensions have been changed from 6 m in diameter and 490 m in depth to 5 m and 485 m respectively.

It is noted in Section 3.13.4 that a number of areas have been removed from the mine plan on environmental grounds, resulting in the sterilisation of an estimated 19.75 Mt of coal.

3.10 Project Schedule

As per Chapter 3 of the EIS, it is anticipated that construction will occur over a three year period. An indicative construction schedule is provided in Section 3.1.2, detailing a breakdown of quarterly

construction activities for the first five years of the Project in the form of a Gantt chart. This includes the phases of Procurement and Mobilisation, Construction and Underground Development and Longwall Extraction.

3.11 Environmental Management System

The Proponent has not developed an Environmental Management System.

It is recommended that the project develops and implements an Environmental Management System based on ISO14001:2004 'Environmental management systems -- Requirements with guidance for use' which is considered best practice.

3.12 Monitoring and Reporting

Monitoring and reporting processes are crucial to the success of adaptive management strategies required to be utilised. By producing regular reports, companies can gain a greater understanding of risks and opportunities, improve efficiency, benchmark environmental and social performance against laws, codes and best practices, as well as identify and mitigate environmental and social impacts.

The proponent has committed to developing Annual Reports (as per Chapter 8 of the Main EIS Report).

"WACJV will prepare an Annual Review Report (which summarises coal quantities, monitoring results and reviews performance against the predictions and commitments in this EIS) and distribute it to the relevant regulatory authorities and make available on the Project website."

An Environmental Monitoring Plan should be produced as a guide to environmental parameter monitoring processes and scheduling. Findings from regular monitoring of air and water quality etc. should be provided to interested stakeholders on a regular basis to ensure that transparency.

3.13 Regular Independent Environmental Auditing

At present, the Proponent has not committed to the conduct of regular environmental and social audits. Regular independent environmental and social audits will provide the Proponent and other stakeholders with an objective view of the Project's performance, and provide recommendations for continuous improvement.

It is recommended that the Proponent commissions an independent expert to conduct Environmental Audits of the project on a regular basis throughout the project life cycle. This audit should:

1. Be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General;
2. Include consultation with the relevant agencies;
3. Assess the environmental performance of the project and 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);
4. Review the adequacy of any approved strategies, plans or programs required under these approvals; and, if appropriate

5. Recommend measures or actions to improve the environmental performance of the project, and/or any strategy, plan or program required under these approvals.
6. Be provided to key stakeholders such as Wyong Shire Council.

4 Water Quality

4.1 Context

Construction and operation of the Wallarah 2 Coal Project has the potential to impact surface and groundwater quality in the Project area affecting downstream or down-gradient waters and potentially sensitive receptors. The Wallarah 2 Coal Project Area is primarily located within one of the catchments feeding the water supply for the Gosford City Council and Wyong Shire Council. The Project area and downstream habitats are of moderately high biodiversity value, with a number of EPBC listed species and communities utilising water from the catchment.

Potential subsidence related impacts from Wallarah 2 Coal Project longwall mining are recognised as being a key factor for consideration for the Project, particularly with respect to their potential effects on residential structures, water catchments and groundwater regimes. However, it is important to note that subsidence and groundwater hydrology issues are not part of this review.

This review evaluates the Project 2013 EIS assessment of potential impacts to surface and groundwater quality and associated management and mitigation measures reported therein.

4.1.1 Reasons for Refusal 2010

The Minister for Planning refused the project application, in-part, because:

“The project does not adequately address potential surface water quality impacts, resulting in uncertainty around the ability of the project to meet acceptable water quality outcomes”

4.1.2 New Director General's Requirements

The Director General's Requirements (DGRs) for the Wallarah 2 Coal Project EIS, dated January 12, 2012, included the following applicable language for water resources and applicable general requirements (supplementary requirements added to the original DGRs for the Project):

General Requirements Relevant to Water Quality

“The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

In addition, the EIS must include a:

- *detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes:*
 - *a description of the existing environment, using sufficient baseline data;*
 - *an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and*
 - *a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and*

- *consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS."*

Key Issues Relevant to Water Quality

The EIS must address the following specific issues:

Water Resources – including:

- *detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including:*
 - *detailed modelling of potential groundwater impacts;*
 - *impacts on riparian, ecological, geo-morphological and hydrological values of watercourses, including environmental flows;*
- *a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures;*
- *identification of any licensing requirements or other approvals under the Water Act 1912 and / or Water Management Act 2000;*
- *demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) or water source embargo; - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP; - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts"*

4.1.3 Earth Systems Recommendations 2010

The Earth Systems' review of the 2010 EIS concluded that the report did not contain an adequate assessment of the potential impacts of the Project on local and regional groundwater and surface water quality. Key issues identified in this review included:

Surface Water

The 2010 EIS failed to identify and describe sources of water pollution beyond salinity and does not assess potential water quality impacts from the construction, operation and closure of the Project. Sources of pollution could include increased turbidity and sedimentation due to erosion from construction, stockpiles, haul roads and other disturbed areas and workshops, vehicle wash facilities, plant and equipment and fuel storage.

Acid and Metalliferous Drainage (AMD)

The review of the 2010 EIS indicated that there had been no consideration of the potential impacts of AMD as a result of the construction and operation of the Project.

4.1.4 New Regulatory Requirements

- *Water Management Amendment Act 2010*
- *Water Management (General) Regulation 2011*
- *Protection of the Environment Operations Amendment (Environmental Monitoring) Act 2010*
- *Protection of the Environment Operations (General) Amendment (Pollution Incident Response Management Plans) Regulation 2012*

Of particular importance to the Project is the **EPBC Act Amendment Bill 2013 - 'Water Trigger' Amendment**, passed through the Senate on the 19th June 2013. The Bill is awaiting assent by the Governor-General. The changes will commence the day after the Bill is assented to.

The bill's passage now means the Commonwealth is responsible for ensuring water systems are not impacted by major coal seam gas and coal mining projects. Under the Bill, a person, a constitutional corporation or the Commonwealth (or agency) has committed an offence if they take an action involving coal seam gas development, or large coal mining development, and the action has, will have or is likely to have a significant impact on a water resource, unless they first obtain approval for the action for the Commonwealth environment minister under the EPBC Act.

The existing EPBC Act provides definitions of "coal seam gas development" and "large coal mining development" as any activity involving coal seam gas extraction or any coal mining activity (respectively) that has, or is likely to have, a significant impact on water resources. The definition of a water resource in this amendment is the same as currently used in the Water Act 2007. A water resource relates to ground water and surface water, and includes organisms and ecosystems that contribute to the physical state and environmental value of the water resource.

According to the Department of Sustainability, Environment, Water, Population and Communities guidelines on the definition of a "significant impact", a significant impact is an impact that is important, notable or of consequence, having regard to its context or intensity. A significant impact on water resources may be caused by one development action relating to coal seam gas or large coal mine, or the cumulative impact of such actions. Under the National Partnership Agreement, factors which may directly or indirectly bring about a significant impact on water resources could include those that:

- change in the quantity, quality or availability of surface or ground water;
- alter ground water pressure and/ or water table levels;
- alter the ecological character of a wetland;
- result in rivers or creeks diverted or impounded;
- alter drainage patterns;
- reduce biological diversity or change species composition;
- alter coastal processes, including sediment movement or accretion, or water circulation patterns;
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the environment such that biodiversity, ecological integrity, human health or other community and economic use may be substantially adversely affected; or
- substantially increase demand for, or reduce the availability of water for the environment.

Although the Amendment post-dates the Wallarah 2 Coal Project EIS submission, it would apply to any developments (such as this Project) that are currently referred for a decision that is in the approval process, where the Independent Expert Scientific Committee has not yet given advice.

This means that the department will work closely with the proponent to identify what additional information is required to assess these impacts. The department will rely on information that has already been collected in the existing state and EPBC Act processes as much as possible, to ensure current assessments proceed efficiently.

The transitional arrangements provide that if the process of having a development assessed under the EPBC Act has already commenced, the Minister has 60 days (from the commencement of the Bill) to decide whether the project requires approval in relation to the new water trigger. The Minister then has to advise and consult with the individual proponents affected on the proposed decision for a period of 10 days before a final decision is made.

4.2 2013 EIS

Surface water quality sampling (initiated in 2006) for field water quality parameters and laboratory analysis continued through development of the 2013 EIS. Sampling has been undertaken monthly at thirteen (13) monitoring stations to determine baseline conditions for electrical conductivity (EC), pH, dissolved oxygen (DO), total suspended solids (TSS) and total dissolved solids (TDS) as well as a for number of total metal species and organic compounds, with results provided in Appendix J to the 2013 EIS.

Groundwater sampling for water quality appears to have been limited to measurement of TDS and pH.

- Concentrations of TDS ranged from 1,800 to 7,500 mg/L
- pH values ranged from 6.3 to 7.6.

Additional groundwater modelling was conducted for the 2013 EIS, with two models (W3 and W4) superseding previous models employed (W1 and W2). Models W3 and W4 incorporated some minor changes to the hydraulic conductivity distribution and the subsidence zone distributions.

A peer review of the groundwater modelling was undertaken by Kalf and Associates in accordance with the Murray Darling Basin Commission's "Australian Flow Modelling Guideline".

The water quality management plan operations phase management plan highlights four specific measures for managing surface water quality:

- (I) Diversion of water affected by the mine (stockpiled coal, disturbed areas, product of dewatering) into water holding facilities for re-use or treatment prior to discharge;
- (II) Implementation of appropriate erosion control measures at the discharge point (an energy dissipation device and channel bed protection);
- (III) Design of erosion and sediment control measures based on recommendations from the following guidelines: Managing Urban Stormwater, Soils and Construction, (Landcom, 2004) and Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries (DECC, 2008).
- (IV) Implementation of a number of small sediment traps to treat runoff from the rail loop.

Mitigation measures for groundwater impacts include commitment to repairing damaged bores from subsidence and replacing sub-surface water supplies if groundwater drawdown exceeds expectations. Mitigation for groundwater quality is not directly articulated.

4.3 Key Issues

Surface Water

The 2013 EIS and Appendix J present a fairly thorough assessment of potential impacts to surface water quality during Project operations and identify a framework for managing water in the Project area. The strategy is based on the separation of runoff from undisturbed catchments from water potentially impacted by Project operations. The key objective of the mine water management system is to minimise the risk of untreated mine water being released to receiving waters. However, the impact assessment and the management measures to mitigate potential impacts are not articulated in a number of respects, including the following:

- The construction phase of the Project is not directly addressed in the 2013 EIS and Appendix J to the EIS. The Proponent does not provide an impact assessment, mitigation and management, or monitoring that specifically address potential water quality aspects during construction.

- Erosion of freshly disturbed land and sediment transport to watercourses is often the paramount water quality impact during construction. Management measures for preventing erosion and sediment during construction are not specified. Operations phase mitigation and monitoring is briefly summarised (refer to Mitigation and Management Planning, Section 12.2).
- The potential for generation of AMD as a result of oxidation waste rock and wallrock in the dewatered zone above the underground mining area was again not addressed. Geochemical data should be collected for the Project to identify the acid base accounting characteristics of the waste material and the rock in the unsaturated fractured wallrock zone.
- The surface water monitoring program does not yet include a sampling point immediately downstream of the proposed Wallarah Creek tributary discharge site (the controlled discharge point for the Project). The Surface Water Impact Assessment (Appendix J) mentions that a site will be set-up at the discharge location (monitoring station WTP), but does not provide a date for implementation. Potential impacts related to discharge will be difficult to interpret without an understanding of baseline at this location. Site W6 is downstream of the discharge point on Wallarah Creek, but exists below additional tributary input and does not provide a direct baseline.
- Turbidity data is not provided in the EIS or Appendix J. It is assumed that measurement for this parameter has not been included in the surface water monitoring program. It will be difficult to assess the level of sediment transport from construction and operations related erosion with measurement of TSS alone. WRM (Appendix J) indicate that erosion is significant in Jilliby Creek, “due to the highly dispersive nature of the bed/bank material” and that the flow of this channel may increase with subsidence of the channel.
- Runoff from the Buttonderry Site buildings, parking areas, paved and hardstand areas will be diverted to the Buttonderry Sediment Dam, which would then overflow to the Entrance Dam. The Entrance Dam overflow will discharge into Buttonderry Creek. Modelling indicates that overflow of the Buttonderry Sediment Dam will occur regularly (median of approximately 15 ML/a; 90th percentile discharge of approximately 40 ML/a; and 99th percentile uncontrolled discharge of approximately 67 ML/a). The EIS and Appendix J indicate that overflow will be “clean water”. The model assumes that the sediment dam will sufficiently ‘treat’ the water passively by allowing sediment to settle out. The strategy does not take into account hydrocarbon input from parking facilities and sealed roads, nor that settling dams are often inefficient in containing suspended solids during high flow events.
- Wallarah Creek would be the receiver for storage overflows from the Mine Operations Dam (MOD), Portal Dam and Stockpile Dam, each of which will be comprised of untreated mine water. Sizing of the mine water storages has been based on achieving no uncontrolled discharge to the receiving environment. However, the EIS does not provide contingency for overflow in the event that it does occur.
- Specific management measures are generally not articulated. The 2013 EIS generally refers to management plans that will be subsequently generated to address potential impacts (e.g. Water Management Plan, Erosion and Sediment Plan, etc.).

Groundwater

The baseline assessment for groundwater quality appears to have included measurement of only pH and TDS. The 2013 EIS indicates that the WACJV will develop a Water Management Plan that will include sampling for the following groundwater quality elements:

- *“Quarterly monitoring of pH and EC in selected piezometers and pumped mine water. Such monitoring may provide early indication of the potential mixing of shallow groundwater within deeper strata groundwaters. Whilst this process is expected within the subsidence zone, it may not be evident*

within the wider piezometer network at the leakage levels predicted by groundwater monitoring:

- *Six month measurement of TDS and speciation of water samples in selected piezometers to support identification of mixing of groundwater types. Speciation will include, as a minimum, major ions such as Ca, Mg, Na, K, CO₃, HCO₃, Cl, SO₄, and elements such as Al, As, B, Ba, F, Fe (total), Li, Mn, P, Se, Si, Sr, Zn, and*
- *Graphical plotting of basic water quality parameters and identification of trend lines and statistics including mean and standard deviation, calculated on a quarterly basis. Comparison of trends with rainfall and any other identifiable processes that may influence such trends."*

The Proponent has not identified baseline water quality conditions for the parameters listed above that would provide the basis for comparison with results from construction and operations phase data collected.

Groundwater monitoring was also limited to the W2CP Honeysuckle Park and Buttonderry properties due to restricted access to other existing bores. The EIS specifies that WACJV will endeavour to re-instate monitoring at existing bore locations while the EIS is being reviewed.

Mitigation measures for groundwater impacts are limited to repairing damaged bores from subsidence and replacing water supply if groundwater drawdown exceeds expectations. Mitigation for groundwater quality is not directly articulated.

4.4 Conclusions and Recommendations

The water quality impact assessment for the W2CP 2013 EIS was not conducted according to conventional methodology (e.g. baseline assessment, impact assessment, management measures, residual impact, reporting). Each phase of construction and operations are not considered individually, with water quality impacts and associated management considered almost exclusively for operations. The 2013 EIS focuses on principal potential impacts: subsidence and hydrology (reviewed in a separate report), transference of saline groundwater to additional aquifers, and potentially sediment laden surface water during operations.

The management planning for avoiding or mitigating impacts to water quality is similarly focused on what are considered the most likely and important potential impacts. The 2013 EIS and applicable technical reports (Appendices I and J) provide a framework for water management during operations, whereby impacts to surface water will be avoided by diverting 'clean' surface water that is not affected by mine operations and containment of 'mine' water for reuse, treatment, or subsurface disposal. This analysis is fairly thorough and the water management infrastructure (dams, sediment traps and water conveyance) may prove effective in containing contaminated waters to within the confines of the Project's area.

However, as specified above there are several gaps in the impact assessment for water quality and additional areas that are not comprehensively evaluated. The following measures are recommended to address these gaps:

- **Identify additional potential sources of contaminants and key water quality parameters** beyond potentially saline water abstracted during operations and potentially sediment laden that comes into contact with coal stockpiles (e.g. potential contaminants from equipment and fuel storage areas, workshops and vehicle wash down areas) and specify management plans for avoiding spillage and remediating contaminated areas.

- **Conduct geochemical assessment for potential AMD impact:** Acid base accounting characteristics of the waste rock should be undertaken to ensure adequate assessment of potential impacts of AMD and the identification of appropriate waste rock re-use and disposal strategies. This assessment should include material from the future wallrock in the dewatered zone.
- **Implement and immediately sample from monitoring station WTP** to provide a baseline for water quality conditions at the controlled discharge site.
- **Develop a construction phase erosion and sedimentation plan** that details erosion control measures and sediment control measures that are consider potential impacts from all potential sources during construction (e.g. specific areas of scheduled for vegetative clearance and major earthworks, stockpiles and haul roads. Specific best practices should be identified for each component of construction. Consideration should be given to the following:
 - Minimisation of vegetative clearance area, inclusion of vegetative buffer zones near surface water drainage and clearing vegetation during the dry season only;
 - Conducting major earthworks during the dry season;
 - Application of best practices to construction and maintenance of the unsealed road network (e.g. minimum road cross-fall to shed water; waterbars with discharge outlets and sediment control devices on steep slopes; and armouring of road surfaces);
 - Installation of sediment control measures downstream of construction works and disturbed land areas (e.g. silt fences, sediment basins, sediment traps, fibre rolls); and
 - Progressive revegetation of disturbed land areas, giving priority to high risk erosion areas such as steep slopes and sites close to rivers and creeks.
- **Include turbidity measurement** in all future surface water quality monitoring (pre-construction) to identify baseline conditions.
- **Regularly analyse Buttondery Sediment Dam and the Entrance Dam for hydrocarbons.** Develop a management plan avoiding input of hydrocarbons into the dam and for removal of hydrocarbons well in advance of the first uncontrolled discharge event;
- **Develop a proactive contingency plan for management / treatment of the Mine Operations Dam (MOD)** water that would be enacted should MOD water levels approach potential uncontrolled discharge stages to prevent untreated water from reaching Wallarah Creek.
- **Sample groundwater monitoring bores for applicable water quality parameters** (at the expanded network of existing bores, if possible) at least quarterly prior to construction to establish a baseline for groundwater quality;
- **Develop management plans** committed to in the EIS (e.g. Water Management Plan, Erosion and Sediment Plan, etc.) prior to the onset of construction.

5 Air Quality

5.1 Context

Mechanical disturbance of rock and soil materials from coal mining project construction and operations (e.g. bulldozing, blasting, and hauling on unsealed roads) and wind erosion of stockpiles and bare ground contribute the majority of particulate matter emitted from coal mining operations, the primary air pollutant emitted from coal mining and processing activities. Diesel powered equipment emit additional pollutants during construction and operations and methane flaring and equipment further emit potential pollutants into the atmosphere during coal mining operations.

The air emissions inventory for the Greater Metropolitan Region (GMR) of NSW (OEH, 2003) determined that the coal mining industry is the largest industrial emitter of Total Suspended Particles (TSP), particulate matter with an aerodynamic diameter of less than 10 microns (PM₁₀) and particulate matter with an aerodynamic diameter of less than 2.5 microns (PM_{2.5}) in the region. Other anthropogenic sources of particulate matter (e.g. farming, construction, travel on unpaved roads, etc.) and natural processes (e.g. high intensity wind, forest fires, etc.) contribute to the atmospheric load, therefore the cumulative input of coal mining, ambient conditions, and future development are of particular importance in assessing the potential impacts of Project implementation.

Impacts from particulate matter emission range from nuisance in surrounding communities from soiling or odour and reduced visual amenity to serious adverse health effects and mortality from high concentrations of particulate matter.

Particulate matter pollution is associated with underground and open-cut mining. The *NSW Coal Mining Benchmarking Study: International Best Proactive Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Donnelly et al, 2011) identifies the components of underground coal mining most commonly associated with particulate emission to the atmosphere.

“The main activities that produce emissions of particulate matter at underground mines are:

- Transport of raw coal from the mine to the raw coal stockpile (run-of-mine (ROM) pad). Wind-blown particulate matter from conveyors or wheel generated particulate matter associated with haul trucks.*
- Stockpiling materials on the ROM pad associated with dumping coal from conveyors or trucks. Wind-blown particulate matter from stockpiled coal and emissions associated with transferring coal to the load-in hopper (ROM hopper) of the processing plant.*
- Emissions of particulate matter from the processing plant may occur from the dry processing operations such as crushing and screening. Emissions from wet processing operations tend to be minimal.*
- Washed or processed coal is then transferred to product stockpiles and subsequently to trucks or trains for transport to the end user. Particulate matter emissions can occur due to wind erosion of product stockpiles if they become sufficiently dry and as a result of loading materials from the stockpile (reclaim). Dumping coal into*

rail wagons and trucks will also produce emissions of particulate matter.”

In addition to fugitive dust emissions (or incorporated within fugitive dust), Project activities will contribute oxides of nitrogen, carbon monoxide, sulfur dioxide, and organic compounds from combustion of diesel in mining equipment and from flaring of coal seam methane, emissions associated with combustion of diesel from the ventilation shaft at the Buttonderry site, and greenhouse gasses (such as fugitive methane and carbon dioxide).

5.1.1 Reasons for Refusal 2010

The Minister for Planning did not cite air quality as one of the justifications for refusing the 2010 Project application.

5.1.2 New Director Generals Requirements

The Director General's environmental assessment requirements (DGRs) for the preparation of an EIS for the proposed Wallarah 2 Coal Project, data January 12, 2012, included the following applicable language for water resources and applicable general requirements, which are supplementary to initial DGRs provided for the 2010 EIS:

General Requirements Relevant to Air Quality

“The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

In addition, the EIS must include a:

- ***detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes:***
 - ***a description of the existing environment, using sufficient baseline data;***
 - ***an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and***
 - ***a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and***
- ***consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.”***

Key Issues Relevant to Air Quality

“The EIS must address the following specific issues:

Air Quality – including a quantitative assessment of potential:

- ***construction and operational impacts, with a particular focus on dust emissions including PM_{2.5} and PM₁₀ emissions and the dust generation from coal transport;***
- ***reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such measures available other than those proposed; and***
- ***monitoring and management measures, in particular real-time air quality monitoring”***

5.1.3 New Regulatory Requirements

Protection of the Environment Operations (Clean Air) Regulations 2010 (POEO (Clean Air) Regulation (POEO, 2010))

5.2 2013 EIS

PAE Holmes conducted an assessment for background concentrations of applicable air quality parameters, modelling for Project-related impacts to air quality during operations, and provided management measures that are consistent with the most up to date best practices for the industry in NSW (Appendix L to the 2013 EIS). The CALMET/CALPUFF modelling system was used to simulate the effects of meteorological conditions on pollutant transport, transformation and removal. PM₁₀, TSP and dust deposition have been directly measured and background NO₂ levels, collected as part of the Munmorah Rehabilitation EA, were used to estimate impacts for the W2CP. In the absence of PM_{2.5} data, an estimate was made using ratios of PM₁₀ / PM_{2.5} measured at the closest EPA monitoring sites.

Direct air quality measurement for the Project continued, with two high volume air samplers (HVAS) measuring PM₁₀ on a one day in six cycle, two HVAS measuring total suspended particles (TSP) on a one day in six cycle and six dust deposition gauges located near each of the Tooheys Road and Buttonderry Road Sites.

Local wind data was collected at the Tooheys Road site from 2007 – 2011. Local climatic data compilation also continued through 2011, provided by the Norah Head Automated Weather Station located approximately 10 km southeast of the Project.

For the impact assessment of air quality from Project operations (Appendix L), predicted ground level concentrations for 24-hour average and annual PM₁₀ concentrations, 24-hour average and annual PM_{2.5} concentrations, incremental annual average TSP concentration, incremental ground level dust deposition, incremental ground level odour concentration, ground level concentration of NO₂ from combustion of methane were modelled, with contour plots provided for each. Each considers the likely maximum daily or annual production scenarios from Project activities provided the implementation of best practice management measures listed in Table 7.7 of Appendix L.

5.3 Key Issues

The specialist study provides sound investigation of ambient baseline conditions for applicable parameters, analyses of potential Project-related emissions impacts according to maximum production scenarios, and provides management measures that consider up-to-date best practices for NSW.

However, it appears that the methodology for impact assessment (Section 8) was not undertaken in a manner consistent with applicable legislation (DECC, 2005) and therefore cannot be compared with the associated NSW impact assessment criteria for estimation of potential exceedences. The following gaps in the analyses appear to require attention:

- The modelling for predicted impacts (Sections 8.1 – 8.7) and associated contour plots consider emissions from Project-related operations alone (with exception of the abbreviated cumulative impact assessment discussed below). Predicted impacts from the Project must be summed with respective background concentrations to determine **total impact for each parameter and averaging period**. Instead, the impact assessment compares predicted emissions from Project operations alone against the impact criteria, giving the impression that concentrations of applicable parameters will be compliant with impact criteria, when this may not necessarily be the case.
- The cumulative impact assessment is provided in Section 8.8, which would be suitable for comparison with impact assessment criteria provided the assessment was conducted according to Sections 5 and 7 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005) (refer to below). However, the cumulative impact assessment does not provide all the required information as detailed below:

- Appendix L cumulative impacts (i.e. total impact) for annual concentrations sum average ambient conditions with predicted Project operational emissions (Table 8.2 of Appendix L). According to the approved methodology for this assessment (DECC, 2005), the maximum ambient (background) concentrations should be used. The outcome will likely effect whether predicted emissions exceed impact criteria.

For example, for receptor P11, located at the closest residence to the north of the Tooheys Road Site, the predicted annual average PM₁₀ concentration of 1.6 µg/m³ was added to the average of the HVAC annual PM₁₀ concentrations from 1999-2012 (18 µg/m³) for a total concentration of 19.6 µg/m³ (below the 30 µg/m³ impact criteria). However, the addition of the maximum concentration predicted for the parameter, in this case reported to be 22 µg/m³ for P11, should have been added. The total impact would be quantified as 40 µg/m³ (18 background + 22 predicted), well above the 30 µg/m³ impact criteria.

- For predicted daily maximum PM₁₀ concentrations, a statistical approach (Monte Carlo Simulation) was used to randomly select background daily PM₁₀ concentrations from those measured to be added to predicted operational emissions. While there may be merit in selecting this methodology, *The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005) specifies the use of maximum measured volumes in cases where measurements were not taken often enough to include them in the model (i.e. PM₁₀ concentrations were measured every sixth day). The results, provided in Figure 8.12 of Appendix L, are not very clear given the unit selection of the Y-axis. According to Figure 8.12, daily PM₁₀ concentrations would exceed impact criteria on approximately 20 – 25 days per year.

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005) advises that for use of an approach other than those outline in Section 5 of that report, the Air Technical Advisory Services Unit of the DEC should be consulted.

- A single value was provided for each parameter (average of the two HVAC values) for background concentration, regardless of the location of the receptor. Data recorded at the nearest HVAC would be more applicable. For receptor P11, HVAC-E data for PM₁₀ averaged 21 µg/m³. In averaging the Tooheys Road HVAC data (HVAC-E) with the Buttonderry HVAC data (HVAC-C), the concentration was reduced to 18 µg/m³.
- The cumulative impact assessment (i.e. impact assessment) was conducted for only a subset of the parameters analysed (i.e. 24 hour PM₁₀ and annual PM₁₀, PM_{2.5}, TSP and dust deposition), with the assessment for cumulative NO₂ not assessed quantitatively. Cumulative impacts are not considered for 24-hour PM_{2.5}.

A cumulative impact assessment should capture total impacts (background concentration summed with predicted Project-related inputs) combined with anticipated future development. The cumulative impact assessment, as identified in Appendix L and the EIS, should be renamed the 'Impact Assessment', with a cumulative assessment undertaken that considers planned construction or industry in the region.

- According to Figure 5.2 of Appendix L, 24-hour PM₁₀ concentration (background conditions from HVAC-E) exceeded the 24-hour average goal criteria of 50 µg/m³ on more than 16% of the measurement days. This assumes of the 2,047 days between the 1 October 2006 and 30 April 2012, PM₁₀ was measured on 341 days (i.e. 1 day in 6 measuring cycle). Figure 5.2 identifies 55 days that exceeded 50 µg/m³ for 24-hour PM₁₀ (approximately 16%) at HVAC-E. In Section 5.2.1 of the specialist study, it is noted that the HVAC-E data is 90-93% complete, therefore more than 16% of the measurement days may have exceeded 50 µg/m³ for average 24-hour PM₁₀ as PM₁₀ was measured for less than 341 days..
- Data provided in Table 5.3 is considerably different for HVAC-E measured days above the 24-hour PM₁₀ goal criteria of 50 µg/m³ for 2006 – 2012 (12 days, or ~4% of measurement days). This discrepancy (as compared to Figure 5.2) is fairly significant and should be clarified.
- The dispersion model was not run for impacts during construction. The justification provided is that because construction related air quality impacts are estimated to be less than 35% of the emissions estimated to occur during operations, compliance with impact criteria during operations would necessarily translate to compliance during construction. Provided the uncertainty regarding compliance with impact criteria during operations, this assumption may not be justified. For example, given that ambient conditions for PM₁₀ exceed criteria on occasion, air quality impact criteria during construction and operations will both exceed 50 µg/m³ for an undetermined number of days per year.

Determination of Total Impacts

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005) provides the criteria for application of impact assessment in Section 7.1.2 of the plan. The assessment criteria (e.g. 50 µg/m³ average PM₁₀ for 24 hours) "must be applied as follows:

1. *At the nearest existing or likely future off-site receptor*
2. *The incremental impact (predicted impacts due to the pollutant source alone) for each pollutant must be reported in units and averaging periods consistent with the impact assessment criteria.*
3. **Background concentration must be included using the procedures specified in Section 5.**
4. *Total impact (Incremental plus background) must be reported at the 100th percentile in concentration or deposition units consistent with the impact assessment criteria and compared with the relevant impact assessment criteria."*

Section 5.1.1 Accounting for background concentrations (referred to in item number 3, above) provides the following:

"For impact assessments of sulfur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃), PM₁₀, total suspended particulates (TSP), deposited dust, lead (Pb), carbon monoxide (CO) and hydrogen fluoride (HF), the existing background concentrations of the pollutant in the vicinity of the proposal should be included in the assessment as follows:

Level 1 Assessment

- Obtain ambient monitoring data that includes at least one year of continuous measurements.
- **Determine the maximum background concentrations of the pollutant being assessed for each relevant averaging period.**
- At the maximum exposed off-site receptor, add the **maximum background concentration** and the 100th percentile dispersion model prediction to obtain the total impact for each averaging period.

The Level 2 assessment criteria (DECC, 2005) do not apply as HVAC measurements need to have been conducted daily to add daily measured averages to the daily modelled averages.

Exceedences in the EPA's impact assessment criteria

Where impact assessment criteria will likely be exceeded (e.g. for PM₁₀), DECC (2005) specifies the following:

If the EPA's impact assessment criteria are exceeded, the dispersion modelling must be revised to include various pollution control strategies until compliance is achieved. To determine incremental increases in the cost of air pollution abatement, a sensitivity analysis can be carried out by varying:

- source release parameters
- separation distance
- efficiency of pollution control equipment
- level of management practice.

The results can be used to select the most cost-effective and environmentally effective control strategy.

For circumstances where background concentrations regularly exceed impact assessment criteria, the EPA should be consulted.

2013 EIS, Air Quality Impact Assessment

The 2013 EIS provides a summary of baseline conditions, impact assessment and mitigation and management measures provided in Appendix L. For some aspects, the EIS does not clearly convey the results of the impact assessment or the management measures provided in Appendix L. For example:

- In Section 7.5.3, the EIS summarises results of the cumulative assessment, indicating that the Project is unlikely to result in additional exceedences of relevant impact assessment criteria at the neighbouring receivers. As background concentrations of PM₁₀, for example, commonly exceed impact criteria and the Project is predicted to add as much as 27 µg/m³ at the nearest receptor, the accuracy of this determination requires consideration.
- The EIS provides a summary of recommended management and mitigation measures, but the list is slightly less comprehensive than that described in Appendix L.
- Predicted emission concentrations from dispersion modelling assume Project implementation of best practices listed in Table 7.7 of Appendix L. Therefore, these estimates are only relevant provided Project implementation of these controls.
- It is difficult to determine whether the EIS is committed to management and mitigation measures provided in Appendix L, or whether these are considered recommended best practices.

5.4 Conclusions and Recommendations

The assessment of ambient conditions (background concentrations) of applicable parameters, modelling for impacts during Project operations for these parameters, and recommendations for applicable best practices were thorough and conducted according to approved guidelines and current best practices. However, the impact assessment should be conducted according to the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005), with predicted emissions added to maximum background concentrations measured at the applicable monitoring station. Contour plots and comparison to applicable impact criteria should address total impacts instead of emissions from Project operations alone. Modelling should be conducted for the construction phase of project implementation, with total impacts determined as above. Cumulative impacts should address potential near-term development in the Project area (if applicable).

As dispersion modelling for each parameter was conducted under the assumption of Project implementation of mitigation and management measures provided in Table 7.7 of Appendix L, the Proponent should clearly demonstrate commitment to these measures. The management and mitigation measures should be further developed in the Air Quality Management Plan for the Project. Some of the measures identified should be described in detail (e.g. specific speed limits, progressive rehabilitation plans for disturbed areas, etc.) according to *Coal Mining Benchmarking Study: International Best Proactive Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Donnelly et al, 2011).

SO₂ was not measured for this assessment. The inclusion of this parameter during construction and operations phase monitoring should be considered.

Further details regarding reactive management strategies for exceedences (particularly PM₁₀) and provision for investigations in response to complaints should also be provided in the Project's Air Quality Management Plan. A robust report reporting strategy will be needed, to enable reactive management to exceedences of impact criteria for applicable parameters measured for hourly or daily concentrations.

6 Greenhouse Gases

6.1 Context

6.1.1 Reasons for Refusal 2010

The Minister for Planning did not cite greenhouse gas emissions as one of the reasons for refusing the 2010 Project application.

6.1.2 New Director General's Requirements

The Director General's Requirements issued to the Proponent in 2012 require the EIS to include the following:

Greenhouse Gases – including:

- ***A quantitative assessment of potential Scope 1, 2, and 3 greenhouse gas emissions;***
- ***A qualitative assessment of the potential impacts of these emissions on the environment;***
and
- ***An assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency***

In addition, the Supplementary Director General's Requirements was also issued in July 2012 in accordance with section 78A (8A) of the *Environmental Planning and Assessment Act 1979*. In relation to greenhouse gases, the EIS must also include the following (summarised extract) as stated in the Supplementary Director General's Requirements (full reference can be found in Appendix B):

Proposed safeguards and mitigation measures

7. A description of feasible mitigation measures, changes to the action or procedures, which have been proposed by the proponent or suggested in public submissions and which are intended to prevent or minimise impacts. Information must include:

- a. Description of the mitigation measures, these measures should be justified and based on best available practices;**
- b. An assessment of the expected or predicted effectiveness of the mitigation measures;**
- c. Any statutory or policy basis for the mitigation measures;**
- d. The cost of the mitigation measures;**
- e. An environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs (including any relevant thresholds for corrective actions). Include the person or agency responsible for implementing these programs and any provision for independent environmental monitoring;**
- f. The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;**
- g. Identification of mitigation measures proposed to be undertaken by State or local governments or the proponent.**
- h. Any changes to the action which prevent or minimise relevant impacts on listed threatened species or communities.**

6.1.3 New Regulatory Requirements

Carbon Pricing Mechanism (Carbon Tax)

The carbon pricing mechanism started on 1 July 2012. It applies to Australia's biggest polluters who have to report on, and pay a price for, their carbon pollution. This creates incentives to reduce emissions.

The price is fixed each year for the first three years, starting at \$23/tCO₂e in 2012 – 2013. The price will then be set by the market in 2015 – 2016.

Clean Energy Act 2011

The Clean Energy Act 2011 sets up the carbon pricing mechanism and contains rules for who is covered by the carbon pricing mechanism, what sources of carbon pollution are included, the surrender of emissions units, caps on the amount of carbon pollution from 1 July 2015, international linking, monitoring, enforcement, and appeal and review provisions.

6.2 2013 EIS

6.2.1 Quantification of Greenhouse Gas Emissions

Greenhouse gas emissions calculations have been updated to include more thorough analysis on each of the activity producing Scope 1, 2, and 3 emissions compared to the 2010 EIS (Scope 1: direct emissions, Scope 2: indirect emissions with respect to purchased electricity, and Scope 3: general indirect emissions).

In relation to estimating fugitive methane emissions (Scope 1), a site specific emission factor has been determined based on a gas content testing by Geogas in 2011. Separate calculations have been made to distinguish between the emissions of the methane gas due to flaring and the emissions of the methane gas due to venting (via Mine Ventilation Air).

The end-of-use coal emissions (emissions from the combustion of product coal) has been also been updated to include the total mass of the coal and multiplied by the emission factor from NGA Factors.

6.2.2 Impact of Greenhouse Gas Emissions

The EIS estimates the Project's greenhouse gas emissions impact by drawing comparison between the Project's Scope 1 emissions and estimates for the total global (2005 data) and national anthropogenic total emissions (2009 data). The Project's Scope 1 emissions would represent 0.04% of Australia's allowance under the first Kyoto Protocol commitment and a very small portion of global emissions.

An attempt to quantify the temperature increase associated with various global warming scenarios has also been carried out for towns/cities closest to the Project. This has been derived from studies conducted by CSIRO (2007). It is noted that the Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions.

The 2013 EIS has also included an analysis on the impact carbon tax has on the Project. A benefit cost analysis and sensitivity analysis has been conducted and are shown in Appendix W: Economic Impact Assessment.

6.2.3 Greenhouse Gas Mitigation and Management

Due to the proposed flaring activities during operations of the Project, it is claimed in the EIS that when compared with 100% fugitive emissions of methane venting only, the flaring scenario results in GHG saving of approximately 54% of Scope 1 emissions over the Project life.

6.3 Key Issues

Quantification of Greenhouse Gas Emissions

- Assumptions and methodology (with references) need to be more clearly stated in estimating the greenhouse gas emissions. Due to uncertainties in the methodology used, it cannot be determined whether the figures presented are accurate. Earth Systems' internal calculations did not produce the same results as stated in the report. It is possible that the 2013 EIS has underestimated the emissions from fugitive methane flaring and venting;
- The use of NSW stationary power plant emission factors to represent end-use of coal in another part of the world requires justification; and
- Emissions from the shipping of the product coal have been excluded due to the difficulties in emission estimates. To understand the potential magnitude of such emissions, a conservative scenario should have been assumed and modelled. Emission factors for shipping of bulk commodities are available (e.g. from IPCC reports) and could be applied. It is likely that this Scope 3 emission source will be significant.

Impact of Greenhouse Gas Emissions

- The impact assessment is largely based on the Project's Scope 1 direct emissions only. When considering the impact in national and global context, all three scopes of emissions should be included to reflect the overall impact (direct and indirect) of the Project's construction, operation, and closure activities. Limited attention has been given to the most significant GHG emission activity – the 'energy production' emissions (emissions from the use and combustion of the product coal) – although it is the largest source of total Project emissions (representing ~98% of total Project emissions);
- The Project's total emissions impact in the national and global context has not considered recent scientific literature regarding greenhouse gas emissions and impacts, such as:
 - The Global Carbon Budget of 750 GtCO₂e should be used as a basis for assessing the Project's total emissions (including Scope 1, 2 and 3) contribution. The Project would represent 0.05% of total international greenhouse gas emissions under the Global Carbon Budget approach.
 - No consideration has been given to the implications of recent International Energy Agency (IEA) analysis regarding remaining Global Carbon Budget and what proportion of existing known fossil fuel reserves must not be combusted. The IEA in the World Energy Outlook report (2012) indicated that to "*no more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2 °C goal*".
 - There is no mention of the internationally agreed threshold of limiting anthropogenic global warming to 2 degrees above pre-industrial levels, nor is there analysis conducted on long term impacts at 2100, which is a standard scientific reporting timeframe. Discussion of global warming impacts at projected temperature increases of 4 to 6 degrees in 2100 would have been more appropriate.

- The local impact of the Project's emissions will be better perceived by the public if the emissions associated with operations are compared to the WSC region's baseline emissions.

Greenhouse Gas Mitigation and Management

- The limited list of possible greenhouse gas emission reduction strategies stated in 2013 EIS does not meet the 2013 Director-General's Environmental Assessment Requirements and the Supplementary Director General's Requirements. There are many more significant greenhouse gas emission reduction measures that could be undertaken than those mentioned. A comprehensive review of international best practice mining energy efficiency should be conducted by the Proponent, with particular emphasis on reductions to the major extraction emissions; and
- As part of managing carbon tax liability, it may be worth considering carbon offset mechanisms (e.g. actual purchase of carbon credits for offsetting purposes or co-investment in local renewable energy projects). The latter would represent a long term tangible emission reduction measure, for example through funding a local renewable energy plant to offset a certain percentage of the Project's annual emissions.

6.4 Conclusions and Recommendations

Calculations carried out in estimating greenhouse gas emissions are generally well conducted and are in accordance with the National Greenhouse and Energy Reporting (Measurement) Determination (DCCEE, 2008) and the National Greenhouse Accounts Factors July 2012 (DCCEE, 2012) methodology. The calculations have included the majority of emission activities and Scopes 1, 2, and 3.

However, the greenhouse gas emission mitigation strategies are very brief, do not demonstrate a sufficient level of commitment by the Proponent to reduce emissions, and do not adequately address the terms listed in the Director-General's Environmental Assessment Requirements and the Supplementary Director-General's Requirements (as mentioned in Section 6.1.2).

In order to fully address these requirements and to achieve emissions reduction during construction and operation, the following key actions are considered necessary:

- Develop more detailed approaches for implementing the proposed greenhouse gas reduction measures. For example, conduct feasibility assessments of each proposed measure including establishment of best practice, document planning and management of measures to be implemented, list goals to be achieved and develop a monitoring framework, as well as conducting financial assessments).
- Provide a more realistic assessment of greenhouse gas (GHG) impacts by including Scope 2 and 3 emissions sources in the analysis of the GHG impacts and updating impacts of the Project on anthropogenic global warming, such as using a Global Carbon Budget approach as defined in the scientific literature.

7 Ecology

7.1 Context

7.1.1 Reasons for Refusal 2010

The Minister for Planning cited the following reasons for the refusal of the 2010 Project application in relation to ecological issues:

- *Uncertainty around the ecological impacts of the project, particularly in the western portion of the site, as a result of a lack of ecological survey effort combined with uncertainty as to subsidence predictions in this area;*
- *Uncertainty around the subsidence predictions for the project, particularly in the western portion of the site under Jilliby Conservation Area and the Wyong State Forest.*

7.1.2 New Director General's Requirements

In relation to ecological issues, the 2012 DGRs state that the EIS must address the following:

Biodiversity

- ***Measures taken to avoid, reduce or mitigate impacts on biodiversity;***
- ***Accurate estimates of proposed vegetation clearing;***
- ***A detailed assessment of potential impacts of the development on any:***
 - ***Terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems (including the following threatened species: Angophora inopina, Cryptostylis hunteriana, the Giant Barred Frog (Mixophyes iterates), the Stuttering Frog (Mixophyes balbus), the Littlejohns Tree Frog (Litoria littlejohnni);***
 - ***Migratory bird species listed under CAMBA, JAMBA and/or ROKAMBA; and***
 - ***Regionally significant remnant vegetation, or vegetation corridors;***
- ***Impacts on Jilliby State Conservation Area, including impacts on the conservation and recreational values of the reserve and landowner consent issues; and***
- ***A comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.***

The Supplementary DGRs aim to ensure that sufficient information is provided to assess the potential impacts to State biodiversity and Commonwealth Matters of National Environmental Significance (MNES). A summary of the Supplementary DGRs in relation to ecological issues is provided below (refer Appendix B for the full document):

Description of the existing environment**3. A description of the existing environment of the proposed location and the surrounding areas that may be affected by the action, including but not limited to:**

- a. Surveys using accepted methodology for targeting EPBC listed threatened species and their respective habitat, including but not limited to OEHS (2009) and DSEWPaC (2013) guidelines;**
- b. A description of the distribution and abundance of threatened species, as well as suitable habitat (e.g. breeding, foraging) within the site and in surrounding areas that may be impacted by the proposal. Specifically, this must include but not be limited to the Charmhaven Apple (*Angophora inopina*), Black-eyed Susan (*Tetraheca juncea*), Spotted-tail Quoll (*Dasyurus maculatus maculatus*) and Giant Barred Frog (*Mixophyes iterates*);**
- c. The regional distribution and abundance of suitable and potential habitat for EPBC listed threatened species surrounding the site.**

Description of the relevant impacts of the controlled action**4. An assessment of all relevant impacts with reference to the EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance (2009) that the controlled action has, will have or is likely to have on relevant threatened species and/or ecological communities. This includes impacts such as vegetation removal, ground subsidence and alteration of hydrological processes on species including but not limited to Charmhaven Apple, Black-eyed Susan, Spotted-tail Quoll and Giant Barred Frog. Information must include:**

- a. A description of the relevant impacts of the action on MNES;**
- b. Detailed assessment of the nature and extent of the likely short term and long term relevant impacts;**
- c. A statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;**
- d. Analysis of the significance of the relevant impacts;**
- e. Any technical data and other information used or needed to make a detailed assessment of relevant impacts.**

5 & 6. A description of the relevant impacts on the Charmhaven Apple and the Giant Barred Frog should include an analysis of the current distribution and/or potential habitat on the site. It should also include direct, indirect, cumulative and facilitative impacts on the:

- a. Extent of the population, including connectivity to populations on the site and in the surrounding area;**
- b. Quality or integrity of the populations;**
- c. Abiotic factors necessary for the survival of the species, particularly impacts associated with ground subsidence and alteration to ground and surface hydrology.**
- d. These impacts should be described for both the construction and operational phases of the controlled action.**

Proposed safeguards and mitigation measures**7. A description of feasible mitigation measures, changes to the action or procedures, which have been proposed by the proponent or suggested in public submissions and which are intended to prevent or minimise impacts. Information must include:**

- a. Description of the mitigation measures, these measures should be justified and based on best available practices;**

- b. An assessment of the expected or predicted effectiveness of the mitigation measures;**
- c. Any statutory or policy basis for the mitigation measures;**
- d. The cost of the mitigation measures;**
- e. An environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs (including any relevant thresholds for corrective actions). Include the person or agency responsible for implementing these programs and any provision for independent environmental monitoring;**
- f. The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;**
- g. Identification of mitigation measures proposed to be undertaken by State or local governments or the proponent.**
- h. Any changes to the action which prevent or minimise relevant impacts on listed threatened species or communities.**

Offsets

- 8. Any residual impacts should be offset to ensure protection of MNES. Reference should be made to the department's draft policy statement, including any revisions to this statement, and:**
 - a. Description of any offset package including how the offset compensates for the residual impacts, when the offset will be delivered and how the offset will be managed;**
 - b. An assessment of the impact of the offsets on other matters of environmental, economic or social significance; and**
 - c. Analysis of cost, both financial and other, related to offsets.**

7.1.3 Earth Systems Recommendations 2010

In relation to ecological issues, Earth Systems' 2010 EIS Review recommended:

- Further ecological surveys and assessment, including comprehensive Commonwealth threatened species and aquatic fauna surveys.

Key issues identified with the 2010 EIS included:

- The ecological assessment had been undertaken without the establishment of an adequate baseline.
- Only limited field surveys were conducted for the proposed mining area, which is particularly significant given the potential presence of Commonwealth threatened species in the area. Detailed field information on these species was not able to be provided in the EA.
- No current field baseline had been established for aquatic fauna.

7.1.4 New Regulatory Requirements

Environment Protection and Biodiversity Conservation (EPBC) Environmental Offsets Policy 2012

The new policy outlines the Australian Government's commitment to the use of environmental offsets and replaces the draft policy statement *Use of environmental offsets under the EPBC Act (2007)*. The policy and associated offset calculation guidelines provide much more transparency about the suitability of offsets. The decision to approve a proposed action considers the suitability of proposed offsets. This new policy applies to "any new referrals and variations to approval conditions from 2 October 2012. It also applies to any projects currently under assessment for which a proposed decision has not yet been made" (DSEWPC 2012).

Forestry Act 2012

The new act repeals the *Forestry Act 1916* and the *Timber Marketing Act 1977* to provide for the dedicated management and use of state forests and crown timber land for forestry and other purposes. Additionally, the Act serves to constitute the Forestry Corporation of New South Wales as a statutory state owned corporation. The western portion of the proposed mining Project is within the Wyong State Forest.

7.2 2013 EIS

Catchments and State Forests in the vicinity of the Project are discussed in Chapter 2 of the main EIS Report by Hansen Bailey. Potential ecological impacts and proposed management/mitigation measures are discussed in Chapter 7 (Sections 7.9 and 7.10).

These sections are based on the specialist studies provided as appendices to the EIS as follows:

- Appendix O: Cumberland Ecology (2013) Wallarah 2 Coal Project Ecological Impact Assessment.
- Appendix P: Marine Pollution Research Pty Ltd (2013) Wallarah 2 Coal Aquatic Ecology Impact Assessment

Additional work conducted for the 2013 EIS in relation to terrestrial and aquatic biodiversity is summarised below.

7.2.1 Terrestrial Biodiversity

Additional terrestrial vegetation mapping, flora and fauna surveys were conducted within the eastern and western portions of the proposed mining Project area since the 2010 EIS submission (

Table 7.1). Vegetation mapping was conducted and vegetation condition assessed throughout the entire Project Boundary (except for in areas with logistic constraints, e.g. difficult terrain). Based on these field surveys and satellite imagery, an overall assessment of the vegetation within the Project Boundary was conducted.

Quadrats and transects within the eastern portion of the Project Boundary and two quadrats around the Western Ventilation Shaft were assessed for all vascular plants and targeted for threatened species and orchids. Fauna habitat surveys, particularly focused on the presence of tree hollows, was predominantly conducted in the eastern portion of the Project Boundary. All vertebrate species (except fish) were surveyed for throughout the entire site, using a variety of methods. These surveys were much more comprehensive (both spatially and taxonomically) than previous work conducted for the 2010 EIS.

Table 7.1 A summary of additional field biodiversity surveys conducted for the Wyong 2 Coal Project EIS

| Year/s | Assessment conducted | Area/s assessed |
|-----------|--|--|
| 2009-2012 | <ul style="list-style-type: none"> • Vegetation mapping • Vegetation condition | <ul style="list-style-type: none"> • Buttonderry • Tooheys Rd • Hue Hue Rd Offset • Western Project (Extraction) Area (mostly along public roads) • Western Ventilation Shaft • Honeysuckle Park |
| 2009-2012 | <ul style="list-style-type: none"> • Flora surveys (quadrats) | <ul style="list-style-type: none"> • Buttonderry |

| | | |
|-----------|---|---|
| | <ul style="list-style-type: none"> Targeted threatened flora species surveys Orchid surveys | <ul style="list-style-type: none"> Tooheys Rd Hue Hue Rd Offset Western Ventilation Shaft |
| 2012 | <ul style="list-style-type: none"> Targeted <i>Angophora inopina</i> and <i>Melaleuca biconvexa</i> searches | <ul style="list-style-type: none"> Buttonderry Tooheys Rd |
| 2009-2012 | <ul style="list-style-type: none"> Fauna habitat assessment Tree hollow assessments | <ul style="list-style-type: none"> Buttonderry Tooheys Rd Hue Hue Rd Offset |
| 2009-2012 | <i>Fauna surveys</i> <ul style="list-style-type: none"> Ground and arboreal mammals Micro-bats Nocturnal mammals, birds and amphibians Diurnal birds Reptiles and amphibians | <ul style="list-style-type: none"> Western Project (Extraction) Area Tooheys Rd Hue Hue Rd Offset Buttonderry |

7.2.2 Aquatic Biodiversity

A new Aquatic Ecology Impact Assessment was commissioned for this EIS (Appendix P). The study involved a broad, catchment-wide literature and database review of the current aquatic ecology of the region and included an assessment of potential impacts from the Project on local and downstream ecology and aquifers (Table 7.2). The study also surveyed local rivers and tributaries for flora, fauna, ecological communities, water quality and stream health over three seasons. In addition, boreholes were assessed for the presence of stygofauna in aquifers near to the proposed mining operations in the western portion of the Project Boundary.

Table 7.2 Summary of the baseline aquatic ecology study undertaken for the Wyong 2 Coal Project EIS

| Year/s | Assessment method | Area/s assessed |
|-----------------------------------|--|---|
| 2011 | <ul style="list-style-type: none"> Literature review | <ul style="list-style-type: none"> Walarah Creek sub-catchment Wyong River sub-catchment |
| Autumn/Spring 2011 Autumn 2012 | <ul style="list-style-type: none"> Macroinvertebrates AusRivAS sampling Fish and other vertebrates Stream condition Aquatic plants Water quality Aquatic groundwater dependent ecosystems | <ul style="list-style-type: none"> Wyong River Jiliby Jiliby Creek Little Jiliby Jiliby Creek Spring Creek Walarah Creek Buttonderry Creek Hue Hue Creek |
| 2010 | <ul style="list-style-type: none"> Stygofauna (13 bores) | <ul style="list-style-type: none"> Jiliby Jiliby Creek Little Jiliby Jiliby Creek Honeysuckle Park |

7.3 Key Issues

Description of the existing environment

The additional aquatic surveys conducted have allowed the aquatic baseline of the Project to be described based on field surveys, which was not conducted in the previous EIS. The additional terrestrial ecology surveys conducted have also increased the robustness of the ecological baseline, although there are still some aspects not well covered as described below.

- The Study Area (defined as the Project Boundary) did not include a continuous buffer around the Project infrastructure and extraction zone. In some parts, the Infrastructure Boundary and Project Boundary shared the same “boundary line” or were very close to each other (e.g. along the Motorway Link Road). This is not consistent with the OEH’s *Survey and Assessment guidelines* (2009) which require fauna surveys to be conducted in a continuous buffer zone around the Project Boundary to allow for the consideration of potential impacts on highly mobile fauna, as well as indirect impacts on flora and fauna in the surrounding area.
- Confirmation of the results of the database searches of fauna occurring in the wider region was not adequately conducted. A search for existing records was conducted in a 10 km radius of the centre of the Project, but no confirmation of these results was conducted. An (on site) overview assessment of the surrounding region could have provided much more information about the species potentially (indirectly) impacted by the Project. This could have simply involved incidental records and vehicular inspection along roads.
- Detailed flora quadrat surveys (including surveys for threatened species) were not conducted throughout the Subsidence Impact Limit area. It was noted that incidental observations were taken when conducting other surveys, but no justification was provided as to why quadrats were not completed in other areas (especially in the Jilliby State Conservation Area and Wyong State Forest).

One of the 2012 DGRs is for the EIS to provide (3b) “a description of the distribution and abundance of threatened species”. A statement of abundance and distribution of threatened species has been included for surveyed sites in the eastern portion of the Project Boundary. However, no detailed threatened species population distribution and abundance estimates of the Project Boundary (as a whole) and surrounding area were provided based on available information.

Description of the relevant impacts of the controlled action

Descriptions of the relevant impacts of the Project are discussed briefly within the main text of the 2013 EIS and further detail is provided within two appendices (Appendices O and P). Main findings of the review regarding ecological impacts are as follows:

- The 2012 DGRs specifically require impacts on Jilliby State Conservation Area to be considered in relation to biodiversity. The potential impacts on this area are not specifically discussed in the main text of the EIS, although there is some discussion of likely impacts of subsidence in the conservation area within the relevant Appendices.
- The assessment of the likely extent of indirect impacts on fauna in the main text of the 2013 EIS is too general. For example, Section 7.9.3 indicates that indirect impacts may include “Lighting spillage effects as a result of infrastructure areas” but does not include an assessment of the potential magnitude or duration of this impact. The assessment of indirect impacts of issues such as lighting are also very general in the relevant Appendices and conclusions are largely unjustified. For example, Appendix O states that “light pollution is unlikely to have a significant long term impact on any fauna species” (Section 6.3.2). This statement implies that all fauna species are unlikely to be impacted in the long-term; however some disturbance-intolerant species may flee and not return. Some nocturnal species may also be attracted by an increase in

insect activity around the lights. These impacts may continue for the life of the Project and possibly beyond, and should be appropriately considered in the EIS.

- One of the Supplementary DGRs (4c) states that the EIS is required to include “a *statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible*”. Many of the potential ecological impacts listed in the 2013 EIS can be unpredictable and/or irreversible, yet these issues are not discussed in detail in either the main text of the EIS or the relevant appendices (O and P).
- There is limited evidence provided for the conclusion that the impact on species/communities resulting from subsidence “*are expected to be minor and temporary*” (section 6.2.5 of Appendix O) and the level of uncertainty of this conclusion has not been identified. Ecological systems are inherently complex and potential impacts are often unpredictable. Some impacts on ecological values from subsidence may be unpredictable, and it is possible that some impacts could be severe and long-lasting. Given that the NSW Scientific Committee have listed “Alteration of habitat following subsidence due to longwall mining” as a Key Threatening Process, a detailed assessment of these potential impacts and uncertainties should have been included in the 2013 EIS.
- Very limited detail was provided in the EIS main text regarding potential ecological impacts during the different phases of the mine (i.e. construction, operation, closure). There are expected to be markedly different potential impacts on flora and fauna in these three phases. Potential impacts associated with each phase should be clearly identified. The 2012 Supplementary DGRs state that “*impacts should be described for both the construction and operational phases of the controlled action*” for the Charmhaven Apple and Giant Barred Frog (Art. 5 & 6).

Proposed safeguards and mitigation measures

Key findings regarding the proposed safeguards and mitigation measures are:

- A costing of mitigation measures is required by the Supplementary DGRs (Art 7d) but this has not been provided in detail. Brief costing information is found within Appendix O however is not provided within the main EIS text.
- A detailed *environmental management plan* has not been included, which is required by the Supplementary DGRs (Art 7e). However, details regarding the contents of the management plan have been discussed.
- Details of rehabilitation/revegetation procedures to be implemented have not been provided (relevant procedures briefly discussed in Appendix O).

Biodiversity Offset Strategy

Key findings regarding the proposed offset strategy are:

- The Biodiversity Offset Strategy has been developed based on NSW State and 2007 Commonwealth policy guidelines. For the EPBC Act listed species identified within the Project Boundary the Biodiversity Offset Strategy should have been developed in accordance with SEWPac's new Environmental Offsets Policy (2012). As stated in DSEWPC (2012), this policy “*applies to any projects currently under assessment for which a proposed decision has not yet been made*”, which includes the current Project. In addition, the Supplementary DGRs (Art 8) specifically states that “*reference should be made to the department's draft policy statement, including any revisions to this statement*”.
- Some information on costs of the Biodiversity Offset Strategy has been provided. However limited detail is provided and this is unlikely to meet the requirement of the Supplementary DGRs (Art 8c) to provide “*an analysis of cost, both financial and other, related to offsets*”.

- The Biodiversity Offset Strategy has not appropriately taken into account the precautionary principle which is required in the absence of scientific certainty in accordance with SEWPaC's Environmental Offsets Policy (2012). Much of the Subsidence Impact Limit area could not be surveyed due to limited access and difficult terrain, however it is highly likely that EPBC and TSC Act species inhabit the area. Due to the likely impact of subsidence on these areas, appropriate offsets for the Subsidence Impact Limit area that were unable to be surveyed should be included in the Biodiversity Offset Strategy.
- Offset areas have been proposed for land beside the Project infrastructure. It is highly likely that these areas will be indirectly impacted by mining activities over the life of the Project. Although the Proponent has proposed a buffer (of unknown size) around the offsets to allow for greater protection, highly mobile fauna (especially species with large territories) are likely to avoid these areas. Disturbance tolerant species (e.g. Noisy Miner *Manorina melanocephala*) will probably use the offset areas, but sensitive species (especially threatened) may not use these areas near to the disturbance source (i.e. negating one of the purposes of the offset).
- No details have been provided as to how offsets for impacted vegetative and fauna species have been calculated.

7.4 Conclusions and Recommendations

In general, the 2013 EIS provides a much more comprehensive understanding of the ecological characteristics present within the Project Boundary than was previously presented in the 2010 EIS. Most of the 2012 DGRs and Supplementary DGRs have been addressed. However, there are several requirements that have not been adequately addressed, particularly in relation to the coverage of baseline surveys, assessment of indirect impacts and the approach to the Biodiversity Offset Strategy.

Clarification of the issues identified will be required to ensure that the potential impacts on flora and fauna are adequately assessed and an appropriate management and offset strategy are in place to address these impacts. Further survey work will also be required if these issues are unable to be addressed based on existing data.

One of the key 2012 DGRs is for the EIS to provide (3b) "*a description of the distribution and abundance of threatened species*", however this requirement has not been adequately met in the revised EIS. While a statement of abundance and distribution of threatened species has been included for the eastern portion of the Project Boundary, no detailed threatened species population distribution and abundance estimates of the Project Boundary (as a whole) and surrounding area were provided. Threatened species abundance estimates should be calculated for the entire Project Boundary, including estimates for the surrounding area (i.e. within a buffer zone).

The flora baseline surveys were found to have not adequately covered the Subsidence Impact Limit area. It is therefore recommended that further detailed surveys for flora be conducted to establish a robust flora baseline for the Subsidence Impact Limit (or justification provided as to why significant areas are not able to be surveyed within this zone, and particularly in Jilliby State Conservation Area and Wyong State Forest).

Very limited detail was provided regarding potential indirect impacts on flora and fauna in the area surrounding the Project Boundary. Furthermore, fauna surveys were not conducted in a continuous buffer zone around the Project Boundary to allow for the consideration of potential impacts on highly mobile fauna, as well as indirect impacts on flora and fauna as required by OEH's *Survey and Assessment guidelines* (2009). It is therefore recommended to conduct further baseline surveying within a continuous zone around the Project Boundary. Potential indirect impacts on flora and fauna should then be described in detail in EIS and management measures should be developed accordingly.

The Biodiversity Offset Strategy for flora and fauna species in the 2013 EIS does not take into account the new Environmental Offsets Policy released in October 2012. It is therefore recommended that the Biodiversity Offset Strategy for threatened species is revised based on the latest policy (or evidence be provided of approval from SEWPaC that assessment based on the State recommendations is acceptable). This should also include a much more comprehensive costing of the offsets, to ensure the Supplementary 2012 DGRs are met appropriately.

Considering much of the Subsidence Impact Limit area could not be surveyed due to difficult terrain or access limitations, the precautionary principle should be adopted. It is highly likely that EPBC and TSC Act species inhabit the area and due to the likely impact of subsidence, appropriate offsets for this area should be included in the Biodiversity Offset Strategy. DSEWPaC be consulted regarding the most suitable way to offset the impact on the threatened species potentially inhabiting this western portion of the Project Boundary.

Finally, it is recommended that the suitability of currently proposed offsets for fauna habitat should be reviewed as the proposed offset areas include land is located directly adjacent to the mine disturbance areas and therefore will not be appropriate offsets until the closure of the mine.

A detailed *environmental management plan* should be developed as required by the Supplementary DGRs (Art 7e). This should include specific sections covering terrestrial and aquatic biodiversity management and monitoring. It is hard to assess the impact on the ecology from the Project without an explicit ecological management and monitoring plan.

8 Noise and Vibration

8.1 Context

The impacts of exposure to noise emission from industrial activity (and associated activities, including construction, operations, and transport of personnel / product) range from nuisance levels to intensities that may degrade health and well-being. While there is variability in response to elevated noise according to individual receptors, decibel levels and the frequency and timing of disturbance; scientific evidence has demonstrated that impacts from construction and industrial operations can sufficiently compromise health and well-being for humans and animals to warrant diligent impact assessment and mitigation measures where required.

Similarly, vibrations resulting from construction or industrial operations may impact nearby receptor due to the nuisance of sustained vibration to potentially compromising the integrity of adjacent structures or geotechnical stability of landforms.

For their 2013 EIS, the Wallarah 2 Coal Project conducted assessments to determine whether noise and vibration from construction or operations may pose a threat to nearby receptors, and if so, to develop management and mitigation measures to avoid or mitigate for potential impacts.

8.1.1 Reasons for Refusal 2010

Noise and vibration were not identified as sources for refusal of the 2010 EIS.

8.1.2 New Director General's Requirements

The Director General's environmental assessment requirements (DGRs) for the preparation of an EIS for the proposed Wallarah 2 Coal Project, dated January 12, 2012, included the following applicable language for noise and vibration and applicable general requirements (supplementary requirements added to the original DGRs for the Project):

General Requirements Relevant to Noise and Vibration

"The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

In addition, the EIS must include a:

- ***detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes:***
 - ***a description of the existing environment, using sufficient baseline data;***
 - ***an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and***
 - ***a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and***

- ***consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.***

Key Issues Relevant to Noise and Vibration

“Noise - including a quantitative assessment of potential:

- ***construction, operational and transport noise impacts;***
- ***offsite road noise impacts; and***
- ***reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and***
- monitoring and management measures, in particular real-time and attended noise monitoring”

8.1.3 Earth Systems Review 2010

The Earth Systems’ review of the 2010 EIS indicated that the noise assessment does not adequately identify and assess the potential construction noise impacts from the surface facility works.

The noise assessment does not identify and consider future changes in land uses such as the proposed Warnervale Town Centre and the Wyong Employment Zone when determining the land zoning and noise amenity goals in accordance with the *NSW Industrial Noise Policy*. It is also noted that no reference measurement or assessment locations were established at the proposed Warnervale Town Centre.

8.1.4 New Regulatory Requirements

New regulatory requirements or updates to regulatory requirements following the submission of the 2010 EIS include:

- *NSW Road Noise Policy* (OEH 2011); and
- *Assessing Vibration: a Technical Guideline* (OEH, 2009).

8.2 2013 EIS

Noise

Additional ambient noise monitoring was undertaken for the 2013 EIS. Post 2007 noise monitoring was comprised of the measurement of ambient sound pressure levels at six locations, conducted for one week (24 hours/day) in March 2012. Measurements were recorded at five of the locations used for previous assessment and one new location, on Propan Way in Blue Haven, set-up to account for Warnervale Town Centre and the Wyong Employment Zone.

Results were then evaluated to establish (or confirm) Rating Background Levels (RBL) and to establish the Project Specific Noise Criteria (PSNC) for the Project. Quantitative and qualitative methods were used to evaluate whether noise from construction, blasting, road traffic and rail traffic during daytime, evening or night would exceed PSNC during varying meteorological conditions and whether sleep disturbance criteria may be exceeded.

Daily traffic estimates for construction personnel were elevated to a predicted level of 440 two-way car movements at Buttonderry Site, 800 two-way car movements at Tooheys Road Site and 90 at the Western Ventilation Shaft (modified from 290, 500 and 90, respectively).

Contour plots were generated that indicate the areas of exposure to noise levels above 40 and 45 dBA for daytime and evening operations. The proponent developed 'feasible and reasonable' noise control measures that will be incorporated into Project construction and operations.

As per the New DGRs, the 2013 EIS includes Proponent development of a leading practice noise monitoring network that will include quarterly attended noise monitoring during construction and operations, a network of real time noise monitors, a meteorological monitoring systems, and regular correlation of real time noise monitoring data with meteorological station data.

Vibration

Structural damage assessment criteria and human disturbance were assessed for the construction phase of the Project, with predictions of vibration levels from dynamic rollers and rock hammers (identified for their potential to create the highest levels of ground vibration during construction) included in the assessment.

Dozers and trucks were identified as key sources of vibration from mining related activity and were therefore assessed for their potential to impact private receptors.

Qualitative modelling was conducted for blasting during construction to determine whether air blast overpressure criteria and ground vibration criteria would be satisfied at the closest private receptors.

8.3 Key Issues

Noise

Ambient noise measurement was conducted at thirteen (13) potentially sensitive receptor locations. Modelling was utilised for estimates of: construction noise, construction vibration, and blasting; operational noise and vibration at the Tooheys Road Site and Buttonderry Site, road and rail traffic noise; and sleep disturbance assessing whether Project Specific Noise Criteria (PSNC) may be exceeded and/or structural or human comfort criteria from vibration or blasting would be exceeded.

While some data was provided for estimates of unmitigated noise generation, the noise modelling for conditions at sensitive receptors assumed the implementation of recommended noise attenuation components in Project development and operations. The exception to this was for predicted short term noise disturbance from train horn, wagon bunching, coal bin loading, and transfer chute plates, where the results of unmitigated and mitigated noise modelling is provided.

The following potentially excessive noise related issues are identified in the 2013 EIS:

- Noise modelling indicates that construction noise levels have the potential to exceed the PSNC at Amberwood Close (Project-owned residences). The predicted noise levels of 50 – 55 dBA exceed the daytime PSNC of 46 dBA.
- The specialist study (Appendix N) indicates that predicted noise levels may exceed the PSNC for more than 25% of a contiguous block of land for two privately owned properties in single land ownership in the Tooheys Road Site area, Receiver 57 (K.R. Drake) and Receiver 58 (K.L. Norman). Atkins Acoustics (Appendix N) identified two additional private receptors, Receiver 56 (The Commissioner for Main Roads) and Receiver 152 (Roads and Traffic Authority of NSW) where predicted noise levels exceed the PSNC for more than 25% of the land.
- Noise contributions would exceed recommended sleep disturbance criteria if unmitigated, including: train horn, wagon bunching, coal bin loading and transfer chute plates. The 2013 EIS

indicates that with implementation of noise controls described in Section 7.8.4 of the EIS, modelling has shown that noise levels are predicted to remain below sleep disturbance criteria.

The 2013 EIS defines daytime construction hours of 7am to 6pm on Saturday and 8am to 6pm on Sundays and Holidays. DECCW's recommended hours are 8am to 1pm on Saturday and no work (or blasting) on Sundays or public holidays.

Vibration

Assessment of construction and operations equipment indicated that the respective equipment that would create the greatest vibration will satisfy human comfort criteria and structural damage assessment criteria at all private receptors.

Qualitative modelling results indicate that air blast overpressure criteria and ground vibration criteria will be satisfied at the closest private receiver with the employment of Maximum Instantaneous Charge and 'detailed planning of any blasts needed to assist in construction of either surface facilities or underground activities' (2013 EIS, Section 7.8.3).

The management and mitigation for blasting has not been assessed to the level required during construction and operations. Specific management measures should be incorporated into the Noise Management Plan that addresses the procedure for implementing blasting.

8.4 Conclusions and Recommendations

The impact assessment and management strategies for noise were conducted according to applicable guidelines, with identification of appropriate PSNC and few predictions of exceedences of PSNC. However, it is important to note that noise modelling estimates for operations for the Tooheys Road and Buttonderry Sites assume Project adoption of specific strategies for ameliorating noise from the site. The validity and applicability of predicted outcomes for Rating Background Levels and potential exceedences of PSNC should only be considered applicable if the Project implements all the 'feasible and reasonable noise control' mitigation and management measures listed in Section 7.8.4 of the EIS.

Potential exceedences of PSNC listed in Section 7.8.3 of the EIS should be considered 'best case scenario' residual impacts that would apply if each of the management measures listed in Section 7.8.4 of the 2013 EIS and Sections 3.1.1 and 3.2.1 of the *Noise and Vibration Impact Assessment Report* (Appendix N) are implemented.

The EIS specifies that the WACJV will develop a Noise Management Plan for construction and operation of the Project that will incorporate noise attenuation and management. The Noise Management Plan will also identify a noise monitoring network comprised of quarterly attended noise monitoring, correlation of real time noise monitoring results with meteorological station data, a network of real time noise monitors, and trigger levels developed to notify site supervisors of noisy operations.

Earth Systems recommends WACJV incorporation of the following measures, should the Project be granted approval:

- Construction of the preferred option (refer to Appendix N), with incorporation of all the Feasible and Reasonable Noise Control measures identified in Section 7.8.4 of the EIS. As the majority of management relies on design elements and equipment selection (and modelling assumed their implementation), anticipated noise levels are dependent on this commitment.
- Development of a Noise Management Plan that includes targeted actions that would be employed following exceedence of trigger values;

- Identification (and justification) of key sensitive receptors in the Noise Management Plan for incorporation into the monitoring program.
- Specific provisions for identifying and contacting applicable residents that would be impacted by construction that occurs outside of the recommended hours (e.g. after 6 p.m. Monday – Friday, after 1 p.m. on Saturday, and on Sunday);
- Provision for investigations and response to complaints.

Vibration

Equipment identified to pose the greatest risk regarding vibration during construction and operations are predicted to satisfy structural damage assessment criteria and human comfort criteria. Impacts from blasting, however, are expected to require the employment of Maximum Instantaneous Charge (MIC) and 'detailed planning of any blasts needed to assist in construction of either surface facilities or underground activities' (2013 EIS, Section 7.8.3).

Earth Systems recommends WCJV incorporation of the following measures, should the Project be granted approval:

- Inclusion of vibration management in the Noise Management Plan or development of a Vibration Management Plan prior to construction;
- The plan should require MIC for required blasting unless it can be conclusively demonstrated that it is not required for a specific blasting scheme;
- The plan should identify and develop specific management requirements for blasting to replace the ambiguous language that is currently applied; and
- The plan should identify provision for investigations and response to complaints.

9 Visual Amenity

9.1 Context

9.1.1 Reasons for Refusal 2010

No reasons associated with Visual Amenity were cited in the 2010 Project Refusal.

9.1.2 New Director General's Requirements

The Director General's Requirements have been updated in 2012 to include the following:

Visual - including:

- ***A detailed assessment of the:***
 - ***Changing landforms on site during the various stages of the project; and***
 - ***Potential visual impacts of the project on private landowners in the surrounding area as well as key vantage points in the public domain, and particularly the proposed Warnervale Town Centre, Wyong Employment Zone and the major elements of the public domain linking these two.***
- ***A detailed description of the measures that would be implemented to minimise the potential visual impacts of the project.***

9.1.3 Earth Systems Recommendations 2010

Earth Systems review of the EIS in 2010 found that the natural feature baseline for the project needed to be strengthened to provide a more accurate representation of the visual character of the site. It was further noted that no mitigation and management measures were presented

9.1.4 New Regulatory Requirements

There are no new regulatory requirements directly applicable to the visual amenity aspects of the EIS.

9.2 2013 EIS

Visual Impacts are discussed in Section 7.16 of Chapter 7 of the EIS Report by Hansen Bailey. This section was based on the specialist studies provided as appendices to the EIS as follows:

- Appendix U: The Design Partnership (2013) Wyong Areas Coal Joint Venture, Wallarah 2 Coal Project Visual Impact Assessment.

9.3 Key Issues

The specialist study conducted for the Project provides a description of the existing visual character of the proposed surface facility sites as well as key visual elements of the region. The study makes good use of topographic surveys and aerial photographs in its baseline assessment. Whilst a generally sound assessment from key viewpoints to the proposed surface facility sites has been made, our review notes the following limitations:

Director General's Requirements

The Director General's Requirements outline that the assessment should provide '*a detailed assessment of changing landforms on site during the various stages of the project*'. The EIS Report has not broken down the anticipated visual impacts by project phase and as such does not meet the DGR.

Warnervale Town Centre

In 2010 it was noted that the Warnervale Town Centre development was not adequately considered in respect to visual impacts. This was addressed in the 2013 EIS, with visual impacts upon the site considered in the Main EIS Report. The report suggests that it is unlikely to be visually impacted as a result of the ridgeline and existing vegetation.

A viewshed analysis for the Warnervale Town Centre has been deduced from that conducted for Bruce Crescent, which is closer to the proposed project site. The viewshed analysis in Appendix U indicates that the site will not be visible due to topography.

Visual Landscape Character Assessment Viewpoints

The 2013 EIS Report stated that a Visual Landscape Character Assessment was undertaken to determine key viewpoints for the project, all of which were for roads. This has mitigated the discrepancy noted in the methodology of the 2010 EIS Report, which stated that key viewpoints for the assessment will be from public spaces such as parks, roads and lookouts; however all the key viewpoints appeared to be from roads only.

Bushell's Road Residences

The 2010 EIS Review indicated that it was unclear whether the residential properties on Bushell's Ridge Road would have partial views of the Project Site. The 2013 EIS indicates in the Social Impact Assessment that the residents were unlikely to have views of the site, however, they would have views to the Buttonderry Site when using Hue Hue Road or the Freeway.

Surface Facility Infrastructure Exterior Palette

Appendix U indicates that surface facility infrastructure and buildings will be constructed in neutral colours as to blend into the natural vegetation. Heights and materials used for elevated structures are indicated in limited detail in Appendix U.

Photomontages

The photomontages of the Tooheys Road Site from the F3 Freeway and Motorway Link Road show that the coal stockpiles and gantry and conveyor are visually prominent. A proposed concept landscape design is provided in Appendix A of Appendix U, which is anticipated to mitigate these views.

Landscape Concept Designs

Landscape Concept Designs have been prepared for both sites which incorporate management and mitigation measures to minimise the potential visual impacts of the Project. Although the focus of the

mitigation measures proposed is on the continuation and enhancement of endemic vegetation to screen the surface facilities and stockpiles from major travel routes, the plans do not identify any of the endemic species proposed to be planted. The Landscape Concept Designs should list the proposed endemic flora as a palette to give an indication of the mature height, density and bulk of vegetation.

9.4 Conclusions and Recommendations

The visual assessment conducted for the Project provides a good site analysis and identification of key viewpoints, assessment of potential visual impacts and recommendations for mitigation measures to minimise impacts of the Project.

10 Traffic and Transport

10.1 Context

10.1.1 Reasons for Refusal 2010

No reasons associated with Traffic and Transport were cited in the 2010 Project Refusal.

10.1.2 New Director General's Requirements

The Director General's Requirements have been updated in 2012 to include the following:

Traffic and Transport- including:

- ***A detailed assessment of the project on the capacity, efficiency and safety of the:***
 - ***Rail network, having regard to the strategic objectives for passenger and freight rail network (such as Northern Sydney Freight Rail Corridor Project); and***
 - ***Local road network, with particular regard to the Wallarah interchange (F3 Freeway and Sparks Road), Motorway Link Road / Tooheys Road intersection, and the Sparks Road / Hue Hue Road intersection; and***
- ***A description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the project.***

10.1.3 Earth Systems Recommendations 2010

Earth Systems' 2010 EIS Review recommended the development of a supplementary environmental assessment that included consideration of the findings of further traffic assessment investigations currently being undertaken by the Proponent.

Key issues identified included:

- Limited consideration of road safety aspects, and
- No evidence of a detailed study of the capacity, efficiency and safety of the rail network.

10.1.4 New Regulatory Requirements

Since submission of the 2010 EIS, no significant new regulatory requirements directly applicable to the Traffic and Transport assessment for the Wallarah 2 Coal Project.

10.2 2013 EIS

Traffic and Transport Impacts are discussed in Chapter 7 of the main EIS Report by Hansen Bailey. This section was based on the specialist studies provided as appendices to the EIS as follows:

- Appendix Q: Parsons Brinckerhoff Australia (2013) Wyong Areas Coal Joint Venture, Wallarah 2 Coal Project Traffic Impact Study.
- Appendix R: Rail Management Consultants Australia (2013) Wallarah 2 Coal Project Rail Study

10.2.1 Traffic and Transport

Traffic and Transport is discussed in Section 7.12 of Chapter 7 of the EIS. This section is a summarised version of the Traffic and Transport Assessment in Appendix by Parsons Brinckerhoff (PB). Issues considered in the 2013 assessment additional to those considered in 2010 included:

- A review of existing crash data and road safety deficiencies;
- A traffic impact analysis was performed for key intersections in the vicinity of the Project using intersection simulation software (SIDRA). The intersection analysis was applied to future scenarios with and without the proposed Project to account for background traffic growth as well as anticipated traffic generated by the Project. The analysis was performed on the following intersections:
 - *Walarah Interchange (F3 Freeway and Sparks Road);*
 - *Sparks Road - Hue Hue Road; and*
 - *Motorway Link - Tooheys Road interchange.*
- A cumulative assessment including surrounding developments and their impacts on the surrounding road network.
- Recommendations of potential mitigation measures and road safety improvements.

10.2.2 Rail Study

Section 7.13 of Chapter 7 of the EIS also details potential impacts upon the local and regional rail network. The relevant section is based upon a detailed Rail Study that was developed by Rail Management Consultants Australia (RMCA) as an Appendix to the 2013 EIS to address the Director's General Requirement relating to rail services. The study included:

- A description of the existing rail network and its capacity; and
- A discussion of the anticipated impacts of the Project upon the capacity of the rail system.

10.3 Key Issues

Director General's Requirements

The review of the traffic assessment found that it provided a detailed analysis of the forecast traffic and transport impacts (including rail) on the surrounding road network that are likely to arise as a result of the Project.

A traffic impact analysis was performed for key intersections in the vicinity of the Project using intersection simulation software (SIDRA), including:

- *Wallarrah Interchange (F3 Freeway and Sparks Road);*
- *Sparks Road - Hue Hue Road; and*
- *Motorway Link - Tooheys Road interchange.*

Cumulative Impacts

The 2010 EIS Review noted a lack of consideration of potential cumulative traffic impacts associated with traffic flows generated from new developments in the area. This has been addressed in the 2013 EIS, giving reference to the detailed cumulative assessment as undertaken in Section 1.4 of Appendix Q.

Consideration of new developments

The EIS states that a Traffic Management Plan would be required prior to construction, which would include any official revised traffic predictions covering new developments in the area. It was noted in 2010 that for the EIS to adequately assess the potential traffic impacts of the Project on the surrounding road network, the traffic assessment would require revision to take into account the traffic generated by the Warner Industrial Park (Precinct 14). As such, in 2010 WSC advised Earth Systems that the revised intersection analysis would need to re-evaluate the following intersections:

- Sparks Road / Hue Hue Road;
- Sparks Road / Precinct 14; and
- Hue Hue Road / Precinct 14.

These intersections have been evaluated in the 2013 EIS (Appendix Q), giving consideration for background traffic associated with Precinct 14 (Warner Industrial Park / Wyong Employment Zone) in scenario modelling for construction and operations phases, and 'no-project' scenarios.

Internal Haulage Route

As noted in the 2010 review of the EIS, the 2013 Report has not identified the internal haulage routes to be utilised for the movement of excavated material within the site.

Chapter 2 of the EIS Main Report notes that all excavated material from the Tooheys Road and Buttonderry sites will be re-used onsite for the creation of a perimeter bunding and landscaping features. However, Appendix Q of the EIS states that "*the construction traffic management plan should also be used to develop site-specific management measures once the construction methods and haulage routes are finalised*". This indicates that the route is at present unconfirmed, and as such, the potential environmental impacts of utilising such an internal route are unable to be identified.

Haulage of spoil offsite

The haulage route for excavated material to be moved offsite from the Western Ventilation Shaft has not yet been confirmed.

An estimated 5700 m³ of material from the excavation of the Western Ventilation Shaft is required to be taken offsite by road. It is quoted that "*at this stage the destination of this material has not been identified*", with a suggestion that upon confirmation of the route, efforts would be made to minimise impacts on the road network.

WSC expressed concerns during the 2010 Review about the potential adverse impacts on the road network due to the accelerated loss of pavement life caused by the additional truck movements during the construction of the Western Shaft. The anticipated number of truck movements are detailed in the 2013 EIS Report (Appendix Q), however, their impacts on pavement and drainage structures are not covered in

specific detail. Section 8 of Appendix Q addresses road dilapidation and recommends that heavily utilised roads are monitored, and for any impacts beyond reasonable wear and tear to be addressed immediately by WACJV or the road authority.

Traffic Management Plans

A Traffic Management Plan has not been developed as part of the 2013 EIS.

Appendix Q of the EIS indicates that Traffic Management Plans would be developed for the construction of rail bridges for the new rail spur line crossing over Tooheys Road, as well as Traffic Control Plans for road works to be undertaken. It is noted that a specific management plan for this issue is not mentioned in the Statement of Commitments or in Chapter 8 of the EIS (Table 103: Project Management and Monitoring Measures).

Temporary Road Closures of Brothers and Tooheys Roads

The traffic assessment indicates that both Brothers Road and Tooheys Road would be upgraded as part of the Project and will likely be closed temporarily. Whilst the assessment does indicate that a Traffic Management Plan would be developed in coordination with road authorities and landholders to manage traffic along Tooheys Road during construction, limited details are provided on the potential impacts on traffic flows.

Rail Impacts

Appendix R: Rail Study notes that the Wyong – Newcastle Rail System is almost wholly within RailCorp's network, with a small area of overlap with the Australian Railway Track Corporation (ARTC). A number of planned upgrades are being introduced to meet anticipated demand from a number of projects within the area, irrespective of the approval of the Wallarah 2 Coal Project.

It is anticipated that the project will require an average of 4.33 trains per day during operations for coal transport, with capacity for 6 trains per day 6 days per week. The additional services as a result of the project are anticipated to result in level crossing closures for an additional 56 minutes per day.

Three scenarios have been modelled in conjunction with RailCorp, the third option inclusive of the installation of new passing loops at Awaba North. This is the selected option anticipated to have the least impacts upon existing services, as well as catering for anticipated future growth in service requirements.

The installation of the Awaba North Passing Loops has been recommended as a mitigation and management measure for rail impacts. This is a measure to be considered by RailCorp and is outside the scope of WACJV's individual capacity to manage the capacity, efficiency and safety of the local and regional rail network.

10.4 Conclusions and Recommendations

In general, the 2013 EIS document addresses the major traffic and transport requirements of the Director General, as well as the issues noted by Earth Systems in the 2010 EIS Review. It is clear that further investigations and studies have been completed to meet these requirements and identified gaps.

Further investigation is required to confirm the haulage route and its potential environmental impacts, and to confirm the off-site disposal site for spoil from the excavation of the Western Ventilation Shaft and whether the transport of spoil would have an impact on existing road use to the site.

A Traffic Management Plan should be developed immediately to ensure all stakeholders have the opportunity to comment on the recommended management and mitigation measures and to understand any potential residual impacts. Specific Traffic Management Plans for the construction of rail bridges for

the new rail spur line crossing over Tooheys Road, as well as Traffic Control Plans for road works to be undertaken should also be developed as recommended by Parsons Brinckerhoff in Appendix Q.

An evaluation of potential mitigation measures for managing rail network capacity limitations outside the proposed ARTC rail network upgrades would support the Traffic and Transport assessment in comprehensively meeting the Director General's Requirements.

11 Archaeology and Heritage

11.1 Context

11.1.1 Reasons for Refusal 2010

The 2010 EIA prepared for the Wyong Areas Coal Joint Venture was rejected in 2011 because there was uncertainty around the heritage impacts of the Project. In particular, the refusal was issued because insufficient surveying was conducted within the western portion of the site (i.e. above the mine) and the impact of subsidence on the heritage characteristics of the site was not adequately addressed.

11.1.2 New Director General's Requirements

The Director General's Environmental Assessment Requirements and a Supplement to the Director General's Requirements were issued to the Proponent in 2012. The primary document detailing the Director General's requirements states that the EIS must address the following:

Heritage

- **An Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:**
 - **Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures;**
 - **Outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures); and**
- **A Historic heritage assessment (including archaeology) which must:**
 - **Include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items; and**
 - **Outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures)**

The Supplementary Director General's Requirements state that:

Consultation

14. Any consultation about the action, including:

- a. Any consultation that has already taken place;**
- b. Proposed consultation about relevant impacts of the action;**
- c. If there has been consultation about the proposed action – any documented response to, or result of, the consultation.**

15. Identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.

11.1.3 Earth Systems Recommendations 2010

Generally, one of the limitations of the assessment for the Project included a lack of detail regarding the Chance Find Procedure and monitoring program. Further details regarding these aspects should have been provided.

11.1.4 New Regulatory Requirements

There are no new major regulatory requirements regarding cultural and historic heritage since the 2010 EIS submission. There are some minor amendments to acts that have or are still in the process of being incorporated. The current 2013 EIS has included a summary of all relevant legislation.

11.2 2013 EIS

Additional archaeological, cultural and historic surveys were conducted within the eastern and western portions of the proposed mining Project area since the 2010 EIS submission (Table 11.1). The main method to survey ridgelines and waterways in accessible areas was to walk transects that followed the topography, while surveying the ground for evidence. Similar to pre-2010 surveys, the locations of these transects were limited by accessibility to private property and difficult terrain. Additionally, only a small area could be searched due to dense ground cover, with test pits only being dug in one area.

Table 11.1 A summary of additional archaeological, cultural and historic heritage field sampling within the Project Boundary for the Wyong 2 Coal Joint Venture

| Year | Project Boundary area surveyed | Area/s assessed | Methodology or description |
|------|---|--|--|
| 2010 | Eastern portion (Project footprint) | Tooheys Road site, banks of: <ul style="list-style-type: none"> • Wallarah Creek | 60 test pits measuring 1 x 1 m |
| 2010 | Western portion (Subsidence Impact limit) | Ridgelines in the Wyong State Forest/Jilliby SCA: <ul style="list-style-type: none"> • Whitemans Ridge; • Little Jilliby Ridge; • Harris Point; and • Ridgelines accessed on the Watagan Forest Road | Restricted transects along ridgelines (i.e. did not follow arbitrary linear transects) |
| | | Waterways: <ul style="list-style-type: none"> • Calmans Gully; • Myrtle Creek; • Little Jilliby Jilliby Creek; • Armstrongs Creek; and • Unnamed waterway to the east of Smithys Road West | Restricted transects along creeks (vegetation and topography limited) |
| | | Honeysuckle Park | Meandering transects (cleared land) |
| 2011 | Western portion | Ridgelines in the Wyong State | Restricted transects along |

| | | |
|---------------------------|---|---|
| (Subsidence Impact limit) | Forest/Jilliby SCA: <ul style="list-style-type: none"> • Spotted Gum Ridge; • Woodward's Ridge; • Pole Ridge; • Big Pole Ridge; • Daniels Ridge; • Calmans Ridge; • Coutts Ridge; • Goldsmiths Ridge; • Whitemans Ridge; and • Little Jilliby Ridge | ridgelines (i.e. did not follow arbitrary linear transects) |
| | Waterways: <ul style="list-style-type: none"> • Myrtle Creek; and • Little Jilliby Creek | Restricted transects along creeks (vegetation and topography limited) |

11.3 Key Issues

- Much of the Project Boundary, particularly within the eastern part of the Subsidence Impact Limit area was not surveyed due to accessibility restrictions. It is understandable that access may be restricted by private land or difficult terrain. However, as Aboriginal cultural and historic heritage sites have been found elsewhere within the Project Boundary, it is highly likely that other sites exist in inaccessible areas. Although it may be currently impossible to survey these undiscovered sites, these potential sites should still be considered within mitigation and management measures (under the precautionary principle). Currently, mitigation measures are only applicable in areas where sites have been found and if sites are discovered during earthworks.
- Although most sites found were considered to have little archaeological, aesthetic or historic value, Aboriginal cultural significance has simply been considered as "high" for all sites. The NSW OEH (2010) guidelines state that *"when identifying values, it is not necessary to agree with or acknowledge the validity of each other's values but it is necessary to document the range of values identified."* The conclusion that all sites *"are held in high cultural value by the local Aboriginal community"* may be partly accurate, but it is more likely that this value ranges on a broad scale. There was limited discussion of how these cultural values were assigned/assessed, whether they were, for example, spiritual sites, and how did the Aboriginal representatives come to categorise all sites as "high".
- Since the 2010 EIS and the completion of field work in 2011, two new corporations became Registered Aboriginal Parties (RAPs). These two corporations feel that they have been inadequately consulted regarding the Project and were not asked to assess the significance of found sites. With the information collected, this could certainly have been done before the EIS was submitted (without necessarily a site visit). It appears that an assessment was only made by representatives that assisted with field surveys. However, it also is stated that every attempt has been made to organise meetings with these RAPs and have been largely unsuccessful. It is a difficult issue and probably requires the input of an independent third-party (i.e. not the heritage consultants or the Proponent).

- These new RAPs are also concerned that the Proponent has not adequately included their connection to the land within the Project Boundary, placing “*the Project Boundary within Darkinjung Country although in an area in close proximity to the Awabakal (to the north) and the Daruk to the south*” (section 4.1; Appendix S). It is understandably difficult to ascertain the exact boundaries of the different Aboriginal group’s pre-European settlement. However it would be a relatively minor change to the EIS and appendices to recognise that many RAPs and people have a connection to the land within the Project Boundary.
- The management plan has not been developed and details regarding its development and contents were not extensive. All interested stakeholders should also be consulted during this process.

11.4 Conclusions and Recommendations

In general, a comprehensive survey and report of the Aboriginal cultural and historic heritage of the areas surveyed within the Project Boundary has been prepared. The inaccessibility of the western portion of the Project Boundary and wide-spread low visibility of sites surveyed makes it particularly difficult to ascertain the number and type of cultural and historic sites that may be impacted by the Project. Since these issues are not due to a lack of survey effort on behalf of the Proponent, general mitigation measures and the (to be prepared) management plan should cover all areas within and surrounding the Project Boundary (i.e. not limited to areas where sites were found).

For the most part, it appears every effort has been made to consult with most (if not all) RAPs. As consultation with the community and RAPs is such a crucial component of the Aboriginal cultural and historic heritage assessment, the Proponent should continue attempts to consult any interested parties. However, it is difficult to independently ascertain the progress of consultations from the EIS and associated appendices. Perhaps an independent group could liaise with stakeholders and the consultants conducting the surveys and writing the management plan, since attempts by the heritage consultants to arrange meetings with all stakeholders have been unsuccessful.

12 Socio-Economic Planning

12.1 Context

12.1.1 Reasons for Refusal 2010

The 2010 Project Application refusal did not cite any reasons associated with Social Planning.

12.1.2 New Director General's Requirements

The Director General's Requirements have been updated in 2012 to include the following:

Social and Economic – including an assessment of the:

- ***Potential impacts on local and regional communities including:***
 - ***Increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services); and***
 - ***Impacts on social amenity;***
- ***A detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the Project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism***
- ***Impacts on Jilliby State Conservation Area- including impacts on the...recreational values of the reserve and landowner consent issues.***

Supplementary Director General's Requirements include:

- ***A description of the short term and long term social and economic implications and/or impacts of the project.***

12.1.3 New Regulatory Requirements

No significant new regulatory requirements or updates to regulatory requirements relevant to social planning were identified following the submission of the 2010 EIS.

12.2 2013 EIS

Section 7.17 of the Main EIS Report discusses the findings of the Social Impact Assessment. This section is based upon the Social Impact Assessment provided as Appendix V – The Wallarah 2 Coal Project Social Impact Assessment (2012) Martin and Associates Pty Ltd.

Section 7.7 of the Main EIS Report discusses the finding of the Health Risk Assessment. This section is based upon the Health Risk Assessment provided as Appendix M – The Wallarah 2 Coal Project Health Risk Assessment (2012) PAE Holmes.

A Benefit Cost Analysis was undertaken for the Project as part of the broader Economic Impact Assessment and the findings of our review are discussed in Chapter 12 of this Report.

Key tasks undertaken for the Social Impact Assessment (Appendix V) included:

- An assessment of relevant government policy and guidelines;
- Characterisation of the existing community, current behaviour and interactions of residents;
- Characterisation and assessment of Project perceptions by those within the directly affected area;
- Assessment of potential Project impacts upon the population, temporary accommodation and housing;
- Identification of the present use of social infrastructure and observed or perceived gaps from a community perspective;
- Discussion of implications for the directly affected area, particularly the likely spatial distribution of any non-local operational and construction work forces and their impacts on the community;
- Discussion of implications for the broader Secondary Study Area in relation to employment and population impacts; and
- Preparation of a social management and monitoring program to mitigate potential and perceived impacts.

The study was undertaken utilising information from:

- The ABS 2001 and 2006 Census Data;
- WSC Social Planning Reports;
- Community Attitude Surveys of 400 residents within the Secondary Study Area in 2006 and 2012;
- A community baseline survey conducted in 2008 with the Directly Affected Area.

Consultation was also undertaken with key relevant Wyong Shire Council (WSC) and Lake Macquarie City Council (LMCC) staff.

12.3 Key Issues

Director General's Requirements

The report provides very little description of the long term social and economic implications and/or impacts of the project. Short term impacts are discussed in relation to the construction and operations phase impacts, however a discussion of impacts beyond the project life span (28 years) regarding social impacts of closure is not included in this assessment. Rehabilitation and Closure is discussed briefly in Section 7.25 of the Main EIS Report however

Flow-on Employment Opportunities

An overview of the regional and local economy was well presented and Project benefits to the local economy and surrounding region have been identified. It has been estimated that 504 flow-on jobs will be created as a result of the Project (Table 90, EIS Page 224) however there remains some

discrepancies in numbers between documents, including EIS Chapter 3, Project Description; EIS Chapter 7, Impacts Management; Appendix V, Social Impact Assessment and Appendix W, Economic Impacts.

Mitigation and Management Measures

Section 7.17 of the EIS refers to a Social Management and Mitigation Program, and outlines a number of mitigation and management strategies to address social impacts.

A Social Management and Monitoring Plan has not been developed.

Project Closure

It is noted that EIS Section 7.17 and Appendix V are broken down into impact assessment of the Construction and Operations Phases. The review of the EIS Section 7.17 and Appendix V indicates that the socio-economic impacts of mine closure have not been considered.

Cumulative Impacts

There is little discussion of the Project's cumulative socio-economic impacts in relation to other proposed projects within the region or Council area. Some discussion of the Warnervale Town Centre development is provided in regard to employment opportunities, however, impacts of cumulative developments in respect to housing and demand on resources have not been discussed.

Community Health and Safety

The EIS does not provide a comprehensive assessment of all potential impacts on community health and safety associated with the Project. The Health Risk Assessment considers impacts on human health and safety associated with water quality, air quality and noise and vibration impacts.

As a result of the identified knowledge gaps and uncertainties in the Air and Water Quality assessments, the potential health and safety impacts associated with the Project should be re-evaluated to ensure they accurately reflect the anticipated environmental scenario.

Monitoring and Reporting

Appendix V notes that the Community Reference Group (CRG) will assist in monitoring the progress of the project and report back to the community. It is unclear however how monitoring of Project progress will be undertaken.

12.4 Conclusions and Recommendations

The Social Impact Assessment and Economic Impact Assessment appear to adequately describe the baseline of the local and regional socio-economic setting, however, there are some gaps and limitations in these studies. The main failing of this assessment is derived from a lack of clarity regarding the physical impacts and risks associated with the Project that leads to underestimation of social and economic risks.

There is a lack of consideration of long-term impacts of the Project. This includes little to no consideration of socio-economic impacts of Project closure / mine cessation. A Mine Closure Plan should be developed which would consider the potential socio-economic impacts of closure.

Some Socio-economic mitigation and management measures have been outlined however it is recommended that these are presented in the form of a structured Social Management and Monitoring Plan.

13 Benefit Cost Analysis

13.1 Context

13.1.1 Reasons for Refusal 2010

No reasons associated with Benefit Cost Analysis were cited in the 2010 Project Refusal.

13.1.2 New Director General's Requirements

A detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community.

13.1.3 Earth Systems Recommendations 2010

The review found that the BCA lacks sufficient detail. A number of key assumptions have been made in the quantification and valuation of costs and benefits. These decisions and assumptions need to be made more explicit in order for the reader to understand the limitations of the BCA tool. Similarly the report needed to provide more information on the calculations, techniques applied and sources of information used to quantify and value the Project's benefits and costs.

As such it was recommended that a revised benefit cost analysis be developed based on the findings of the supplementary EIS.

13.1.4 New Regulatory Requirements

Since submission of the 2010 EIS, a November 2012 *Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals* has been introduced.

13.2 2013 EIS

Section 7.18 of the Main EIS Report provides a summary of the economic impact assessment and benefit cost analysis as undertaken in Appendix W: Economic Impact Assessment conducted by Gillespie Economics in 2013.

The document is designed to evaluate the economic efficiency of the project, as well as the project's economic impacts.

13.3 Key Issues

Valuation of Monetary Impact upon affected Stakeholders

As per the NSW Government's 2012 Guideline (as above), a CBA must identify all groups in the community affected by a policy or project and values the effects on their welfare in monetary terms as the effects would be valued by the parties themselves. Neither the Main EIS Report nor Appendix W identifies all affected stakeholders and their valuation of impacts.

Identification of a Baseline Scenario

A baseline scenario has been identified for the Wallarah 2 Project, based on the performance of the Regional Economy from 2005 – 2006. The baseline scenario is mentioned in Section 7.18 of the Main EIS Report however the findings of the economic baseline assessment are not presented in a numerical form. As such, the Main EIS Report does not give a strong indication as to the numerical monetary difference between the 'with project' and 'without project' scenarios.

Further, the economic assessment is based on information provided from 2005 – 2006. Upon commencement of the Project, this data will be almost 10 years old. It is unlikely that information this old provides an accurate reflection of the current economic setting in the region, and as such, the net benefit calculated for the project is unlikely to be accurate.

Economic Valuation of Environmental and Social Impacts

To evaluate the economic value of environmental impacts, the effects of these impacts upon business (for example, on agricultural productivity) and on households (for example, on health) must be evaluated.

The economic assessment suggests that for Air Quality and Groundwater, no impacts are anticipated upon stakeholders within the area, and as such, no economic impacts can be attributed to these aspects. This EIS review has indicated that water impacts have not been adequately assessed and require further investigation, and that the determination of air quality impacts requires further modelling and assessment to ensure an accurate prediction.

Sensitivity Analysis

A sensitivity analysis was undertaken to evaluate whether the Project was sensitive to reasonable changes in assumptions regarding a number of variables. It was found that the results were '*most sensitive to decreases in the value of product coal*', yet it was found that in order for the project to be deemed economical unfeasible these would need to be substantial and sustained. The sensitivity test does not determine the anticipated price of coal during the operations phase and as such it is difficult to understand how the figures were calculated.

13.4 Conclusions and Recommendations

Whilst the Benefit Cost Analysis has been conducted using a systematic method of evaluation, this review has found some key limitations in its undertaking.

The economic baseline has not been calculated in a clear manner, and is not presented in the Main EIS.

Regional economic data utilised to determine the baseline provided in Appendix W utilises data from 2005-2006, which is unlikely to provide an accurate representation of the current regional economic standing.

The EIS Process is designed to identify the environmental and social impacts attributed to the development of the Project. To conduct an effective cost benefit analysis, monetary values must be attributed to these environmental and social impacts. This review has indicated that some environmental and social impacts have not been evaluated effectively, particularly those in regard to air quality and

water management. Consequently the monetary values attributed to environmental and social impacts are likely to be inadequate, and the overall Cost Benefit Analysis optimistic.

14 Stakeholder Engagement

14.1 Context

14.1.1 Reasons for Refusal 2010

The 2010 Project Application refusal did not cite any reasons associated with Stakeholder Engagement.

14.1.2 New Director General's Requirements

The Director General's Requirements have been updated in 2012 to include the following:

The EIS must:

- ***Describe the consultation process used and demonstrate that effective consultation has occurred.***
- ***Describe the issues raised by public authorities, service providers, community groups and landowners.***
- ***Identify where the design of the development has been amended in response to issues raised.***
- ***Otherwise demonstrate that issues have been appropriately addressed in the assessment.***

14.1.3 Earth Systems Recommendations 2010

The 2010 EIS Review found that the 2010 EIS Report did not meet the Director-General's Environmental Assessment Requirements, which specifically required the EIS to describe both the consultation process and the issues raised during this consultation process. The EIS was found to have described the consultation strategy implemented for the Project, but it did not adequately identify and describe the issues raised by the community during the consultation process. Therefore the Director-General's Environmental Assessment Requirements in relation to community consultation have not been met by the EIS.

As such, Earth Systems recommended that *an independent credible organisation should be engaged by the Proponent to facilitate open and transparent community consultation during the supplementary EIS process.*

14.1.4 New Regulatory Requirements

New regulatory requirements or updates to regulatory requirements following the submission of the 2010 EIS include:

- National Parks and Wildlife Amendment (Aboriginal Places and Aboriginal Objects) (DECCW 2010)

14.2 2013 EIS

Chapter 5 of the EIS Main Report details the stakeholder consultation process that was undertaken for the Wallarah 2 Project.

- Chapter 5 outlines the DGRs and where they are addressed in the report. It also provides tables indicating issues raised in consultation at both regulatory and community levels.
- During preparation of the Main EIS Report, consultation was conducted with the stakeholders identified in the DGRs, as well as other stakeholders such as service providers, local community groups and the Aboriginal community (detailed in Section 5.2 of the Main EIS Report).
- The Main EIS Report (Section 5.4.4) summarises the key concerns raised during regulatory and community consultation. These include potential air quality, noise, visual amenity, social economic, water management, transport, heritage, ecology, and subsidence impacts.
- Concerns regarding consultation with the community and understanding of the 2010 Refusal of the W2CP EIS are also noted in Table 19.
- Section 5.5 outlines the proponent's commitment to ongoing stakeholder engagement and details the mechanisms it intends to utilise to ensure effective ongoing engagement and communication with Project Stakeholders.
- Appendix D: Stakeholder Engagement provides newsletters dating from September 2011 through to 'Spring 2012', and a copy of a letter sent to residents providing information regarding the Project and how residents can contact the Proponent for further information.

14.3 Key Issues

Key findings of the review, with respect to the above requirements are summarised below:

Stakeholder Responses

An overview of the general issues raised by each stakeholder and how these are addressed in the EIS is provided in Section 5.4.4, Table 18 and 19. Table 19, however, does not indicate the level of concern attributed to each issue, or how many stakeholders indicated concern. As such it is difficult to understand the key issues of community concern.

Consultation Process

The 2007 NSW Government Guidelines for Major Project Community Consultation states that '*a project proponent [should choose] engagement techniques that offer opportunities to participate across all relevant groups*'. Whilst it appears that all major groups and special interest groups have been consulted, it appears that much of the consultation has been conducted in a passive manner, with an emphasis upon the distribution of newsletters.

Monitoring and Reporting

It is unclear how performance on community engagement will be monitored, however, it is stated that an annual report made available to the public will detail annual performance in consultation and other environmental and social concerns.

Ongoing Consultation

On behalf of the project proponent, the EIS makes a commitment to ongoing stakeholder engagement throughout the project life cycle. This does not, however, detail a proposed schedule of consultation within which mechanisms for engagement will be conducted.

A Stakeholder Engagement Plan has not been developed for the Project.

Grievance Procedure

The development of a grievance procedure / complaints-handling procedure is considered to be international best practice for a mine operation (IFC 2009). There is no evidence of the establishment of a grievance procedure or complaints-handling procedure to manage public complaints.

Director General's Requirements

The Director General's Requirements require that the report describes the issues raised by stakeholders during the consultation process. The Main EIS Report outlines a detailed list of stakeholder issues, however provides no detail to indicate the number of stakeholders who raised a particular issue or the subsequent level of concern. As such, the DGR is not adequately addressed.

Further, the DGRs detail that it must be identified where the design of the development has been amended in response to issues raised during consultation. The report gives an indication as to which sections outline relevant strategies to manage issues raised, however does not provide a detailed description of the community concern and how it will be managed. Mitigation and management measures were consistently found to be poorly articulated throughout the Main EIS Report. Specific management measures to be undertaken not adequately provided and as such it is likely that the mitigation of community issues is not adequately addressed.

Stakeholder comments such as those of the ATOAC who feel as if the Social Impact Assessment is not conducted to an adequate level (Appendix S) have not been considered by the Main EIS Report in great detail. Section 5.6.5 mentions that the ATAOC have expressed concern, however the specific concerns are not outlined in the Main EIS Report.

Regulatory Requirements

The National Parks and Wildlife Amendment (Aboriginal Places and Aboriginal Objects) revised in 2010 outlines that a specific process of community consultation with relevant aboriginal parties must be undertaken before a person makes an application for an Aboriginal heritage impact permit.

Whilst no evidence is provided, it is stated in Chapter 5 of the EIS Main Report that the requirements outlined in the updated legislation were followed for all Aboriginal Cultural Heritage consultation that occurred from 2011 onwards.

14.4 Conclusions and Recommendations

In general, community engagement and consultation has been conducted with a variety of stakeholders, ranging from community groups to regulatory institutions. The consultation conducted however is not described in great detail, and consultation appears to have been conducted utilising a primarily passive approach, with the distribution of Project newsletters a prominent method of engagement.

The issues raised during community consultation have been listed, however, the strength of the concern, or how vocal the community was about a particular issue is not provided. Key concerns are not noted in terms of their priority to the community.

Whilst the EIS states that the proponent is committed to continuing its stakeholder engagement program throughout the life of the project, a structured Stakeholder Engagement Plan has not been developed to

outline ongoing strategies for consultation and detailing solid commitments to consultation, including consultation schedules and grievance procedure / complaints handling procedures.

15 Prioritised Measures to Address Areas of Uncertainty

The following table outlines recommendations to address areas where information is unclear or uncertainty to fully assess impacts. The measures provided below are intended for consideration by approving authorities.

Table 15.1 Guidance for Further Assessment / Validation and Monitoring

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|----------------------------|-----------------------------------|--|
| Air Quality | High | Air quality impacts are assessed utilising relevant methodologies to ensure that detailed impact assessments of project phases are conducted effectively. |
| Greenhouse Gas | Medium | A more realistic assessment of greenhouse gas (GHG) impacts is provided by including Scope 2 and 3 emissions sources in the analysis of the GHG impacts and updating impacts of the Project on anthropogenic global warming. |
| Water Quality | High | Surface water quality is investigated further to ensure that all sources of contaminants are identified and that water sources are effectively monitored for changes associated with the Project. A geochemical assessment for potential AMD / salinity is conducted, including development of contingency plans for the management and treatment of the Mine Operations Dam. |
| EPBC Water Amendment | High | The EPBC Act Water Trigger Amendment (2013) is considered by the Proponent. |
| Ecology | Medium | Further detailed surveys for biodiversity are conducted, including extended flora survey to establish a robust flora baseline for the Subsidence Impact Limit. The Biodiversity Offset Strategy for threatened species is revised to ensure it addresses the current Policy and that currently proposed offsets for fauna habitats are reviewed for suitability. |
| Mine Design and Layout | Medium | Internal haulage routes are confirmed to allow assessment of potential impacts of heavy vehicle movement. |
| Stakeholder Engagement | High | A robust Stakeholder Engagement Plan is developed that is inclusive of commitments to ongoing consultation and a structured grievance procedure. |
| Rehabilitation and Closure | High | A comprehensive Rehabilitation and Closure Plan is prepared. |
| Risk Assessment | Medium | The Risk Assessment and Cost Benefit Analysis are |

| ITEM / AREA OF UNCERTAINTY | IMPORTANCE (Low, Medium and High) | MEASURES |
|--------------------------------------|-----------------------------------|---|
| and Cost Benefit Analysis | | reviewed and revised based on detailed findings of further recommended work. |
| Disaster Risk Management | High | A Disaster Risk Management Plan is developed to cover natural and human-induced emergencies associated with the Project. This Plan should be inclusive of specific Contingency Plans to manage particular events, including the management / treatment of the Mine Operations Dam (MOD) and spontaneous combustion. |
| Community Health and Safety | Medium | The Community Health and Safety assessment is reviewed and revised based on the findings of the further work recommended. Potential impacts upon the Buttonderry Waste Management Facility associated with the development of the Project are fully considered. |
| Management, Monitoring and Reporting | High | Management and Monitoring Plans are prepared for each aspect of assessment prior to commencement of the Construction phase to clearly outline how impacts will be mitigated and managed. An independent expert is commissioned by the Proponent to conduct Environmental Audits of the project on a regular basis throughout the project life cycle. An Environmental Management System based on ISO14001:2004 'Environmental management systems -- Requirements with guidance for use' is developed and implemented for the Project. |

16 References

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